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GOUDA ISMAIL ABDEL-GAWAD

Maastrichtian non-cephalopod mollusks (Scaphopoda, Gastropoda and Bivalvia) of the Middle Vistula Valley, Central Poland

ABSTRACT: The non-cephalopod mollusks from the Maastrichtian opokas and marls exposed along the Middle Vistula Valley, Central Poland, are represented by 2 scaphopod, 92 gastropod, and 105 bivalve species. Of these mollusks, all systematically studied, 13 gastropod species are new, viz. *Loxotoma multiradiata* sp. n., *Calliomphalus (Planolateralus) nasilowensis* sp. n., *Cerithium mazureki* sp. n., *Helicaulax pozaryskii* sp. n., *Cultrigera turriformis* sp. n., *Columbellaria laevicostata* sp. n., *Cassidaria truncata* sp. n., *Biplex cretaceus* sp. n., *Buccinum giganteum* sp. n., *Graphidula radwanskii* sp. n., *Graphidula vistulensis* sp. n., *Tudicla (Tudicla) globosa* sp. n., and *Tornatellaea kongieli* sp. n. The aporrhaid gastropod genus *Kaunhowenia* gen. n. is established as new. Amongst the bivalves, only one species is introduced as new: *Pinna (Plesiopinna) kasimirensis* sp. n.

A special attention is given for some species, such as *Volutispina kasimiri* (KRACH, 1931), *Pholadomya (Pholadomya) kasimiri* PUSCH, 1837 and *Pholadomya (Bucardiomya) esmarki* (NILSSON, 1827), the taxonomy of which has often been confused. Discussed is also the occurrence of the two tegulated inoceramids, *Spyridoceramus tegulatus* (v. HAGENOV, 1842) and *Tenuipteria argentea* (CONRAD, 1858). The latter species is first recorded in Poland, and it is challanged as an alternative index of the Belemnella kazimiroviensis Zone in the uppermost Maastrichtian.

Biogeographic comparisons with the Maastrichtian faunas of other regions show that the studies faunas reflect influences of the North Temperate Realm. Paleoecologic reconstruction of the studied faunal assemblages (since the Campanian/Maastrichtian boundary through the topmost Maastrichtian) indicates an increase in the density and diversity of the faunal assemblages along with the appearance of new trophic groups, and with the decrease both in depths and in the distance to the shore. The latter factors were obviously controlled by the major regressive phase of the mid- to Upper Cretaceous sea which occupied the Central European Basin.

INTRODUCTION

The Maastrichtian deposits developed as opokas and marly opokas, and exposed along the Middle Vistula Valley in Central Poland (Text-fig. 1) yield unusually rich and diversified fossil assemblages, if compared with these of the other Maastrichtian facies (white chalk) of north-

-western Europe. These assemblages are comparable to those of the clastic facies, such as the Aachen and Vaals greensands (Campanian) and of the Maastrichtian stratotype.

The present study deals with the systematic paleontology of the non-cephalopod mollusks contained in the Maastrichtian deposits, the outcrops of which are scattered on both sides of the Middle Vistula Valley *(see* Text-fig. 1). These mollusks appear to be represented by 2 scaphopod species, 92 gastropod species and subspecies belonging to 26 families, and 105 bivalve species and subspecies belonging to 39 families. More than 60 percent of the studied species are first recorded in the study area. Moreover, one gastropod genus and 13 species, as well as one species of the bivalves are established as new.

The Maastrichtian gastropods and bivalves from the North European Province *(sensu* KAUFFMAN 1973) were described in considerable details from the Maastrichtian stratotype in the Netherlands (BINKHORST 1861; VOGEL 1895; KAUNHOWEN 1897; DHONDT 1979, 1983c), Hemmoor (DHONDT 1982) and Isle of Rügen (v. HAGENOW 1842, WOLANSKY 1932) in Germany, from Denmark (RAVN 1902; ØDUM 1922; HEINBERG 1976, 1978, 1979), and from the Russian Platform (KNER 1850, 1852; ALTH 1850; PŁACHETKO 1863; FAVRE 1869; ROGALA 1911; PASTERNAK & *al.* 1968; BLANK 1974; SAVCZINSKAJA 1974; SOBETSKI 1982).

The abundant, and sometimes well preserved (external molds) studied gastropods and infanual bivalves, if compared with the scarcity and badly preserved (steinkerns) gastropods and infaunal bivalves of the Maastrichtian chalk facies, will help in understanding the substrate characters as well as other paleoecologic conditions prevailed during the deposition of the opokas and marls of the present-day area of Central Poland. Some Maastrichtian genera from the North American Province were accepted herein for the North European species. On the other hand, some newly described species and attributed to the Recent and Tertiary genera, not as yet reported from the Cretaseouus strata, may give a light upon the ancestors of these genera. The tegulated inoceramid species, *Tenuipteria argentea* (CONRAD), first reported in the uppermost Maastrichtian of the study area, indicates wide cosmopolitic connections of the uppermost Maastrichtian sea throughout the whole Euramerican Region *(see* DHONDT 1983a,b).

PREVIOUS WORKS

Since the time of PUSCH (1837), who first reported some Maastrichtian fossils from the rocks exposed at Kazimierz-on-Vistula and its environs, many paleontological studies were carried out by successive inve-

stigators. The following is a brief account on the previous works, and its content is subdivided into three subjects, *viz.* the non-cephalopod mollusks, the cephalopod mollusks, and the associated fauna and flora.

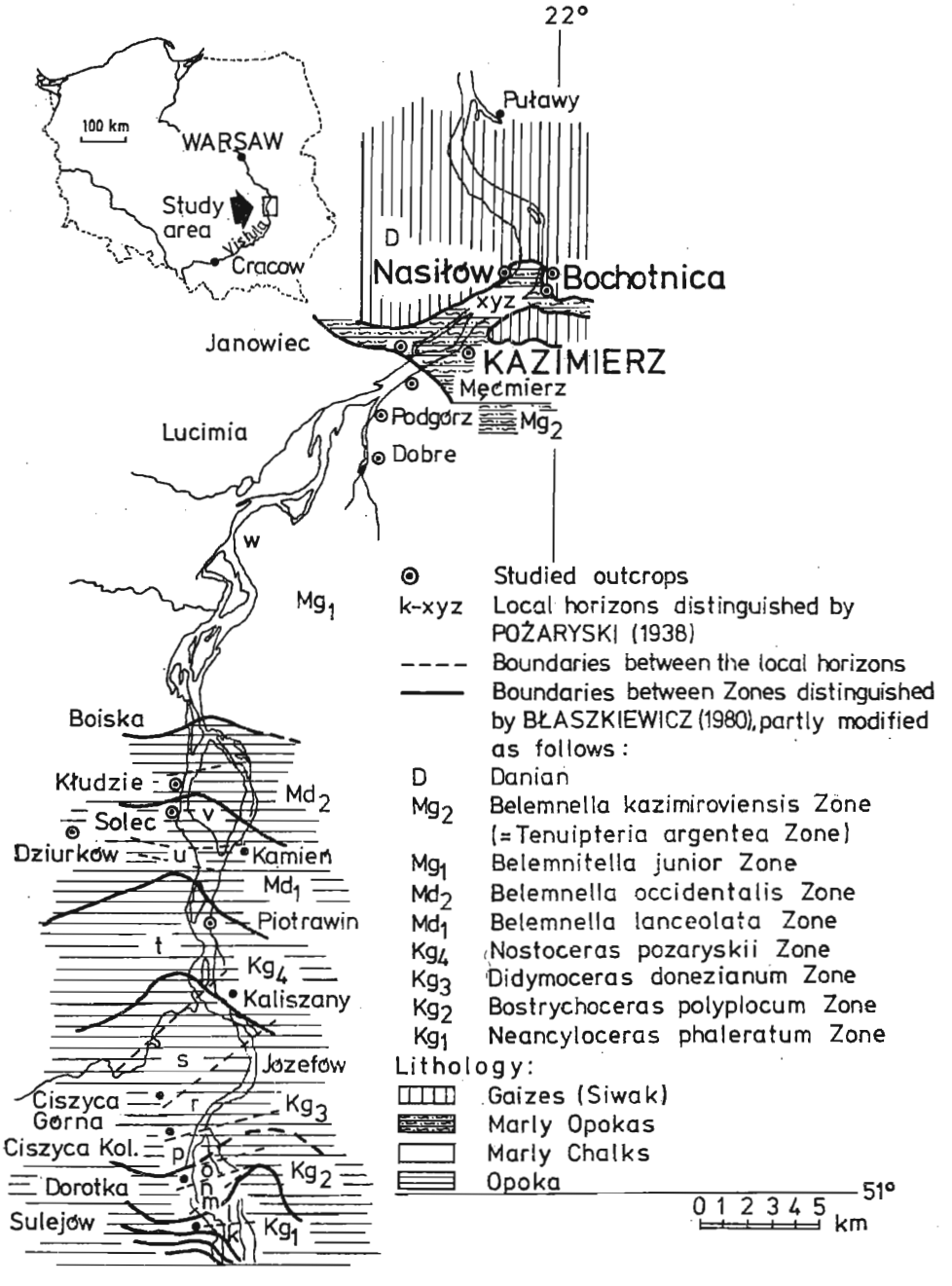


Fig. 1. Biostratigraphic zonation and facies distribution within the Upper Campanian — Maastrichtian deposits of the Middle Vistula Valley (*adopted from*: POŻARYSKI 1938, 1962, *and* BŁASZKIEWICZ 1980)

Non-cephalopod mollusks

Scaphopods

The scaphopods are quite rare in the studied area. Only one species has been reported by KRACH (1931) and PUTZER (1942), who identified it as *Dentalium* cf. *alternans* MÜLLER.

Gastropods

PUSCH (1837) described four new species from Kazimierz; two of them are reported in the present study and two others, "*Rostellaria acutirostris* PUSCH and *Tornatella cretacea* PUSCH" are not recognized.

SIEMIRADZKI (1886) erroneously attributed the Upper Maastrichtian — Paleocene? fauna collected from the environs of Nałęczów (Lublin Upland) to the Albian, Cenomanian and Turonian. He described 11 gastropod species, of which only two "*Pterocera bicarinata* d'ORB. var. *tricarinata*" [= *Aporrhais pyriformis* (KNER)], and "*Fusus* sp." [*Volutispina kasimiri* (KRACH)] are listed as synonyms in the present study, while the rest is not recognized by the present author.

KRACH (1931) described 22 gastropod species from Bochotnica, Kazimierz, and Piotrawin; all of them are included in the present study.

POŻARYSKI (1938) listed 32 gastropod species from the Maastrichtian local horizons (*u, v, w, x, y* and *z; see* Text-fig. 1), 25 species of which are reported in the studied fauna and 9 are not recorded, viz. "*Acmae incornata* ALTH, *Pleurotomaria haueri* KNER, *Aporrhais stenoptera* GOLDF., *Fusus galicianus* ALTH, *Voluta granulosa* FAVRE, *Voluta semilineata* v. MÜNST., *Voluta debeyi* BINK., *Globiconcha* aff. *lueneburgensis* STR., *and Ringicula hagenovi* MÜLL.".

PUTZER (1942) listed 31 gastropod species from Bochotnica and Nasiłów (horizons *x, y, z*), of which 28 are recorded in the present study, whereas not recognized are the three species, viz. "*Voluta semilineata* v. MÜNST., *Voluta debeyi* BINK., and *Fusus* ex. aff. *gageli* MÜLL.".

Finally, POŻARYSKA & POŻARYSKI (1951) reported 12 gastropod species from horizons *w, x, y,* and *z;* of these, 11 species are recognized in this work, and one species ("*Voluta*" *debeyi* BINK.) is not recorded.

The species *Pleurotoma semilineata* v. MÜNSTER *and* "*Voluta*" *debeyi* BINKHORST are reported three times by POŻARYSKI (1938), PUTZER (1942) and POŻARYSKA & POŻARYSKI (1951) from the same horizons; most probably they confused them with "*Fusus*" *procerus* KNER and "*Fusus*" *aequecostatus* FAVRE respectively, which are common species in the uppermost Maastrichtian deposits exposed at the Bochotnica and Nasiłów quarries.

Bivalves

PUSCH (1837) described 13 bivalve species from the environs of Kazimierz, seven of which are reported in the present study, but six are not encountered, viz. "*Pecten excisus* PUSCH, *Gryphaea similis* PUSCH, *Amphidonte (Gryphaea) columba* LAM., *Cardita angusata* PUSCH, *Venericardia planicosta* LAM., and *Cardium umbonatum* SOW.,".

SIEMIRADZKI (1886) reported 22 bivalve species from the Maastrichtian deposits exposed in the environs of Nałęczów; only eight of these species are detected in the present study, viz. "*Nucula producta* NILS., *Modiola ligeriensis* d'ORB.,

Pecten membranaceus NILSS., *Pecten dujardini* REUSS, *Lima hoperi* F. ROEMER, *Caprotina russiensis* d'ORB., *Pholadomya casimiri* PUSCH, *and Pholadomya decussata* MANT.". The rest of species are misidentified by SIEMIRADZKI, and they are not recognized by the present author.

ŁOPUSKI (1912) described and figured 17 pteriomorphid species from Piotrawin, Solec, Kazimierz and Bochotnica; all these species are included in this work.

KRACH (1931) identified 13 bivalve species from the Kazimierz and Bochotnica quarries; the 12 of these species are detected by the present author, and one species "*Cucullaea undulata* REUSS") is not recorded.

POŻARYSKI (1938) listed 55 bivavle species from the Maastrichtian local horizons (*t, u, w, x, y,* and *z*); 45 species of them are reported in this study, and 10 species are not encountered, viz. "*Nucula pectinata* SOW., *Arca undulata* REUSS, *Avicula* cf. *biradiata* MÜLL., *Vola quadricostata* SOW., *Spondylus latus* SOW., *Plicatula* sp., *Lima decussata* GOLDF., *Lima canalifera* GOLDF., *Ostrea larva* LAM., *and Ostrea boucheroni* COQ.".

PUTZER (1942) listed from Bochotnica and Nasiłów (horizons *x, y, z*) 54 bivale species, of which 41 are reported in the present work, and 13 are not encountered, viz. "*Nucula pectinata* SOW., *Cucullaea cf. undulata* RSS., *Avicula cf. radiata* MÜLL., *Pecten asper* LAM., *Pecten excisus* PUSCH, *Chlamys trigeminatus* GOLDF., *Lima decussata* GOLDF., *Ostrea subelmina* GR. (also recorded by KONGIEL & MATWIEJEWÓWNA 1937), *Ostrea larva* LAM., *Ostrea similis* PUSCH, *Gryphaea columba* LAM., *Cardita angusata* PUSCH, and *Pectunculus* sp."

POŻARYSKA & POŻARYSKI (1951) reported 34 bivalve species from Kazimierz, Bochotnica and Nasiłów (horizons *w, x, y,* and *z);* 31 species of their list are recorded in this work, and three species are not recorded, viz. "*Nucula pectinata* SOW., *Cucullaea undulata* REUSS, *and Lima decussata* MÜNST.".

PUGACZEWSKA (1977) reported twelve oysters from Nasiłów [uppermost Maastrichtian not Campanian *(sic!)* as she claimed], Bochotnica, and Piotrawin (uppermost Campanian); six species of these oysters are not recorded by the present author, viz. "*Pycnodonte (Costeina)* cf. *akkaptschigensis* (BOBKOVA), *Pycnodonte (Phygraea) bechkochensis* (WEBER), *Exogyra costata* SAY, *Amphidonte decussata* (GOLDFUSS), *Rhynchostreon* cf. *suborbiculatum* (LAMARCK), and *Crassostrea subtriangularis* (EVANS & SHUMARD)". The species *P. (Phygraea) bechkochensis,* as identified by PUGACZEWSKA *(1977),* is identical with *"Ostrea" similis* PUSCH which occurs and is abundant in the Siwak (*see* POŻARYSKA & POŻARYSKI 1951).

POŻARYSKA & PUGACZEWSKA (1981) identified the teredinid tubes, *Kuphus* sp., from the greensand (horizon *z*) exposed at Nasiłów and Bochotnica, which were erroneously introduced as remains of a titanosaurid dinosaur *(sic!),* "*Succinodon putzeri,*" by HUENE (1941).

Moreover, KRACH (1981) monographed the Paleocene mollusks collected at Nałęczów, Bochotnica, Parchatka and Góra Puławska; he figured three Maastrichtian bivalve species from opoka, viz. "*Pecten acuteplicatus* ALTH, *Ostrea semiplana* SOWERBY, and *Cuspidaria caudata* (NILLSON)".

Generally, the author was not able to recognize some of the gastropod and bivalve species mentioned before from the section exposed along the Middle Vistula Valley (*see* Table 1), or even to check up their real specific attribution, because these species were either mentioned in lists, or they were badly illustrated. Moreover, the collections of PUSCH

Table 1

The previous works on the Maastrichtian gastropods and bivalves of the Middle Vistula Valley

Recorded: Species recognized in the present study and included into the synonymies
Not-recorded: Species not recognized in the present study

Author	Gastropod species		Bivalve species	
	Recorded by the present author	Not-recorded by the present author	Recorded by the present author	Not-recorded by the present author
PUSCH (1837)	2	2	7	6
SIEMIRADZKI (1886)	2	9	8	14
ŁOPUSKI (1912)	-	-	17	-
KRACH (1931)	22	-	12	1
POŻARYSKI (1938)	23	9	45	10
PUTZER (1942)	28	3	41	13
ABDEL-GAWAD (1986, this paper)	92		105	

(1837), SIEMIRADZKI (1886), ŁOPUSKI (1912), KRACH (1931), and most of POŻARYSKI (1938) have been lost during the Second World War.

As a conclusion, the previous works on the non-cephalopod mollusks are indeed valuable, but a comprehensive treatment of this fauna has not yet been done for the Maastrichtian sequence of the Middle Vistula Valley. The present study is attempted to meet with this requirement, and to compare these fauna with the other European and extra-European assemblages.

Cephalopod mollusks

Because of the stratigraphic importance of the cephalopod mollusks, particularly ammonites and belemnites, they were carefully studied in the Maastrichtian deposits of the Middle Vistula Valley. The nautiloids were investigated by ŁOPUSKI (1912), KONGIEL & MATWIEJEWÓWNA (1937), POŻARYSKI (1938), PUTZER (1942), and BŁASZKIEWICZ (1984). The ammonites were described and discussed by ŁOPUSKI (1911-1912), NOWAK (1913, 1917), POŻARYSKA (1953), MAKOWSKI (1962), JELINOWSKA (1985) and successively monographed by BŁASZKIEWICZ (1966, 1979, 1980, 1984). The belemnites were studied by NOWAK (1913, 1917), SKOŁOZDRÓWNA (1932), KONGIEL & MATWIEJEWÓWNA (1937), and they were monographed by KONGIEL (1962), and BŁASZKIEWICZ (1984).

Associated fauna and flora

The abundant fauna and flora associated with the studied Maastrichtian non-cephalopod mollusks, recognized and/or partly at least monographed by many investigators, are represented by: calcareous nannoplankton (GÓRKA 1957; GAŹDZICKA 1975, 1978), benthic (POŻARYSKA 1957, 1965, 1967; POŻARYSKA & WITWICKA 1980, 1983) and planktic foraminifera (POŻARYSKI & WITWICKA 1956, POŻARYSKA & PERYT 1979, PERYT 1980), sponges (PUSCH 1837; HURCEWICZ 1966, 1968, 1984; RADWAŃSKI 1985), corals (PUTZER 1942), bryozoans (MARYAŃSKA 1969, MARYAŃSKA 1969, MARYAŃSKA & KOBYLIŃSKA 1984), brachiopods (KONGIEL 1935; POŻARYSKA & POŻARYSKI 1951; FEDOROWSKI 1958; ROSENKRANTZ 1964; POPIEL-BARCZYK 1968, 1984; JELINOWSKA 1985), serpulids (KONGIEL & MATWIEJEWÓWNA 1937), ostracodes (SZCZECHURA 1964, 1965, 1984), cirripides (KONGIEL & MATWIEJEWÓWNA 1937), echinoids (KONGIEL 1935, 1950; MĄCZYŃSKA 1972, 1984), crinoids (KONGIEL & MATWIEJEWÓWNA 1937), ophiuroids and asteroids (MARYAŃSKA & POPIEL-BARCZYK 1969), shark teeth (KONGIEL & MATWIEJEWÓWNA 1937, PUTZER 1942, RADWAŃSKI 1985) and mosasaurid teeth (SULIMSKI 1968, RADWAŃSKI 1985), as well as by terrestrial plants (CIEŚLIŃSKI 1964, KARCZMARZ & POPIEL 1966, MALICKI & *al.* 1967).

GEOTECTONIC SETTING OF THE SEQUENCE

The area of the present-day Middle Vistula Valley belonged throughout the whole Mesozoic time to the Danish-Polish Trough, which south-eastwardly extends to the Lvov region in the western Ukraine, Soviet Union. This Trough was established along the south-western margin of the Fenno-Sarmatian Shield, or the East European Platform *(see* KUTEK & GŁAZEK 1972, MARCINOWSKI & RADWAŃSKI 1983). A tectonic uplift along the axis of this strongly subsiding Trough took place by the end of the Maastrichtian (Laramide phase of the Alpine cycle), resulting in the formation of the Mid-Polish Anticlinorium which divided the Trough into the Szczecin — Łódź — Miechów Synclinorium, and the Gdańsk — Warszawa — Lublin, or the Border Synclinorium (KUTEK & GŁAZEK 1972). The area of the present-day Middle Vistula Valley and the whole Lublin Upland are thus situated within the Border Synclinorium *(see* Text-fig. 2).

The mid- to Upper Cretaceous transgression over the Central European Basin encroached the areas of the Danish-Polish Trough in the Middle Albian, the deposits of which are represented by shallow marine sands and sandstones with phosphatic nodules and with relatively abundant ammonite fauna, as exposed at Annopol-on-Vistula *(see* MARCINOWSKI & RADWAŃSKI 1983, MARCINOWSKI & WALASZCZYK 1985, MARCINOWSKI & WIEDMANN 1985). The transgression attains its climax during the uppermost Turonian and Coniacian *(see* CIEŚLIŃSKI 1964). The regressive cycle continues until the end of the Maastrichtian. It is manifested by the dominance of the opoka and marl facies, and is influenced by transgressive pulses during the Middle Campanian and Middle Maastrichtian *(see* POŻARYSKI 1962).

The highly fossiliferous mid- to Upper Cretaceous deposits exposed along the Middle Vistula Valley from Annopol-on-Vistula as far as Kazimierz-on-Vistula (*see* POŻARYSKI 1938) are considered as the most complete section of the European Upper Cretaceous (KONGIEL 1962).

Fig. 2. Tectonic sketch-map of Poland (without Quaternary and continental Tertiary cover), to show geotectonic setting of the Central Polish Uplands; areas of Cretaceous deposits (commonly, under the Quaternary and continental Tertiary cover) are stippled; axial zones of the main Laramide tectonic units are indicated. Within the Central Polish Uplands indicated are: **MU** — Miechów Upland; **HCM** — Holy Cross Mountains; **LU** — Lublin Upland

Abbreviated are the names of localities discussed in the text: **A** — Annopol-on-Vistula; **N** — Nałęczów (*adopted from*: MARCINOWSKI & RADWAŃSKI 1983)

Rectangled is the area presented in Text-fig. 1

Structurally, the mid- to Upper Cretaceous strata exposed along the Middle Vistula Valley make up a simple, monoclinal sequence featured by a slight regional dip of about 3° toward the NE direction (*see* POŻARYSKI 1938, Fig. 2).

FACIES

The facies pattern of the studied Maastrichtian succession exposed along the Middle Vistula Valley is characterized by the four typical lithofacies: opoka, marly chalk, a limestone bank of the hardground, and greensand. Each lithofacies has specific physical and petrographical characters, faunal content and geographic distribution.

Opoka is yellowish-gray to gray siliceous marl, moderately hard, highly fossiliferous, characterizing the Upper Cretaceous of Central Poland and the Lvov region, and it extends to Crimea. It is well exposed (*see* Text-figs 3 and 7*A*) along along the Solec — Kłudzie escarpment (horizons *u* and *v* of POŻARYSKI 1938).

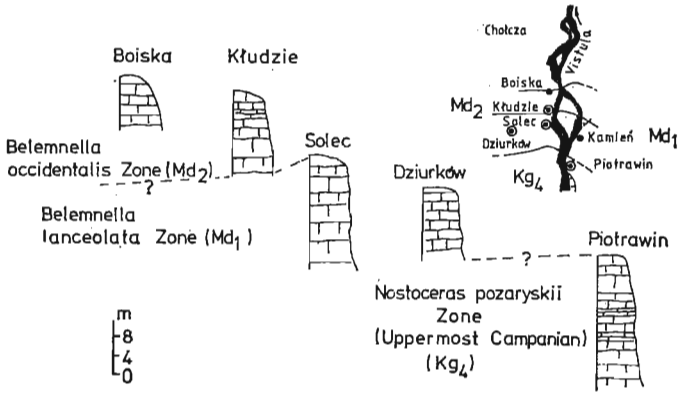


Fig. 3. The uppermost Campanian — Lower Maastrichtian opokas exposed on both sides of the Middle Vistula Valley (*cf.* Text-fig. 1)

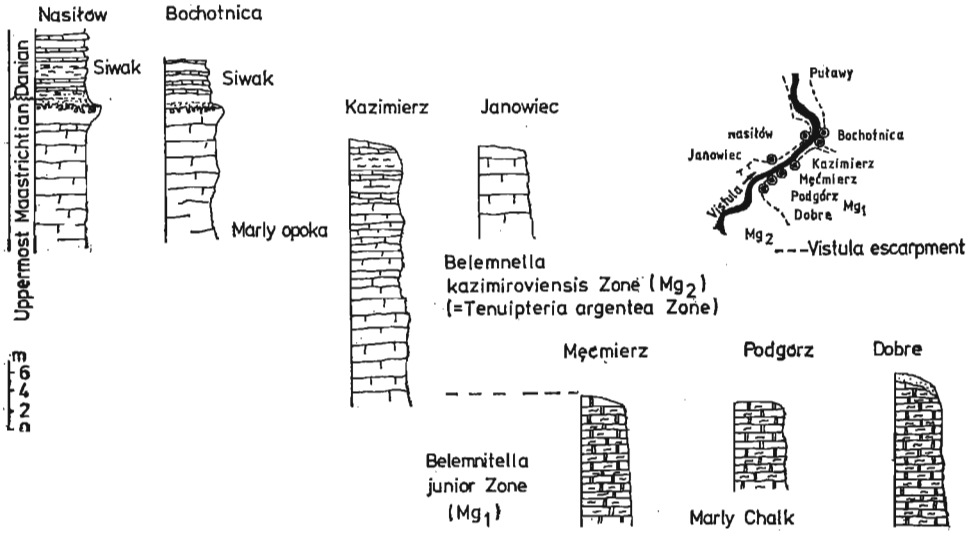


Fig. 4. The Upper Maastrichtian marly chalk and marly opokas exposed on both sides of the Middle Vistula Valley (*cf.* Text-fig. 1)

It changes into sandy marly opoka (*see* Text-figs 4—6 and 8—10), slightly glauconitic, in the uppermost part of the Maastrichtian (*see* POŻARYSKA 1952, GAŹDZICKA 1978) at Kazimierz, Bochotnica and Nasiłów (horizons *w*, upper part; and *x*), very rich in diverse remains of animals and plants, and thus making a paleontological bonanza (*see* RADWAŃSKI 1985).

Marly chalk lithofacies is characterized by white gray, thin bedded, chalky marls or marly chalk, fossilifeorous with relatively rare gastropods and infaunal bivalves. It occupies the lowland in the middle part of the study area (horizon *w*), covered with Quaternary deposits, but its upper part is well exposed along the Dobre — Podgórz — Męćmierz escarpment (*see* Text-figs 4 and 7*B*).

The marly opoka exposed at Bochotnica and Nasiłów is terminated by about one meter light gray of hardground (horizon *y*), with corrugate, uneven and brecciated upper surface which is densely burrowed. The most common are burows of the *Thalassinoides*-type attributed to the shrimps, and J-shaped ones atributable to the ghost crab *Ocypode* (*see* RADWAŃSKI 1985). This hardground was formerly interpreted by POŻARYSKA (1952) as a result of subaequeous dissolution. Recently, RADWAŃSKI (1985) concluded that this hardground has formed under extreme shallow-marine conditions, precisely within a temporarily emerged

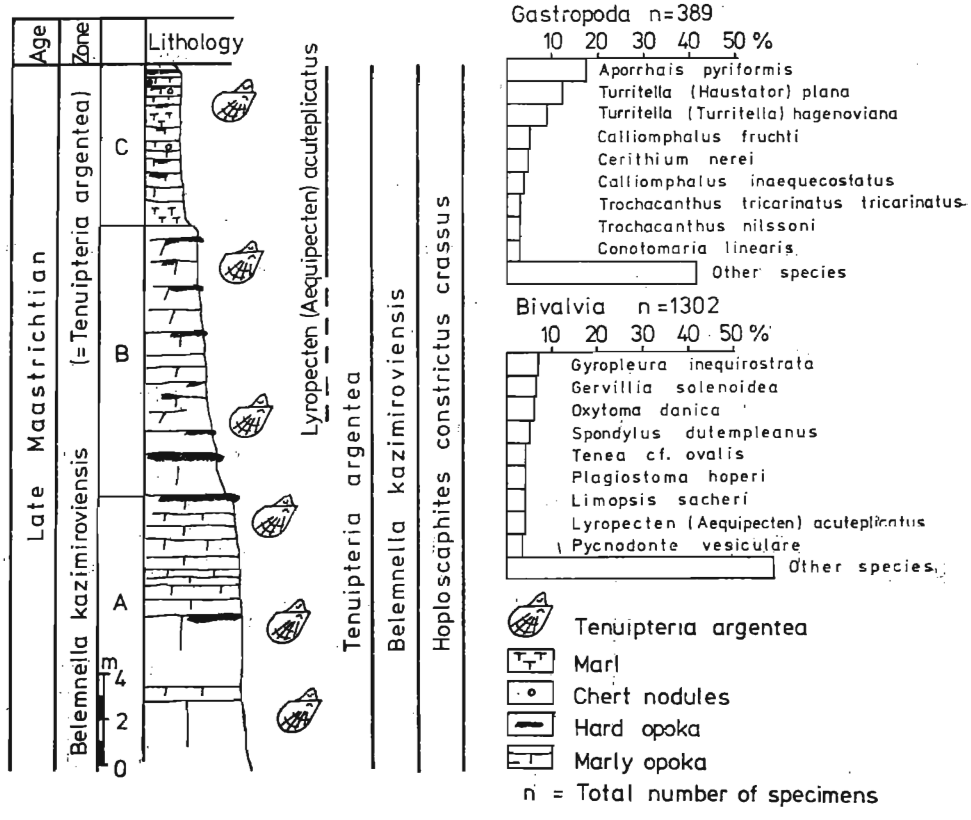


Fig. 5. Kazimierz (Town Quarry) section showing the stratigraphic range of the index molluscan species, and the dominant and most common gastropods and bivalves; occurrence sites of *Tenuipteria argentea* (CONRAD) are indicated

tidal flat, evidenced by the presence of the *Ocypode* burrows. JELINOWSKA (1985) and RADWAŃSKI (1985) illustrate the successive developmental stages of the hardground as well as of the overlying greensand exposed at Nasiłów.

The greensand bed measures about 30 cm and it also fills the thalassinoid burrows which penetrate the hardground. It mainly consists of phosphate-bearing glauconitic sandstone, highly fossiliferous, rich in Maastrichtian fauna such as the petriomorphid bivalves (pectinids, limids and oysters), belemnite quards, brachiopods, sponges, bryozoans and phosphatic steinkerns of some infaunal bivalves and gastropods. According to RADWAŃSKI (1985), most of these fossils are fresh, not being worn, what indicates quiet and slow sedimentation, without reworking and redeposition (except of phosphatized opoka pieces); the greensand is thus considered as a residual lag formed during slow sedimentation and a winnowing action of currents (*see also* KONGIEL 1958, POPIEL-BARCZYK 1968).

Above the topmost part of the Maastrichtian greensand (lag horizon of RADWAŃSKI 1985) the Danian sediments begin. These are mainly composed of alternating hard gaizes and marls, known under the local term *Siwak*, and assigned to the Upper Danian (HANSEN 1970, MARCINOWSKI & RADWAŃSKI 1983, RADWAŃSKI 1985).

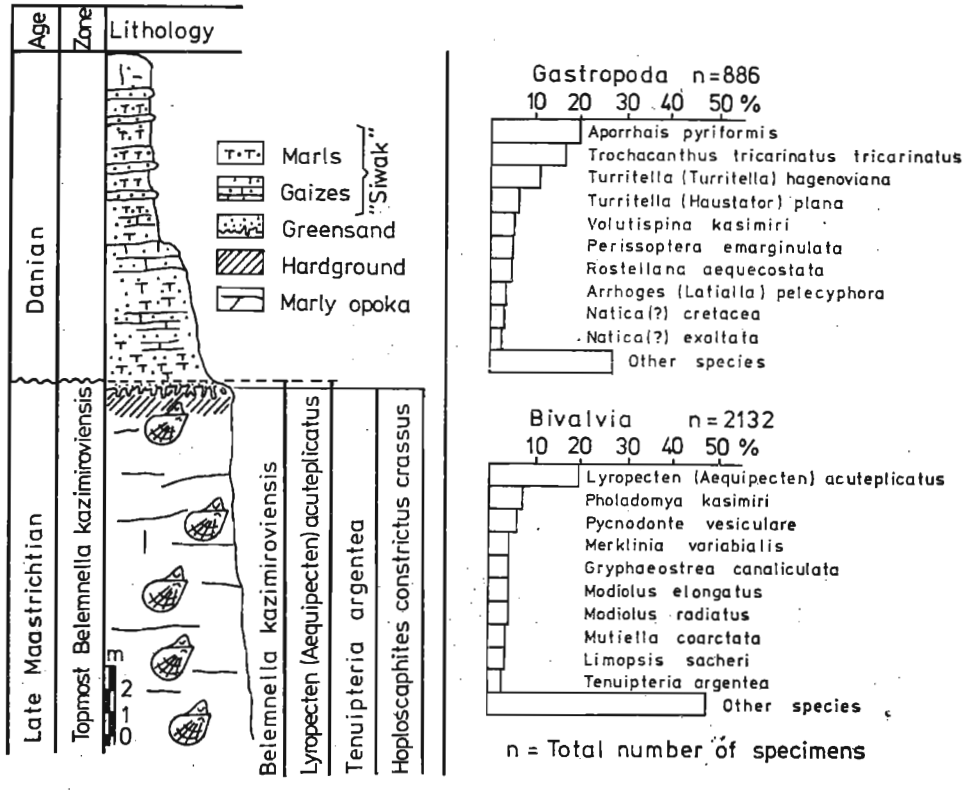


Fig. 6. Nasiłów section showing the stratigraphic range of the index molluscan species, and the dominant and most common species collected from marly opoka, hardground and greensand; occurrence sites of *Tenuipteria argentea* (CONRAD) are indicated

REMARKS ON THE BIOSTRATIGRAPHY

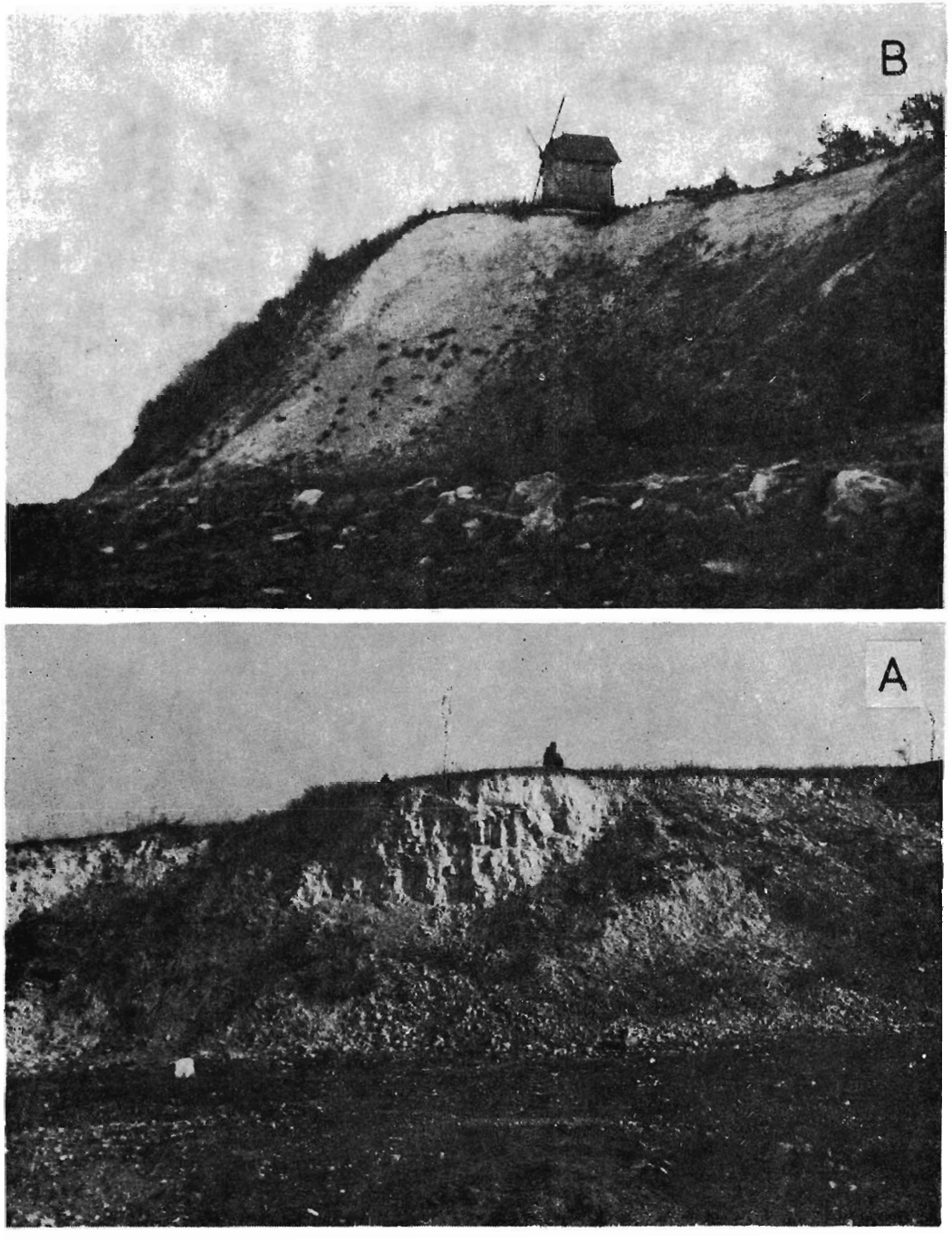
The biostratigraphic zonation of the Upper Senonian of the Middle Vistula Vaalley has been recognized by POŻARYSKI (1938), and followed by KONGIEL (1962), and BŁASZKIEWICZ (1966, 1979, 1980) who based it either on the ammonites or on belemnites, whereas GAŹDZICKA (1978) and PERYT (1980) based the biozones on calcareous nannoplanktoon and planktic foraminifera, respectively (*see* Table 2). According to POŻARYSKA (1965, 1967) and POŻARYSKA & PUGACZEWSKA (1981), the so-called Pseudotextularia Zone, corresponding to the uppermost Maastrichtian, after generally accepted European division, is missing in the Middle Vistula Valley.

Table 2

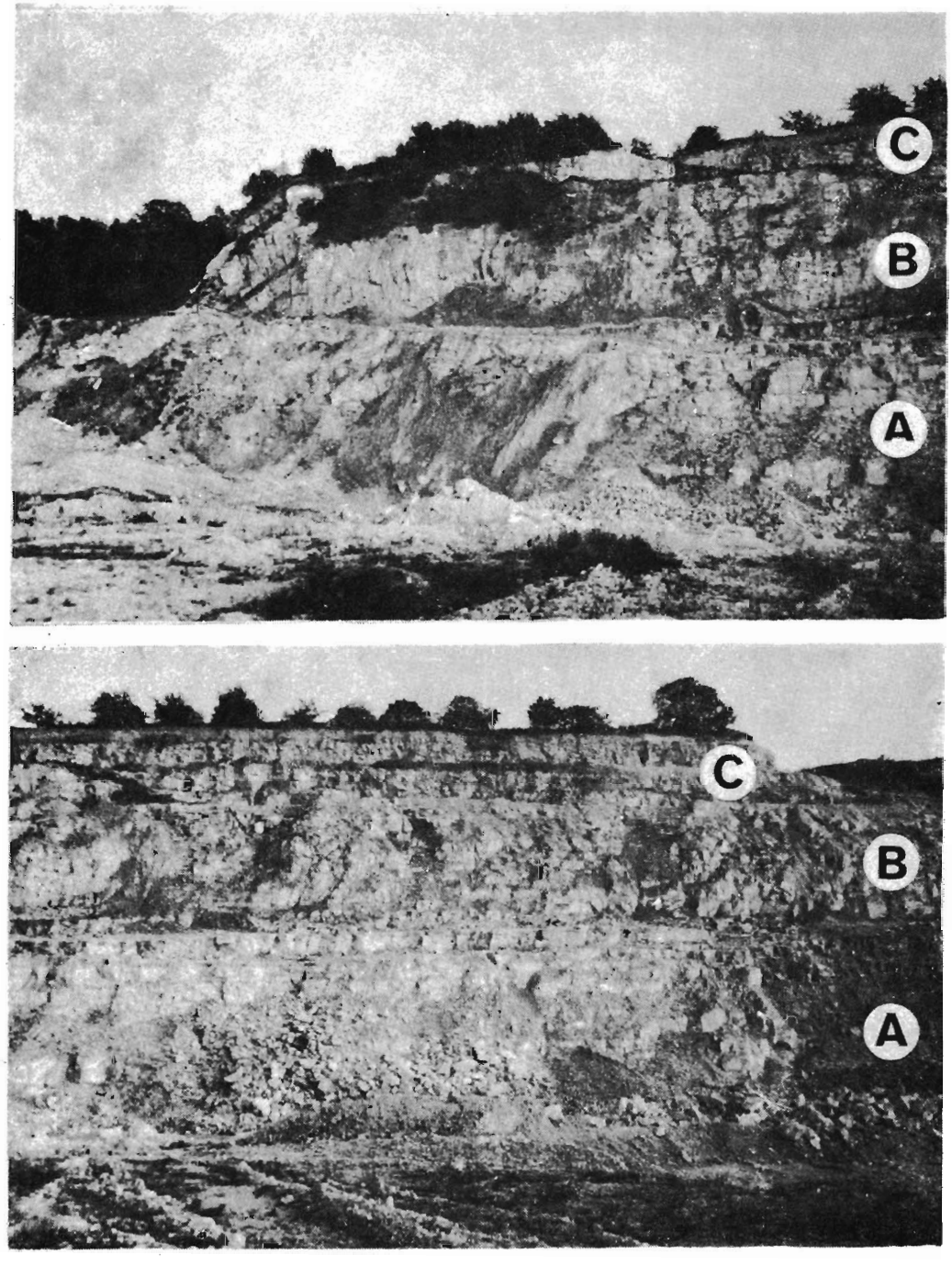
Biostratigraphic zonation of the Maastrichtian deposits in the Middle Vistula Valley

POŻARYSKI (1938)			KONGIEL (1962)		BŁASZKIEWICZ (1979, 1980)		ABDEL-GAWAD (1986, this paper)	PERYT (1980)	GAŹDZICKA (1978)
U. Maastrichtian	250 m	z	U. Maastrichtian	β	Danian-Montian	D-M	Belemnella kazimiroviensis = Tenuipteria argentea	Danian	Nephrolithus frequens
		y			Hoploscaphites constrictus crassus	Mg_2		Guembelitria cretacea	
		x							
		w		α	Belemnitella junior	Mg_1	Belemnitella junior		
L. Maastrichtian	120 m	v	L. Maast.		Belemnella occidentalis	Md_2	Belemnella occidentalis	Rugoglobiger pennyi	Lithraphidites quadratus
		u			Belemnella lanceolata lanceolata	Md_1	Belemnella lanceolata	Globigerinelloides multispinus	Tetralithus aculeus
		t							
		s	U. Campanian	γ	Nostoceras pozaryskii	Kg_4	Nostoceras pozaryskii		
U. Camp.		r		β	Didymoceras donezianum	Kg_3	Didymoceras donezianum		
		p							

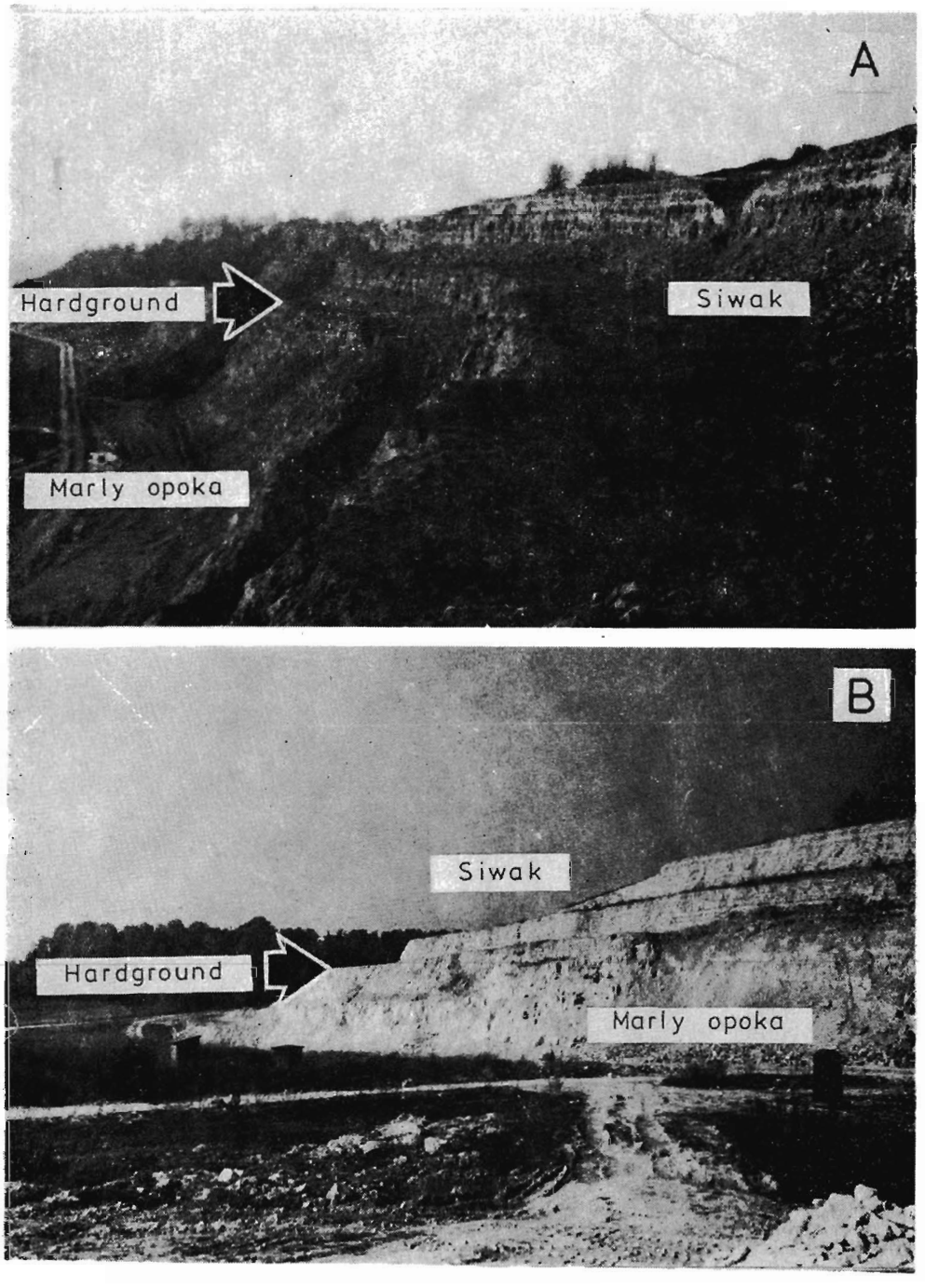
BŁASZKIEWICZ (1979, 1980) accepted *Hoploscaphites constrictus crassus* (ŁOPUSKI) instead of *Belemnella kazimiroviensis* (SKOŁOZDRÓWNA) as an index for the uppermost Maastrichtian zone in the Middle Vistula Valley, judging from the occurrence of *B. kazimiroviensis* in the greensand which he considered as of Paleocene age (*see* Table 2), and from the occurrence of two subspecies of this species (*B. kazimiroviensis* s.s. and *B. kazimiroviensis skolozdrownae* JELETZKY), as well as from the appearance of these two subspecies later than *H. constrictus crassus*. BŁASZKIEWICZ (1979, 1980) lowered the upper boundary of the Belemnitella junior Zone to the deposits exposed at Okale



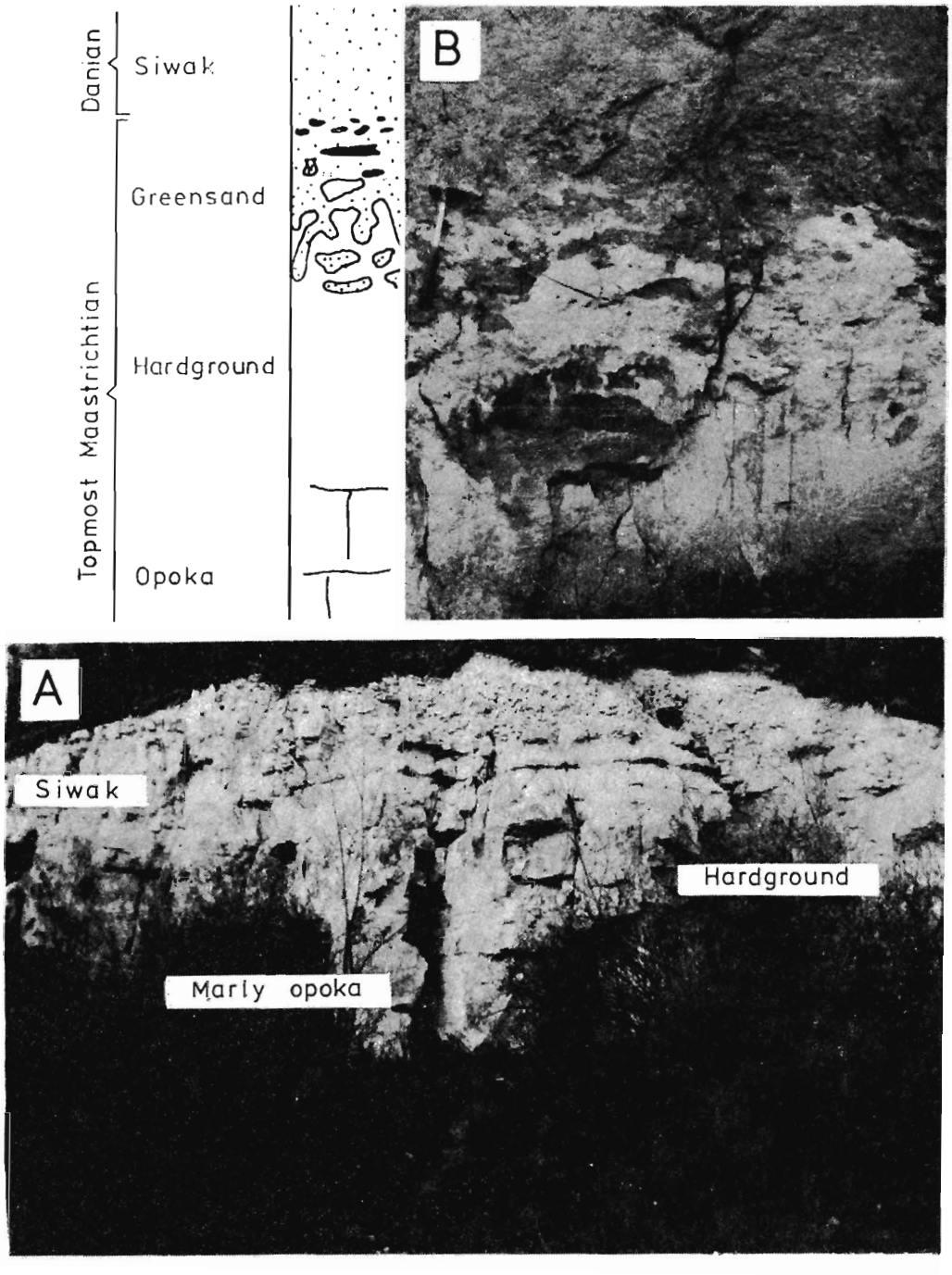
A — Lower Maastrichtian opoka exposed at Dziurków
B — Upper Maastrichtian marly chalk exposed at Męćmierz



Uppermost Maastrichtian marly opoka exposed at Kazimierz (Town Quarry): northern part (*above*), and middle part of the quarry (*below*); marked *A*, *B*, *C* are the lower, the middle and the upper horizons (*see* Text-fig. 5)



Contact between the topmost Maastrichtian and Danian deposits exposed at Nasiłów quarry: **A** — general view, and **B** — southern part of the quarry (*see* Text-fig. 6)



Contact between the tompost Maastrichtian and Danian deposits exposed at Bochotnica: **A** — general view, to show the hardground used as a roof for the exploitation chambers in marly opoka, **B** — close-up view of the contact and its sketched profile, to show the nature of the contact and the biogenic structures developed

near Podgórz. Recently, BIRKELUND (1982) concluded that *H. constrictus crassus* and *H. constrictus anterior* BŁASZKIEWICZ (Upper Lower Maastrichtian) fall within the wide range of variaton of *Hoploscaphites constrictus* (SOWERBY). Hence, the Belemnella kazimiroviensis Zone still has the validity against the Hoploscaphites constrictus crassus Zone of BŁASZKIEWICZ, and consequently the upper boundary of the Belemnitella junior Zone is herein readjusted *(see* Table 2) to the level as previously indicated by KONGIEL (1962), BŁASZKIEWICZ (1966), and POŻARYSKA (1967).

The tegulated inoceramid species, *Tenuipteria argentea* (CONRAD) is the most probably to be indicated as an alternative index of this zone *(see* Table 2 and Text-fig. 15) as appears from the study of DHONDT (1983a, b) who recognized its stratigraphic value, and wide geographic distribution in North Europe, central Asia and North America *(see also* SCHULZ & *al.* (1984).

As mentioned above, the greensand is considered as a residual lag horizon of the latest Maastrichtian (KONGIEL 1935, 1958, 1962; POŻARYSKI 1938; POŻARYSKA 1952; POPIEL-BARCZYK 1968; RADWAŃSKI 1985) and not of Danian age, as previously regarded by POŻARYSKI (1960, 1962), POŻARYSKA (1965, 1967), BŁASZKIEWICZ & *al.* (1970), CIEŚLIŃSKI & POŻARYSKI (1970), POŻARYSKA & PUGACZEWSKA (1981), and KRACH (1981).

OCCURRENCE OF FOSSILS

The majority of the studied fauna come from the uppermost Maastrichtian marly opoka exposed at Nasiłów, Bochotnica and in the upper part of the Kazimierz section (the Town Quarry). The fossils are commonly located along the bedding planes, and this particularly concerns the members of the active and epifaunal assemblages. On the other hand, the infaunal asseblages are commonly recorded in life position. The best preserved and highly concentrated molds of aragonitic shells, associated with fully preserved calcitic shells, were collected from the hardground exposed at Nasiłów and Bochotnica, as well as from several discontinous hard bands of opoka in the middle and upper parts of the Kazimierz section (the Town Quarry).

Complete and fragmented calcitic shelle and belemnite guards together with phosphatized or limonitized molds of aragonitic shells (especially of small-sized gastropods and nuculid bivalves) were accumulated in the greensand above the hardground. Locally, the greensand is replete with these fossils, and with regard to the belemnite guards it was considered as a belemnite battlefield ("Belemnitenschlachfeld") by PUTZER (1942).

PRESERVATION OF FOSSILS

Paleoecologic studies risk serious errors in the obtained conclusions if the effects of preservational differences among collections and taxa are not properly considered *(see* KOCH & SOHL 1983). Furthermore,

taphonomical features of the assemblage as well as associated sedimentary structures, provide valuable insights into the environmental conditions of the living communities (*cf.* JARVIS 1980).

In the Late Cretaceous chalk and opoka facies of the North European Province, there is a preferential preservation of the calcitic shells. The aragonitic skeletons of corals, scaphopods, gastropods, infaunal bivalves, nautiloids and ammonites, are dissolved, while the calcitic skeletons of brachiopods, bryozoans, serpulids, epifaunal bivalves and belemnite guards, as well as echinoderms are well preserved.

The studied faunas of the Maastrichtian opoka and marls are preserved either in the form of calcitic shells (all pteriomorphid bivalves, except, of the order Arcoida, and *Gyropleura)* or in the form of external molds of aragonitic shells, rarely steinkerns (scaphopods, gastropods, arcoids and infaunal bivalves). KOCH & SOHL (1983) classified the paleontological collections into the six types, based on the occurrence of aragonitic and calcitic shells as well as of their molds. In this regard, the studied faunas lie within the type *IV* (calcite + molds) as defined by KOCH & SOHL (1983).

In the studied faunas, the external molds are of well preserved sculpture, and this means the dissolution of aragonite took place post-burial and afterwards when the sediments were sufficiently firm to record the presence of even small and delicate shells as well as of their fine ornamentation. This stage was followed by plastic deformation normal to the bedding.

The abundance of the gastropods and infaunal bivalves besides the epifaunal assemblages in the studied faunas, is most probably related to the bottom conditions of opoka and hardground *(see* RADWAŃSKI 1985) particularly during the Late Maastrichtian. These bottom conditions were favorable for larval settlement of both epifaunal and infaunal taxa. On the other hand, the quaggy or unstable bottom of chalk is unsuitable for larval settlement of the infauunal suspension feeders *(see* JABLONSKI & BOTTJER 1983).

Disarticulated valves in the material studied are common, represented by epifaunal bivalves, whereas articulated valves are represented by semi-infaunal and infaunal bivalves. Most of the gastropod and bivalve molds were stained by limonitic material particularly long suture and hinge line. Specimens filled with drusy calcite are rare or absent in mollusks, whilst they are common in associated brachiopods. A color pattern has been recognized by the author only in in two bivalve species (*see* Pl. 34, Fig. 5 and Pl. 37, Fig. 8).

Epifaunal incrustations composed of serpulids, juvenile forms of diverse oysters and thorny oysters (spondylids), *Atreta nilssoni, Placu-*

nopsis granulosa and bryozoans are found in all studied assemblages. There are preferentially common upon large specimens of *Pycnodonte vesiculare*, volutids, nautioloids, ammonites, belemnite guards, and echinoids.

MATERIAL, DATA, AND ABBREVIATIONS USED

The present study is based on the material collected by the author from several quarries and outcrops scattered on the both banks of the Vistula River (*see* Text-fig. 1) during seasons of 1983—1985, with the help of the KONGIEL's Collection (MZ) and the MACHALSKI's Collection (ZPPAN). Basides, some specimens kept in the collections of the Institute of Geology, University of Warsaw (IGP), Museum of the Geological Survey of Poland (IG), Professor K. POŻARYSKA (ZPPAN), Dr A. BŁASZKIEWICZ (LG) and A. JELINOWSKA M. Sc. (IGP) were also taken into account.

Institutions in which collections used for comparison are kept, are abbreviated as follows:

IG — Geological Survey of Poland, Warsaw;
IGP — Institute of Geology, University of Warsaw:
MZ — Museum of the Earth, Warsaw;
ZPPAN — Department of Paleobiology, Polish Academy of Sciences, Warsaw;
KBIN — Koninklijk Belgisch Instituut voor Natuurwetenschappen, Brussels.

The studied material was compared with older collections housed in several European Museums and Institutions, such as the GOLDFUSS' Collection (Bonn), the KAUNHOWEN's Collections (Berlin), the BOSQUET's Collection (Brussels) and the VOGEL's Collection (Leiden).

Within the forthcoming SYSTEMATIC ACCOUNT, some abbreviations and special signs will be used.

Explanation of signs used in synonymy-lists (as formerly used by DHONDT 1971, 1982) is as follows:

1861. Identification certain, based on comparison with the literature (illustrations or descriptions);
v. 1861. Identification certain, based on study of the original material;
?1861. Identification uncertain;
p.p.1861. Not all the specimens figured are comparable with the species under discussion;
(1861) The species is reported in a list, and the correctness of the specific attribution cannot be checked;
cf. 1861. The specimens are not fully comparable with a given species;
aff. 1861. The specimens display a general affinity with a given species.

Abbreviations used in the headlines of successive taxa are as follows: **M** — monotypy, **OD** — original designation, **SD** — subsequent designation, **SM** — subsequent monotypy.

All the studied specimens are deposited in the Institute of Geology, University of Warsaw.

Within the SYSTEMATIC ACCOUNT the measurements and description are given only for the new species and some others which require a discussion.

For all the studied species the synonymy lists and brief remarks are offered, together with their stratigraphic range and geographic distribution. The latter data, on age and distribution, are simplified as possible. Anyway, to avoid the confusion in the location of discussed occurrences, the following geographic index is used:

Austria: Gosau, Oberösterreich (ZITTEL 1865—66);
Belgium — Netherlands (Limburg area): Maastricht, Kunrade, Geulhem, Saint Pietersberg and Vaals (BOSQUET 1860, BINKHORST 1861, VOGEL 1895, KAUNHOWEN 1897, VAN DER WEIJDEN 1943, DHONDT 1971—1983, MARQUET 1982);
Bulgaria: Pleven and Somovit (TZANKOV 1981, TZANKOV & MOTEKOVA 1981);
Czechoslovakia: Malnitz, Postelberg, Priesen, Randnitz and Trziblitz in Bohemia (REUSS 1845—46, GEINITZ 1873—1875, FRIČ 1877—1911, ANDERT 1934);
Denmark: Møns Klint and Stevns Klint (RAVN 1902, ØDUM 1922, HEINBERG 1976—1979);
Federal Republic of Germany (West Germany): Aachen (MÜLLER 1847, HOLZAPFEL 1887—89) Haldem (GOLDFUSS 1833—1844), Hemmoor (DHONDT 1982), Braunschweig and Ilsede (GRIEPENKERL 1889, MÜLLER 1898), Lüneburg (STROMBECK 1863, WOLLEMANN 1902), Upper Bavaria (BÖHM 1891), other localities indicated by ROEMER (1841) and by GOLDFUSS (1833—1844);
France: localities indicated by d'ORBIGNY (1842—43);
German Democratic Republic: Isle of Rügen (v. HAGENOW 1842; WOLANSKY 1932; NESTLER 1965a,b, 1982);
Great Britain (England): Trimingham, Norfolk and Norwich (MANTELL 1822, WOODS 1899—1913);
POLAND: The Middle Vistula Valley (study area); Nałęczów, Chełm, Zamość in the Lublin Upland, and Miechów in the Miechów Upland (for location *see* MARCINOWSKI & RADWAŃSKI 1983, RADWAŃSKI 1985);
Sweden: Åhus, Balsberg, Ignaberga, Köpinge, Mörby (NILSSON 1827; HENNIG 1897; HÄGG 1935, 1954);
U.S.S.R.: Lvov (Lemberg region) in the western Ukraine (KNER 1850, 1852; ALTH 1850; PŁACHETKO 1863; FAVRE 1869; ROGALA 1911; PASTERNAK & *al.* 1968), Donbass basin (BLANK 1974, SAVCZINSKAJA 1974), Crimea (SOBETSKI 1977), peri-Caspian area (SOBETSKI 1982), and North Caucasus (MOSKVIN 1959);
Yugoslavia: Fruška Gora (PETHŐ 1906).

SYSTEMATIC ACCOUNT

Class **Scaphopoda** BRONN, 1862

Family **Dentaliidae** GRAY, 1934

Genus *Dentalium* LINNAEUS, 1958

Type species: *Dentalium elephantinum; SD* MONFORT, 1910

Subgenus *Dentalium* LINNAEUS, 1958

Dentalium (Dentalium) multicostatum FAVRE, 1869

(Text-fig. 11 and Pl. 24, Figs 10—11)

1850. *Dentalium decussatum* SOW.; ALTH, p. 226, Pl. 12, Fig. 1 (*non* SOWERBY).
1863. *Dentalium decussatum* SOW.; PŁACHETKO, p. 16, Pl. 1, Fig. 13.
1869. *Dentalium multicostatum* FAVRE, p. 101, Pl. 11, Fig. 7.
(1911) *Dentalium multicostatum* RAVRE; ROGALA, p. 492.

MATERIAL: 4 from Kazimierz, 3 from Nasiłów (2 opoka, 1 hardground).

REMARKS: The studied specimens are poorly preserved and in the majority are fragmented. The species can be distinguished from *Dentalium alternans* J. MÜLLER and *D. decussatum* SOWERBY by alternation of longitudinal riblets

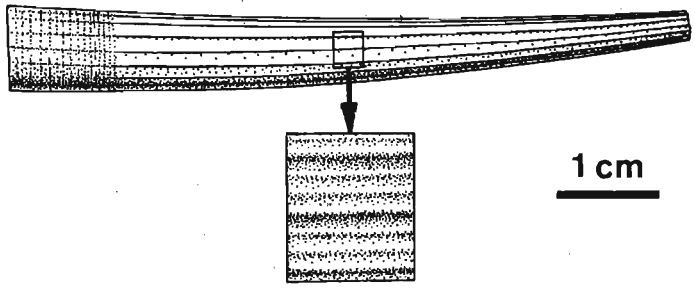


Fig. 11. *Dentalium (Dentalium) multicostatum* FAVRE; Kazimierz (Town Quarry), uppermost Maastrichtian

with numerous fine longitudinal striae which are crossed by fine growth lines (*see* Text-fig. 11).

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Dentalium (Dentalium) sp.
(Text-fig. 12)

MATERIAL: 1 from Kazimierz, 1 from Nasiłów (hardground)

REMARKS: The specimen collected at Kazimierz is nearly complete, while that from Nasiłów (hardground) is a fragment of external cast. They both are ornamented with longitudinal riblets, nearly equal and separated by smooth inter-

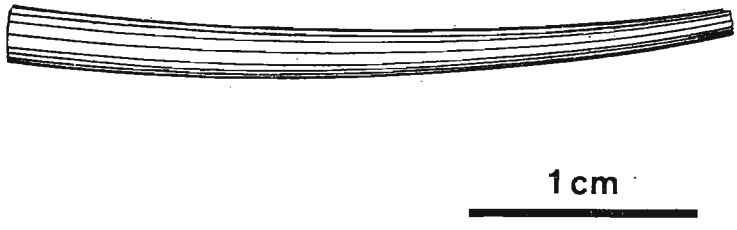


Fig. 12. *Dentalium (Dentalium)* sp.; Kazimierz (Town Quarry), uppermost Maastrichtian

spaces. The ventral riblets are closely spaced. This characteristic ornamentation can easily distinguish this species from *D. multicostatum* FAVRE and *D. alternans* J. MÜLLER from the Campanian Vaals greensand.

Class **Gastropoda** CUVIER, 1797

The terminology for the gastropods generally follows the glossary presented by COX (1960) in the *Treatise on Invertebrate Paleontology*, Part I (Gastropoda), and also that used by SOHL (1960, 1964).

All linear measurements (taken with vernier calipers) are given in millimeters.

Abbreviaion used are: **H** — total height of shell, **EH** — estimated height of shell, **D** — maximum diameter of shell, **HB** — height of last whorl, **HA** — height of aperture, **DW** — maximum diameter + length of expanded outer lip, **PA** — pleural angle (in degrees).

Spire (*after* HONG-FU & YOCHELSON 1983): low — when *PA* larger than 110°, moderately high — when *PA* 50—90°, and high — when *PA* less than 50°.

Size (*after* HONG-FU & YOCHELSON 1983): small — less than 10 mm, moderately small — 10-15 mm, medium — 15-20 mm, moderately large — 20—25 mm, and large — larger than 25 mm.

NOTE: The protoconch in the studied gastropod is commonly damaged, and thus the description concerns the teleconch.

Subclass **Prosobranchia** MILNE-EDWARDS, 1848
Order **Archaeogastropoda** THIELE, 1925
Suborder **Pleurotomariina** COX & KNIGHT, 1960
Superfamily **Pleurotomariacea** SWAINSON, 1840
Family **Pleurotomariidae** SWAINSON, 1840
Genus *Conotomaria* COX, 1959
Type species: *Pleurotomaria mailleana* d'ORBIGNY, 1843

Conotomaria linearis (MANTELL, 1822)

(Pl. 2, Fig. 1)

1822. *Trochus linearis* MENTELL, p. 110, Pl. 18, Figs 16—17.
1840. *Trochus linearis* MANT.; GEINITZ, p. 46, Pl. 13, Figs 6—8; Pl. 15, Figs 18—19.
1844. *Pleurotomaria distincta* GOLDFUSS, p. 75, Pl. 187, Fig. 1.
1872. *Pleurotomaria linearis* MENTELL sp.; GEINITZ, p. 165, Pl. 29, Fig. 10.
1931. *Pleurotomaria linearis* MANT.; KRACH, p. 371, Pl. 9, Fig. 5.
(1942) *Pleurotomaria linearis* MANT.; PUTZER, p. 372.
1965b. *Pleurotomaria linearis* MANT.; CIEŚLIŃSKI, p. 35, Pl. 6, Fig. 3.

MATERIAL: 10 from Kazimierz, 13 from Nasiłów (opoka).

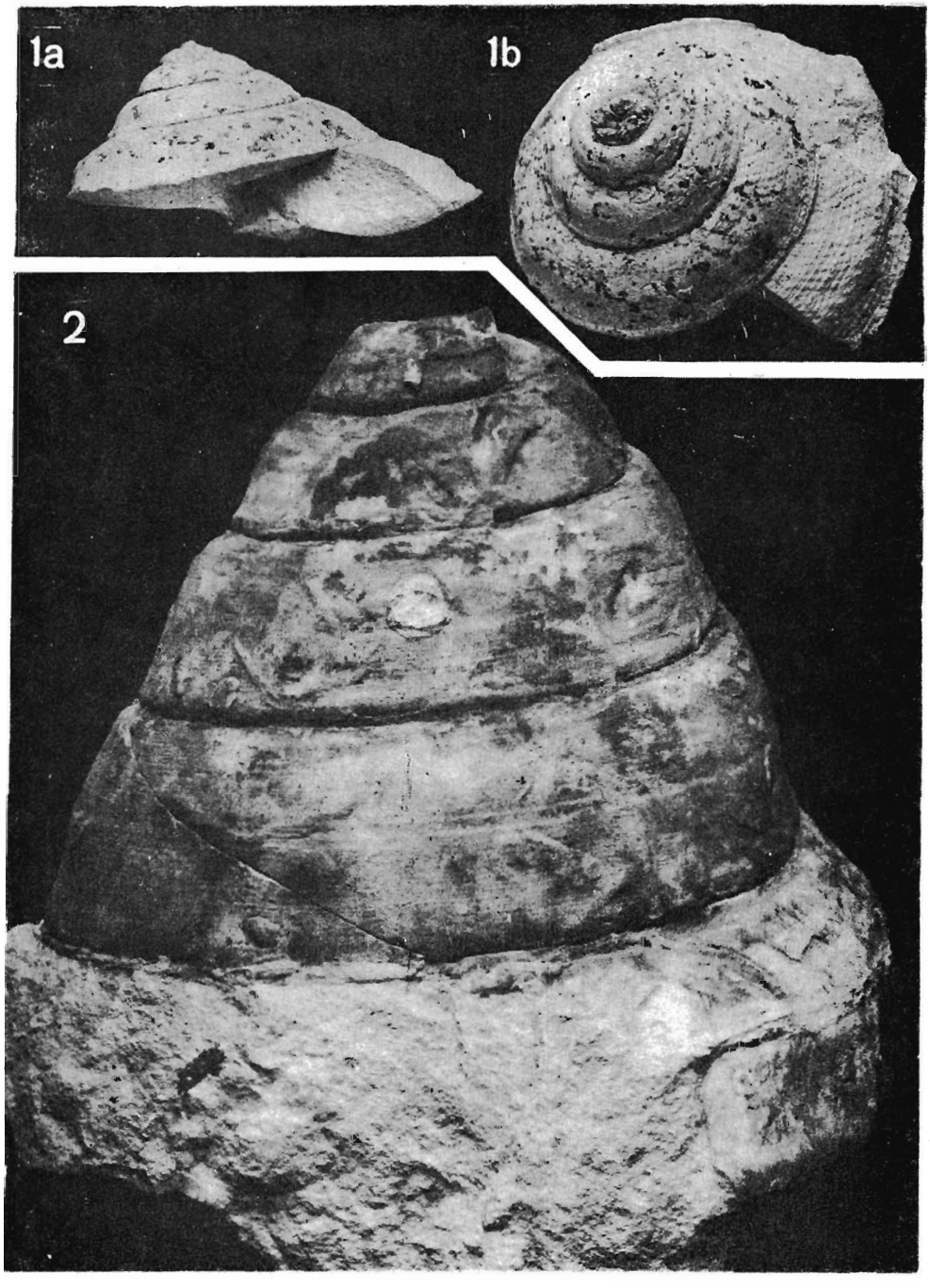
REMARKS: The studied specimens were collected from the deposits of the Belemnella kazimiroviensis Zone. This species is closely allied to *Conotomaria disticha* (GOLDFUSS), but ornamentation is more conspicuous in GOLDFUSS' species. The species *C. granulifera* (v. MÜNSTER) differs from the studied species in having ornate granular sculpture.

AGE and DISTRIBUTION: Turonian — Senonian of Bohemia, West Germany and England; Cenomanian (CIEŚLIŃSKI 1965b) and uppermost Maastrichtian of the Middle Vistula Valley.

Conotomaria granulifera (v. MÜNSTER, 1844)

(Pl. 1, Fig. 1)

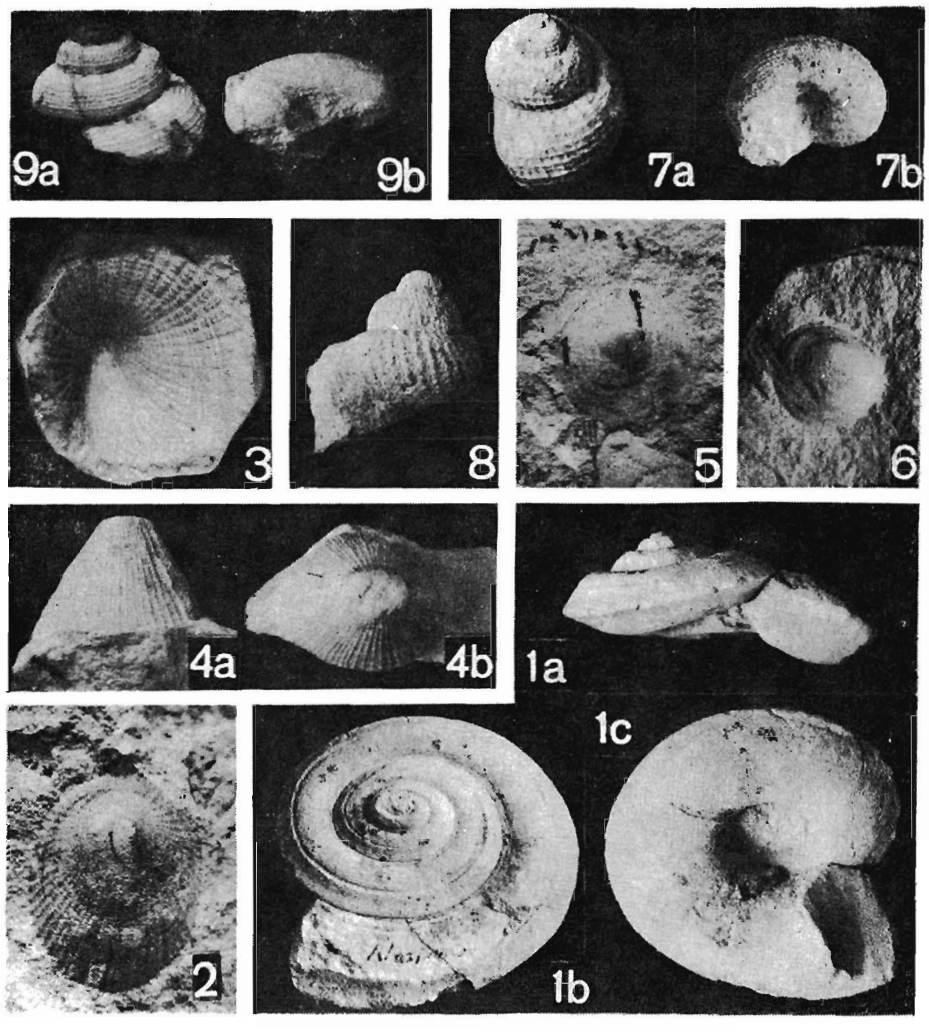
1844. *Pleurotomaria granulifera* MÜNSTER; GOLDFUSS, p. 72, Pl. 187, Figs 3, 3a.
1889. *Pleurotomaria granulifera* v. MÜNSTER; GRIEPENKERL, p. 71.
1898. *Pleurotomaria (Leptomaria) granulifera* MÜNSTER; MÜLLER, p. 86, Pl. 11, Figs 10—13.
1901. *Pleurotomaria (Leptomaria) granulifera* MÜNSTER; WOLLEMANN, p. 24.
1902. *Pleurotomaria granulifera* MÜNSTER; WOLLEMANN, p. 83, Pl. 9, Fig. 3.
?1931. *Pleurotomaria granulifera* MÜNST.; KRACH, p. 370, Pl. 8, Fig. 6.
1937. *Pleurotomaria granulifera* MÜNST.; KONGIEL & MATWIEJEWÓWNA, p. 133.



1a-1b — *Conotomaria granulifera* (v. MÜNSTER); Kludzie (apertural and oblique apical views)

2 — *Leptomaria subgigantea* (d'ORBIGNY); Kazimierz (apertural view)

All figures in natural size



1a-1c — *Conotomaria linearis* (MANTELL); Nasiłów opoka (*1a* apertural, *1b* oblique, *1c* oblique basal views)

2-3 — *Emarginula costatostriata* FAVRE; *2* from Nasiłów opoka (apical view; MACHALSKI's Coll.), *3* plaster cast from Podgórz (apical view), ×2

4a-4b — *Loxotoma multiradiata* sp. n.; Dobre, holotype (*4a* side, *4b* apical views), ×3

5-6 — *Acmaea striatissima* (G. MÜLLER); *5* from Kazimierz (apical view), *6* from Męćmierz (apical view), ×2

7-8 — *Chilodonta (Chilodonta) rudis* (BINKHORST); Nasiłów opoka (*7a* oblique side, *7b* basal, and *8* abapertural views), ×2

9a-9b — *Calliomphalus (Calliomphalus) rimosus granulatus* (KAUNHOWEN); Kamień (incomplete; side and basal views; MZ-Mg. 2548), ×2

(1938) *Pleurotomaria granulifera* MÜNST.; POŻARYSKI, p. 23.
(1942) *Pleurotomaria granulifera* MÜNST.; PUTZER, p. 372.
1954. *Pleurotomaria (Leptomaria) granulifera* MÜNSTER; HÄGG, p. 21, Pl. 1, Figs 5—6.
1974. *Conotomaria granulifera* (MÜNSTER); BLANK, p. 124, Pl. 42, Fig. 2.
MATERIAL: 1 from Kłudzie, 2 from Solec.

REMARKS: The three studied specimens were collected from the Lower Maastrichtian deposits (Belemnella lanceolata Zone and Belemnella occidentalis Zone). However, KRACH (1931), KONGIEL & MATWIEJEWÓWNA (1937), and PUTZER (1942) noted this species at Kazimierz and Bochotnica (Belemnella kazimiroviensis Zone); they probably confused it with *C. linearis* (MANTELL). This species is closely allied to *C. linearis*, *C. disticha* (GOLDFUSS), and *C. haueri* (KNER), but it is easily distinguishable by its ornate granular sculpture.

AGE and DISTRIBUTION: Santonian — Companian of West Germany and Sweden, Upper Campanian of the Donbass basin, Lower Maastrichtian of the Middle Vistula Valley.

„*Conotomaria*" sp. indet.
(Pl. 5, Fig. 4)

MATERIAL: One specimen from Nasiłów (opoka).

REMARKS: The studied specimen is almost complete with well preserved sculpture. Its general features are nearly similar to those of the genus *Conotomaria*, but the absence of the selenizone and the presence of two sinuses along the apertural outer lip make a hesitation, about its belonging to the genus *Conotomaria*.

Genus *Leptomaria* E. EUDES-DESLONGCHAMPS, 1864
Type species: *Pleurotomaria amoena* J. A. EUDES-DESLONGCHAMPS, 1849

Leptomaria subgigantea (d'ORBIGNY, 1950)
(Pl. 1, Fig. 2)

1844. *Pleurotomaria gigantea* SOW.; GOLDFUSS, p. 77, Pl. 187, Fig. 6 (*non* SOWERBY).
(1850) *Pleurotomaria subgigantea* d'ORBIGNY, p. 236.
1851. *Pleurotomaria gigantea*, SOW.; J. MÜLLER, p. 46.
1888. *Pleurotomaria subgigantea* d'ORB.; HOLZAPFEL, p. 175.
1898. *Pleurotomaria subgigantea* d'ORB.; MÜLLER, p. 84, Pl. 11, Fig. 9.
1931. *Pleurotomaria subgigantea* d'ORB.; KRACH, p. 369, Pl. 8, Fig. 7.
1934. *Pleurotomaria subgigantea* d'ORB.; ANDERT, p. 350.
(1938) *Pleurotomaria subgigantea* d'ORB.; POŻARYSKI, p. 23.
(1942) *Pleurotomaria subgigantea* d'ORB.; PUTZER, p. 372.

MATERIAL: 4 from Kazimierz, 3 from Nasiłów (opoka).

REMARKS: This species has unusual large size, if compared with other Upper Cretaceous pleurotomariids. One fragment of an external mold from Kazimierz (collected by M. MACHALSKI), approximately completed, measures about 200 mm in diameter. No other species from the Upper Cretaceous of Europe can be mistaken with *L. subgigantea*, which is more comparable with the Tertiary species *Pleurotomaria sismondai* GOLDFUSS, which differs in having a granular ornamentation. The species *Pleurotomaria nodosereticulata* KAUNHOWEN is closely allied to this species, but it differs in having small tubercles developed at points of intersection of the collabral and axial threads.

AGE and DISTRIBUTION: Santonian — Campanian of Aachen, West Germany; Lower Senonian of West Germany and Bohemia; Upper Maastrichtian of the Middle Vistula Valley.

Superfamily **Fissurellacea** FLEMING, 1822
Family **Fissurellidae** FLEMING, 1822
Subfamily **Emarginulinae** GRAY, 1834
Genus *Emarginula* LAMARCK, 1801
Type species: *Emarginula conica* LAMARCK, 1801
Emarginula costatostriata FAVRE, 1869
(Pl. 2, Figs 2—3)

1869. *Emarginula costato-striata* E. FAVRE, p. 97, Pl. 11, Fig. 3.
1889. *Emarginula costato-striata* E. FAVRE; GRIEPENKERL, p. 70.
(1911) *Emarginula costato-striata* E. FAVRE; ROGALA, p. 491.

MATERIAL: 2 from Podgórz, 4 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The general form and characteristic ornamentation of the studied specimens agree with the specimen figured by FAVRE (1869) from the Lvov region. KAUNHOWEN (1897) described 20 species from the Maastrichtian stratotype, and two of them (*E. conica* BINKHORST and *E. bipunctata* KAUNHOWEN) are closely comparable with the studied species.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and West Germany, Upper Maastrichtian of the Middle Vistula Valley.

Genus *Loxotoma* FISCHER, 1885
Type species: *Emarginula neocomiensis* d'ORBIGNY, 1843
Loxotoma multiradiata sp. n.
(Pl. 2, Fig. 4)

HOLOTYPE: The specimen presented in Pl. 2, Fig. 4a—4b.
TYPE LOCALITY: Dobre, 6 km south Kazimierz.
TYPE HORIZON: Low-Upper Maastrichtian (Belemnitella junior Zone).
DERIVATION OF THE NAME: Latin *multiradiata* — after its numerous radial riblets.

DIAGNOSIS: A conical *Loxotoma* with ovate outline, ornamented with numerous radial riblets cancellated with concentric threads.

MEASUREMENTS: The holotype displays H = 5.55 mm, D = 7.75 mm.
MATERIAL: One specimen from Dobre.

DESCRIPTION: The shell is small, conical, elevated, with ovate outline; asymmetrical where selenizone and exhalant slit are shifted, forming an acute angle with the mid-line of the shell. Apex is subcentral. The shell is ornamented with numerous radial riblets cancellated with concentric threads. The secondary and tertiary fine riblets, developed on the interspaces between the main radial riblets, are more distinct near the margin.

REMARKS: The genus *Loxotoma* is quite rare in the Late Cretaceous deposits. The new species is established on the external mold with the best preserved sculpture; it can easily be distinguished from the Lower Cretaceous species *Loxotoma neocomiensis* (d'ORBIGNY), the type species, by its numerous, fine radial riblets and the more elevated shell.

Suberder **Patellina** VAN IHERING, 1876
Superfamily **Patellacea** RAFINÉSQUE, 1815
Family **Acmaidae** CARPENTER, 1857
Genus *Acmaea* ESCHSCHOLTZ, 1833

Type species: *Acmaea mitra* ESCHSCHOLTZ, 1833; *SD* DALL, 1871
Acmaea striatissima (G. MÜLLER, 1898)
(Pl. 2, Figs 5—6)

1898. *Patella striatissma* n. sp., G. MÜLLER, p. 88, Pl. 11, Figs 2—3.
(1911) *Patella striatissima* G. MÜLL.; ROGALA, p. 492.

MATERIAL: 1 from Mećmierz, 1 from Kazimierz.

REMARKS: The species is characterized by its nearly flat, moderately elevated, and almost smooth shell. By these characters the species can easily be distinguished from *A. laevigata* BINKHORST and *A. rigida* KAUNHOWEN from the Maastrichtian stratotype, as well as from *A. ovialis* NILSSON and *A. incornata* ALTH from the Upper Senonian of Sweden and the Lvov region, respectively.

AGE and DISTRIBUTION: Santonian — Campanian of West Germany, Upper Senonian of the Lvov region, Upper Maastrichtian of the Middle Vistula Valley.

Suborder **Trochina** COX & KNIGHT, 1960
Superfamily **Trochacea** RAFINÉSQUE, 1815
Family **Trochidae** RAFINÉSQUE, 1815
Subfamily **Chilodontinae** WENZ, 1938
Genus *Chilodonta* ÉTALLON, 1862
Type species: *Chilodonta clathrata* ÉTALLON, 1862; *SD* de LORIOL, 1887
Subgenus *Chilodonta* ÉTALLON, 1862;
Chilodonta (Chilodonta) rudis (BINKHORST, 1861)
(Pl. 2, Figs 7—8)

1861. *Turbo rudis* Nobis, BINKHORST, p. 47, Pl. 3, Figs. 8.
1861. *Turbo detritus* Nobis, BINKHORST, p. 45, Pl. 3, Fig. 10.
1861. *Turbo bidentatus* Nobis, BINKHORST, p. 46, Pl. 3, Fig. 9.
v. 1897. *Trochus (Craspedotus) rudis* BINKHORST; KAUNHOWEN, p. 38, Pl. 2, Figs 1—3.
MATERIAL: 3 from Nasiłów (2 opoka, 1 hardground).

REMARKS: KAUNHOWEN (1897) revised the material of BINKHORST (1861) from the Maastrichtian stratotype, and concluded that of this three species, which are conspecific, the selected specific name should be *rudis*. Based on the presence of the teeth in the aperture, KAUNHOWEN put this species into the subgenus *Craspedotus* PHILIPPI, 1847, which was considered by COX (1960) as a junior synonym of the genus *Olivia* CANTRAINE, 1835. This species is assigned herein to the genus *Chilodonta* ÉTALLON, 1862, where the figure of aperture illustrated by KAUNHOWEN (1897, Pl. 2, Fig. 3) is more camparable with *Chilodonta clathrata* from the Upper Jurassic of Europe.

AGE and DISTRIBUTION: Maastrichtian stratotype and uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Margaritinae** STOLICZKA, 1868
Genus *Atira* STEWART, 1927
Type species: *Angaria ornatissima* GABB, 1864
Atira laevis (NILSSON, 1827)
(Pl. 7, Figs 4—5)

1827. *Trochus laevis* n., NILSSON, p. 12, Pl. 3, Fig. 2.
v. 1844. *Trochus laevis* NILSSON; GOLDFUSS, p. 57, Pl. 181, Fig. 18.
1850. *Trochus laevis* NILS.; KNER, p. 16.

1850. *Trochus laevis* NILS.; ALTH, p. 217.
(1850) *Trochus sublaevis* d'ORBIGNY, p. 224.
(1868) *Trochus laeviusculus* MBG.; LUNDGERN, p. 16 (*non* v. SCHLOTHEIM).
1954. *Trochus laeviusculus* MOBERG.; HÄGG, p. 21.
1974. *Atira laevis* (NILSSON); BLANK, p. 127, Pl. 44, Fig. 1.

MATERIAL: 1 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The large size of the studied specimens and their features agree with the specimen from the Campanian of Haldem, West Germany (GOLDFUSS 1844), and another one from the Upper Campanian of the Donbass basin (BLANK 1974). The type specimen of NILSSON is lost (Prof. K. LARSSON, Lund, *in letter*). GOLDFUSS' specimen (No. 1146), preserved in the Institut für Paläontologie, University of Bonn, may be selected as a neotype.

AGE and DISTRIBUTION: Upper Senonian of Sweden, Limburg, and West Germany; Upper Campanian of the Donbass basin; uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Margarites* GRAY, 1847
Type species: *Trochus helicinus* FABRICIUS, 1780
Margarites(?) *leavis* (PUSCH, 1837)
(Pl. 5, Fig. 3)

1837. *Helix laevis* m., PUSCH, p. 94, Pl. 9, Fig. 7.

MATERIAL: 2 from Kazimierz, 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: The studied specimens are of small size, low spire, turbinate, and broadly phaneromphalus. The last whorl is large, and laterally inflated. The aperture is large, with slightly elliptical outline. All the studied specimens are complete steinkerns coincident with the type specimen figured by PUSH (1837), which was collected at Kazimierz.

AGE and DISTRIBUTION: Uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Angariinae** THIELE, 1924
Genus *Calliomphalus* COSSMANN, 1888
Type species: *Turbo squamulosus* LAMARCK, 1804; *OD*

DISCUSSION: SOHL (1960) fully discussed the diagnosis of this genus and subdivided it into two subgenera on the basis of the shape and whorl outline; *Calliomphalus* COSSMANN, 1888, and *Planolateralus* SOHL, 1960. The nominative subgenus *Calliomphalus* (s.s.) differs from *Planolateralus* by its round-sided posteriorly shouldered whorls, which lack either any basal keel or axial sculpture on the base. Moreover, *Planolateralus* differs by having flat-sided whorls and possessing a basal angulation (SOHL, 1960).

The genus *Calliomphalus* has a wide geographic distribution in the Senonian and it ranges through the Tertiary of Europe (SOHL, 1960). In the study area, the two subgenera are common, and the eleven species are identified.

Subgenus *Calliomphalus* COSSMANN, 1888
Calliomphalus (Calliomphalus) boimstrofensis (GRIEPENKERL, 1889)
(Pl. 3, Figs 1—3)

1889. *Turbo Boimstrofensis* n. sp., GRIEPENKERL, p. 73, Pl. 8, Fig. 13.
1898. *Turbo Boimstrofensis* GRIEPENKERL; G. MÜLLER, p. 88, Pl. 12, Figs 20—21.
1901. *Turbo Boimstrofensis* GRIEPENKERL; WOLLEMANN, p. 24.
1930. *Turbo Boimstrofensis* GRIEPENKERL; HÄGG, p. 18, Pl. 1, Fig. 3.
1931. *Turbo* cf. *Boimstrofensis* GRIEP.; KRACH, p. 372, Pl. 9, Figs 16, 16a, b.
(1938) *Turbo boimstrofensis* GRIEP.; POŻARYSKI, p. 23.

(1942) *Turbo* cf. *boimstrofensis* GR.; PUTZER, p. 372.
1974. *Margarites (?) boimstrofensis* (GRIEPENKERL); BLANK, p. 128, Pl. 44, Fig. 9.

MATERIAL: 42 from the Upper Campanian opoka (20 from Ciszyca Kolonia, 21 from Ciszyca Górna, 1 from Piotrawin), 2 from Kamień.

REMARKS: The studied specimens coincide, in general features and size, with those from the Upper Senonian of West Germany (GRIEPENKERL 1889, MÜLLER 1898) and the Donbass basin (BLANK 1974). All the studied specimens come from the KONGIEL's Collection.

AGE and DISTRIBUTION: Campanian — Lower Maastrichtian of West Germany, Denmark, Sweden, the Donbass basin, and the Middle Vistula Valley.

Calliomphalus (Calliomphalus) rimosus granulatus (KAUNHOWEN, 1897) (Pl. 2, Fig. 9)

v. 1897. *Turbo (Solariella) rimosus* BINKHORST var. *granulata* nov. KAUNHOWEN, p. 33, Pl. 2, Figs 4—6.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Kamień, 2 from Nasiłów (opoka).

REMARKS: The studied specimens are incomplete, and one external cast from Nasiłów is preserved as a xenomorphic area of *Pycnodonte vesicularie*. This subspecies differs from the nominative subspecies *C. rimosus rimosus* (BINKHORST) in granular sculpture. It also resembles *"Turbo" granosecinctus* BINKHORST, but the granular sculpture is more distinct on the latter.

AGE and DISTRIBUTION: The Maastrichtian stratotype and the Upper Campanian — Maastrichtian of the Middle Vistula Valley.

Caalliomphalus (Calliomphalus) dichotomus (ALTH, 1950) (Pl. 3, Figs 4—6)

1850. *Trochus dichotomus* m., ALTH, p. 214, Pl. 11, Fig. 8.
1869. *Trochus dichotomus* ALTH; FAVRE, p. 63, Pl. 9, Fig. 10.
(1911) *Trochus dichotomus* ALTH; ROGALA, p. 491.
1982. *Margarites (?) dichotomus* (ALTH); PLAMADIALA, p. 176, Pl. 17, Fig. 8.

MATERIAL: 7 from Ciszyca Kolonia (Upper Campanian), 3 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: Only four incomplete specimens were collected from the deposits of the Belemnella kazimieroviensis Zone and the rest comes from the KONGIEL's Collection from the Upper Campanian of the study area. The characteristic ornamentation of this species is closely similar, and thus probably related, to *"Solarium" kunradtense* BINKHORST, 1861, from the Maastrichtian stratotype.

AGE and DISTRIBUTION: Upper Campanian — Maastrichtian of the Lvov region and peri-Caspian basin, and of the Middle Vistula Valley.

Calliomphalus (Calliomphalus) plachetkoi (FAVRE, 1869) (Pl. 3, Fig. 7)

1863. *Turbo Astierianus* D'ORB.; PŁACHETKO, p. 14, Pl. 1, Fig. 9 (*non* d'ORBIGNY).
1869. *Turbo Plachetkoi* E. FAVRE, p. 60.
1889. *Turbo Plachetkoi* E. FAVRE; GRIEPENKERL, p. 73.

MATERIAL: 3 from Kazimierz.

REMARKS: The studied specimens are damaged and their identification is based mainly on the diagnostic sculpture which coincides with that of the specimens

figured by PŁACHETKO (1863) and FAVRE (1869) from the Lvov region. PŁACHETKO (1863) erroneously defined this species as *Turbo astierianus* d'ORBIGNY; on the other hand, FAVRE (1869) concluded that PŁACHETKO's species is different from d'ORBIGNY's species and introduced a new specific name. D'ORBIGNY's species differs from this species in having more spiral riblets, and equal in strength with those which ornament the basal part.

AGE and DISTRIBUTION: Upper Campanian — Maastrichtian of the Lvov region and Upper Maastrichtian of the Middle Vistula Valley.

Calliomphalus (Calliomphalus) inaequecostatus (KAUNHOWEN, 1897) (Pl. 3, Figs 8—9)

v. 1897. *Turbo inaeque-costatus* nov. sp., KAUNHOWEN, p. 27, Pl. 5, Fig. 2.
1898. *Turbo inaeque-costatus* KAUNH.: G. MÜLLER, p. 90, Pl. 12, Fig. 22.

MATERIAL: 12 from the uppermost Campanian opoka (1 from Kaliszany, 11 from Piotrawin), 1 from Solec, 1 from Dobre, 1 from Podgórz, 13 from Kazimierz, 1 from Janowiec.

REMARKS: The species can be distinguished from other Upper Cretaceous calliomphalids by its more elongated tapering spire, smaller pleural angle and the finer sculpture.

AGE and DISTRIBUTION: Santonian — Campanian of West Germany, Upper Campanian — Maastrichtian of the Middle Vistula Valley, the Maastrichtian stratotype.

Subgenus *Planolateralus* SOHL, 1960

Type species: *Calliomphalus argenteus* WADE, 1926; *OD*

Calliomphalus (Planolateralus) quadricinctus (J. MÜLLER, 1851) (Pl. 3, Figs 10—11)

1851. *Turbo quadricinctus* J. MÜLLER, p. 43, Pl. 5, Fig. 7.
1851. *Turbo quinquecinctus* J. MÜLLER, p. 43, Pl. 5, Fig. 8.
1888. *Eutrochus quadricinctus* MÜLLER; HOLZAPFEL, p. 172, Pl. 19, Figs 4—7.
v. 1897. *Eutrochus quadricinctus* MÜLLER; KAUNHOWEN, p. 27, Pl. 5, Fig. 1.
1931. *Eutrochus quadricinctus* MÜLLER; KRACH, p. 375, Pl. 9, Fig. 18.
(1938) *Eutrochus quadricinctus* MÜLL.; POŻARYSKI, p. 23.
(1942) *Eutrochus quadricinctus* MÜLL.; PUTZER, p. 373.
1943. *Eutrochus quadricinctus* (MÜLLER); VAN DER WEIJDEN, p. 119.

MATERIAL: 1 from Dobre, 1 from Podgórz, 4 from Kazimierz, 9 from Nasiłów (8 opoka, 1 hardground).

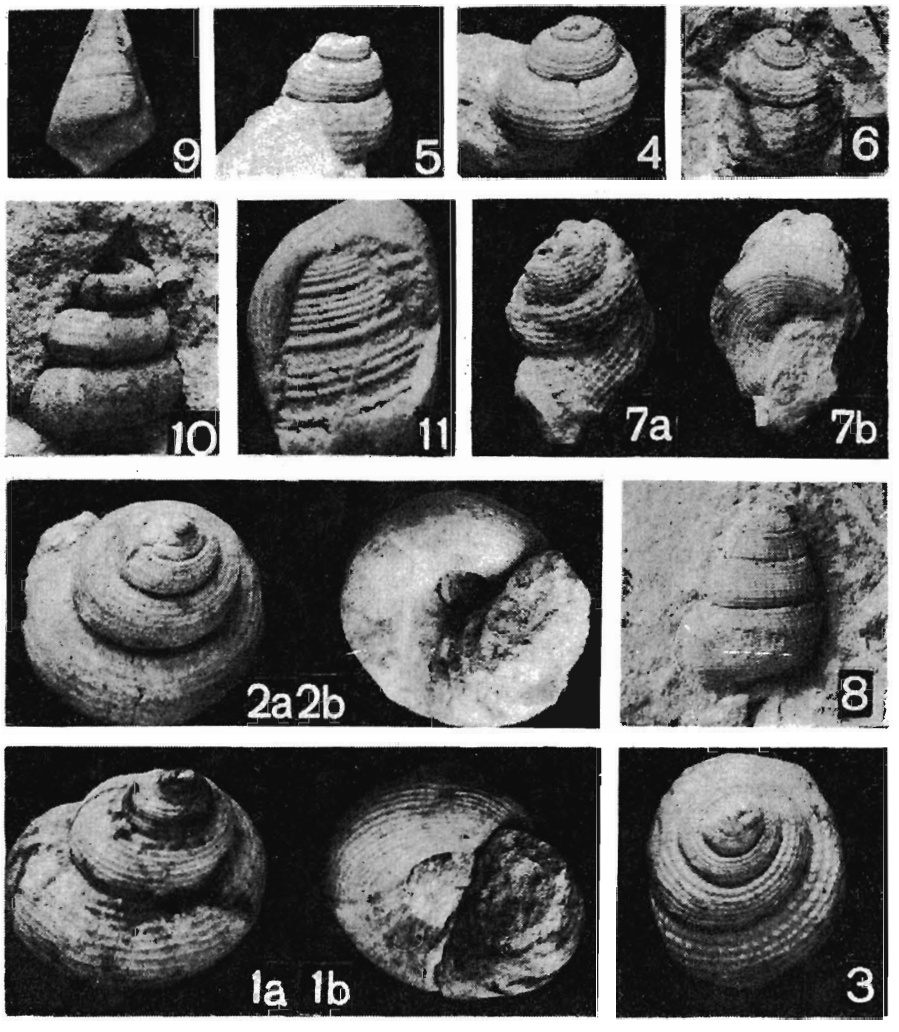
REMARKS: Most of the studied specimens are internal molds (steinkerns), and the ornate sculpture is preserved only on external casts. The studied specimens coincide, in size and sculpture, with the specimens figured by HOIZAPFEL (1889) from the Vaals greensand. The ornate sculpture distinguishes easily this species from other European Upper Cretaceous species.

AGE and DISTRIBUTION: Campanian — Upper Maastrichtian of Limburg (the Netherlands) and Upper Maastrichtian of the Middle Vistula Valley.

Calliomphalus (Planolateralus) nasilowensis sp. n. (Pl. 4, Figs 6—7)

HOLOTYPE: The specimen presented in Pl. 4, Fig. 6.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost Maastrichtian (Belemnella kazimieroviensis Zone).

DERIVATION OF THE NAME: After the finding place of the type specimen (Nasiłów quarry).



1-3 — *Calliomphalus (Calliomphalus) boimstrofensis* (GRIEPENKERL); *1* from Kamień (*1a* oblique apertural view, *1b* oblique basal view); *2-3* from Ciszyca Kolonia (*2a* oblique abapertural view, *2b* oblique basal view, *3* plaster-cast apical view; MZ-Mg. 2526)

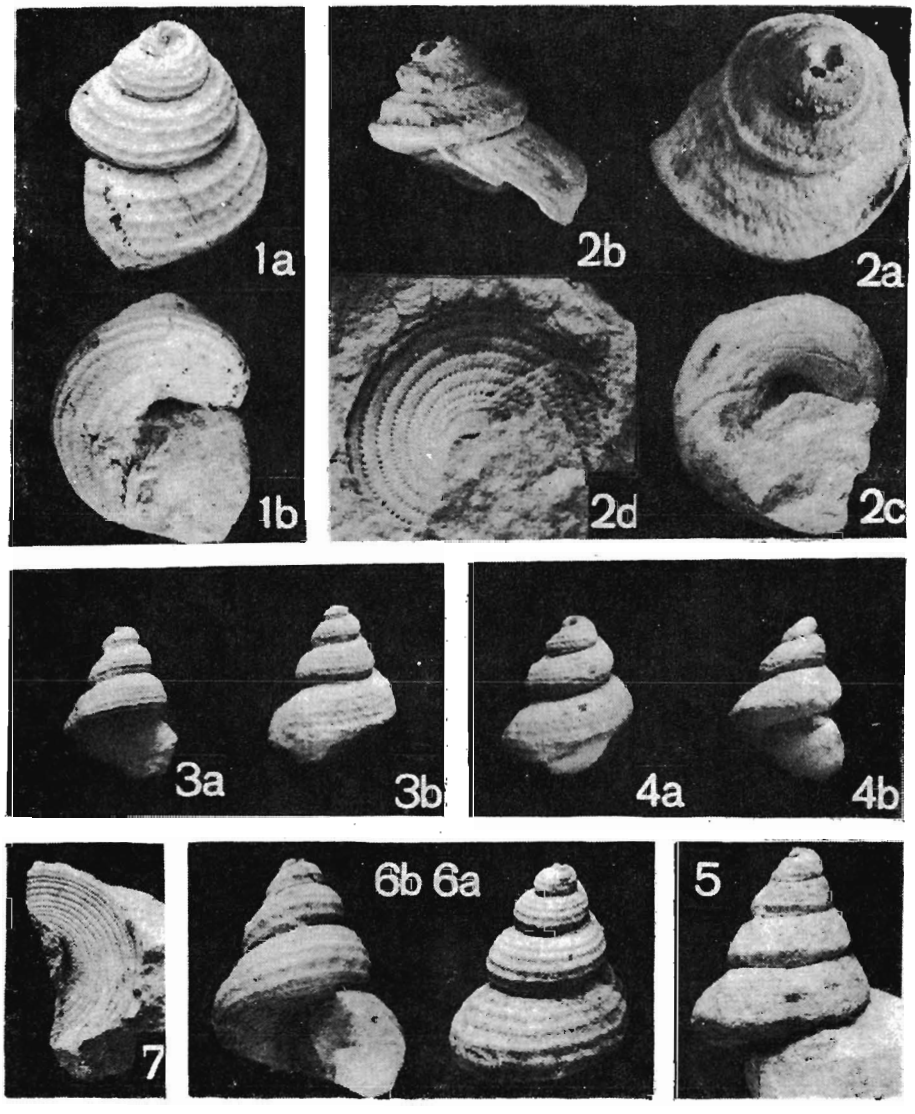
4-6 — *Calliomphalus (Calliomphalus) dichotomus* (ALTH); *4-5* from Ciszyca Kolonia (*4a* abapertural, *4b* apertural views; MZ-Mg. 2561); *6* from Nasiłów opoka (abapertural view)

7a-7b — *Calliomphalus (Calliomphalus) plachetkoi* (FAVRE); Kazimierz (oblique side, and oblique basal views)

8-9 — *Calliomphalus (Calliomphalus) inaequecostatus* (KAUNHOWEN); *8* from Piotrawin (abapertural view), *9* plaster cast from Kazimierz (abapical view)

10-11 — *Calliomphalus (Planolateralus) quadricostatus* (J. MÜLLER); *10* steinkern from Nasiłów opoka (abapertural view), *11* plaster cast from Kazimierz

All figures taken ×2



1a-1b — *Calliomphalus (Planolateralus) fruchti* (G. MÜLLER); Kazimierz (side and oblique basal views)

2a-2d — *Calliomphalus (Planolateralus)* aff. *fruchti* (G. MÜLLER); Kazimierz (*2a* oblique apical, *2b* side and *2c* basal views, *2d* basal view of external mold)

3-4 — *Calliomphalus (Planolateralus) amatus* (d'ORBIGNY); Nasiłów opoka (*3a*, *4b* apertural views, *3b*, *4a* abapertural views)

5 — *Calliomphalus (Planolateralus) miliariformis* (ALTH); Nasiłów opoka (abapertural view)

6-7 — *Calliomphalus (Planolateralus) nasilowensis* sp. n.; Nasiłów opoka, *6* holotype (*6a* abapertural, *6b* apertural views), *7* paratype (external cast, to show basal ornamentation)

All figures taken ×2, except Figs 3-4 and 6-7 in natural size

DIAGNOSIS: A planolaterid with three tuberculate spiral lirae (rasp-like), followed by an abapical spinose spiral cord and a sharp periphery.

MATERIAL: 3 from Kazimierz, 13 from Nasiłów (8 opoka, 5 hardground).

MEASUREMENTS:	H	D	PA	Location
Holotype (Pl. 4, Fig. 6)	32.4	25.4	54°	Nasiłów (opoka)
Paratype	26.2	21.5	57°	,, ,,
,,	26.0	22.0	56°	,, ,,
,,	25.0	20.3	50°	,, ,,
,,	—	13.0	50°	,, ,,
,,	13.7	12.7	51°	Kazimierz

DESCRIPTION: The shell is medium- to large-sized, trochoid, with a moderately high spire, and umbilicate. Whorls are almost flat-sided, numbering four, gradually increasing in size, with subangular periphery. The suture is impressed. Whorls are ornamented with 3—4 spiral rasp-like lirae (commonly three) separated by flat, smooth interspaces, and followed by an abapical spinose spiral cord near the periphery. The periphery bears a subangular prominent cord. The basal part is slightly convex, ornamented with 10—12 finely granulated spiral riblets, separated with flat and wide interspaces. Growth threads are prosocline, crossing the spiral sculpture. Aperture is rounded in its outline, with inclined and rounded outer lip. Umbilicus is wide.

REMARKS: The majority of the studied specimens are incomplete external molds. Well preserved specimens were collected only at Nasiłów. No other species as yet described are likely to be confused with this new species.

Calliomphalus (Planolatralus) amatus (d'ORBIGNY, 1850)
(Pl. 4, Figs 3—4)

1827. *Trochus Basteroti* BRONGN.; NILSSON, p. 12, Pl. 3, Fig. 1 (*non* Al. BRONGNIART).
1837. *?Trochus Basteroti* AL. BRONGN.; PUSCH, p. 107, Pl. 10, Fig. 1.
1844. *Trochus Basteroti* AL. BRONG.; GOLDFUSS, p. 58, Pl. 181, Fig. 7.
1850. *Trochus Basteroti* BRONGN.; KNER, p. 16.
(1850) *Trochus amatus* d'ORBIGNY, p. 224.
1863. *Turbo amatus* d'ORB.; STROMBECK, p. 141.
1869. *Trochus amatus* d'ORBIGNY; FAVRE, p. 57.
1875. *Trochus amatus* d'ORBIGNY; GEINITZ, p. 164, Pl. 29, Fig. 7.
?1954. *Trochus basteroti* BRONGNIART; HÄGG, p. 21, Pl. 1, Fig. 7.

MATERIAL: 1 from Kazimierz, 1 from Bochotnica (hardground), 6 from Nasiłów (4 opoka, 2 hardground).

REMARKS: The studied specimens were collected from the deposits of the Belemnella kazimieroviensis Zone, and the best preserved examples were taken at the Nasiłów hardground. The species *C. (Planolatralus) polonicus* (FAVRE) is distinguished from this species by its larger pleural angle. The specimen figured by HÄGG (1954) is closely similar, and probably related, to the studied species.

AGE and DISTRIBUTION: Senonian of West Germany and Sweden, Upper Senonian of the Lvov region, Maastrichtian of Zamość in the Lublin Upland (PUSCH, 1837), uppermost Maastrichtian of the Middle Vistula Valley.

Calliomphalus (Planolatralus) miliariformis (ALTH, 1950)
(Pl. 4, Fig. 5)

1850. *Trochus miliariformis* m., ALTH, p. 216, Pl. 11, Fig. 11.
1869. *Trochus miliariformis* ALTH; FAVRE, p. 64, Pl. 9, Fig. 11.
1889. *Trochus miliariformis* ALTH; GRIEPENKERL, p. 75.
(1911) *Trochus miliariformis* ALTH; RAGALA, p. 491.

MATERIAL: 1 from Kamień, 3 from Nasiłów (opoka).

REMARKS: The species is characterized by fine ornate sculpture with prominent rasp-like spiral lira along the periphery. No other planolaterid from the Upper Cretaceous can be confused with the studied species.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and West Germany, and Maastrichtian of the Middle Vistula Valley.

Calliomphalus (Planolateralus) fruchti (G. MÜLLER, 1898)
(Pl. 4, Fig. 1)

1898. *Turbo Fruchti* n. sp., MÜLLER, p. 89, Pl. 12, Fig. 5.
1931. *Turbo Fruchti* MÜLL.; KRACH, p. 373, Pl. 8, Figs 4, 4a.
(1938) *Turbo fruchti* MÜLL.; POŻARYSKI, p. 23.
(1942) *Turbo* cf. *fruchti* MÜLL.; PUTZER, p. 372.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 2 from Kamień, 3 from Dobre, 18 from Kazimierz, 5 from Nasiłów (opoka).

REMARKS: The species *C. (Planolateralus) lueneburgensis* (WOLLEMANN) from the "Lüneburger Kreide" in West Germany is closely allied to this species, but it differs by having a sharp periphery and equal spiral riblets.

AGE and DISTRIBUTION: Santonian — Campanian of West Germany, and Upper Campanian — Maastrichtian of the Middle Vistula Valley.

Calliomphalus (Planolateralus) aff. fruchti (G. MÜLLER, 1898)
(Pl. 4, Fig. 2)

MATERIAL: 2 from Kazimierz.

REMARKS: The collected two incomplete specimens are closely similar to *C. (P.) fruchti* (G. MÜLLER) in their main features, but they differ in the arrangement of spiral riblets. In the studied specimens the spiral riblets are arranged as two adapical, closely spaced riblets, separated from other two abapical riblets by a wide interspace, while in *C. (P.) fruchti* the spiral riblets are separated by almost equal interspaces.

Subfamily **Gibbulinae** STOLICZKA, 1868
Genus *Gibbula* RISSO, 1826
Type species: *Trochus magus* LINNAEUS, 1758; *SD* HERRMANNSEN, 1847
Subgenus *Colliculus* MONTEROSATO, 1888
Type species: *Trochus adansoni* PAYRAUDEAU, 1827; *SD* BUCQUOY, DAUTZENBERG & DOLLFUS, 1898
Gibbula (Colliculus) reticulata (PUSCH, 1837)
(Pl. 5, Figs 1—2)

1837. *Turbo reticulatus* m., PUSCH, p. 102, Pl. 10, Fig. 1a, b.
(1942) *Turbo reticulatus* PUSCH; PUTZER, p. 372.

MATERIAL: 1 from Dobre, 2 from Męćmierz, 5 from Kazimierz.

REMARKS: The studied specimens are incomplete, but they possess an ornamentation which agrees with that of the specimen figured by PUSCH (1837). The species is characterized by a compressed conical shell with three closely spaced spiral ribbons, and thus it can be distinguished from *G. echinulatus* (ALTH) and *G. inflexus* (BINKHORST) known from the Upper Senonian of the Lvov region and from the Maastrichtian stratotype, respectively.

AGE and DISTRIBUTION: Upper Maastrichtian of the Middle Vistula Valley.

Suborder Uncertain
Superfamily **Amberleyacea** WENZ, 1938
Family **Nododelphinulidae** COX, 1960
Genus *Trochacaanthus* DACQUÉ, 1936

Type species: *Trochus tuberculatocinctus* GOLDFUSS, 1844; *SD* WENZ, 1938

Trochacanthus tricarinatus tricarinatus (ROEMER, 1841)
(Pl. 5, Figs 5—6 and Pl. 6, Figs 1—3)

p. p. 1841. *Delphinula tricarinata* N., ROEMER, p. 81, Pl. 12, Figs 3—4.
v. p. p. 144. *Trochus plicatio-carinatus* var. *depressus* GOLDFUSS, p. 59, Pl. 181, Fig. 11d, e, f.
p. p. 1850. *Trochus plicatio-carinatus* GOLDFUSS; KNER, p. 16, Pl. 3, Fig. 6.
1850. *Delphinula tricarinata* ROEMER; ALTH, p. 218, Pl. 11, Fig. 15.
1869. *Trochus plicatio-carinatus* GOLDFUSS; FAVRE, p. 62, Pl. 9, Figs 8—9.
p. p. 1898. *Delphinula tricarinata* A. ROEM.; G. MÜLLER, p. 92, Pl. 12, Fig. 9.
1931. *Nododelphinula tricarinata* RÖM.; KRACH, p. 374, Pl. 9, Fig. 1.
(1938) *Delphinula tricarinata* RAEM.; POŻARYSKI, p. 23.
(1942) *Delphinula tricarinata* ROEM.; PUTZER, p. 372.
1961. *Delphinula tricarinata* ROEM.; BLANK, p. 130, Pl. 1, Fig. 1.
1961. *Delphinula plicatiocarinatus* (GOLDFUSS); BLANK, p. 131, Pl. 1, Fig. 7.
1974. *Trochacanthus tricarinatus* (ROEMER); BLANK, p. 125, Pl. 43, Figs 1—2.
1974. *Trochacanthus plicatiocarinatus* (GOLDFUSS); BLANK, p. 126, Pl. 43, Fig. 6.

MATERIAL: 10 from Kazimierz, 1 from Bochotnica, 150 from Nasiłów (145 opoka, 5 hardground).

REMARKS: The subspecies is considered as one of the most predominant gastropods characterizing the uppermost Maastrichtian deposits of the Middle Vistula Valley. Plastic deformation is remarkable in most of the studied specimens. In well preserved specimens large spines are noticed along the carination and the basal angulations. In larger forms, the last whorl is slightly inclined forms an open-spire. The studied specimens were compared with the original type specimen of *Trochus plicatiocarinatus* var. *depressus* GOLDFUSS (1844, Pl. 181, Fig. 11d, e, f) which unfortunately is an incomplete specimen. The other two varieties of *Trochus plicatiocarinatus* GOLDFUSS (*monilifer* and *granulatus*) can be distinguished from the studied subspecies by general form and ornamentation.

POŻARYSKI (1938) recorded this subspecies in the Upper Campanian — Upper Maastrichtian of the study area.

AGE and DISTRIBUTION: Senonian of West Germany and Bohemia, Upper Senonian of the Lvov region and Donbass basin, as well as of the Middle Vistula Valley.

Trochacanthus tricarinatus monilifer (GOLDFUSS, 1844)
PL. 7, Figs 1—2)

v. p. p. 1844. *Trochus plicatio-carinatus* var. *monilifer* GOLDFUSS, p. 59, Pl. 181, Fig. 11c.
1974. *Trochacanthus monilifer* (GOLDFUSS); BLANK, p. 126, Pl. 43, Fig. 7.

MATERIAL: 1 from Dorotka (low-Upper Campanian), 5 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 9 from Nasiłów (opoka).

REMARKS: This subspecies differs from *T. tricarinatus tricarinatus* (ROEMER) in having a row of spiral tubercles on the whorl's upper face near the adapical suture. These tubercles are more distinct on the earlier whorls. The studied specimens coincide with the original type of GOLDFUSS (1844) from Körnchen, West Germany.

AGE and DISTRUBUTION: Upper Senonian of West Germany and of the Middle Vistula Valley, and Lower Maastrichtian of the Donbass basin.

Trochacanthus tuberculatocinctus (GOLDFUSS, 1844)
(PL. 7, Fig. 3)

v. 1844. *Trochus tuberculato-cinctus* nobis, GOLDFUSS, p. 60, Pl. 181, Fig. 12a—b.
1850. *Turbo? Sachert* m., KNER, p. 17, Pl. 3, Fig. 9.
(1850) *Trochus tuberculato-cinctus* GOLDFUSS; d'ORBIGNY, p. 224.
1869. *Turbo tuberculato-cinctus* GOLDF. sp.; FAVRE, p. 54, Pl. 9, Figs 1—3.
1889. *Turbo tuberculato-cinctus* GOLDF. sp.; GRIEPENKERL, p. 74.
(1938) *Trochus tricarinata* v. *tuberculato-cinctus* GR.; POŻARYSKI, p. 23.
(1942) *Trochus tricarinata* v. *tuberculato-cinctus* GR.; PPTZER, p. 372.

MATERIAL: 2 from Kazimerz, 10 from Nasiłów (opoka).

REMARKS: The majority of the studied specimens, although incomplete, agree both with the type specimen of GOLDFUSS (1844) and with those described by FAVRE (1869). This species can be distinguished from *T. tricarinatus* (ROEMER) by highly convex whorls, moderately high spire, almost regular coiling, and smaller basal angulations.

AGE and DISTRIBUTION: Campanian of West Germany, Upper Senonian of the Lvov region, uppermost Maastrichtian of the Middle Vistula Valley.

Trochacanthus nilssoni (v. MÜNSTER, 1844)
(PL. 6, Figs 4—6)

1844. *Trochus Nilssoni* MÜNSTER; GOLDFUSS, p. 58, Pl. 181, Fig. 6.
(1850) *Trochus Nilssoni* MÜNSTER; GEINITZ, p. 132.
1889. *Turbo Nilssoni* v. MÜNSTER; GRIEPENKERL, p. 72.
1898. *Turbo Nilssoni* MÜNST. sp.; G. MÜLLER, p. 87, Pl. 12, Figs 13—14, 17—18.
1902. *Turbo Nilssoni* MÜNSTER sp.; WOLLEMANN, p. 86.
(1938) *Turbo nilssoni* MÜNST.; POŻARYSKI, p. 23.
1974. *Margarites (?) nilssoni* (MÜNSTER); BLANK, p. 128, Pl. 4, Fig. 4.
1982. *Margarites nilssoni* (MÜNSTER); PLAMADIALA, p. 178, Pl. 17, Figs 14, 16.

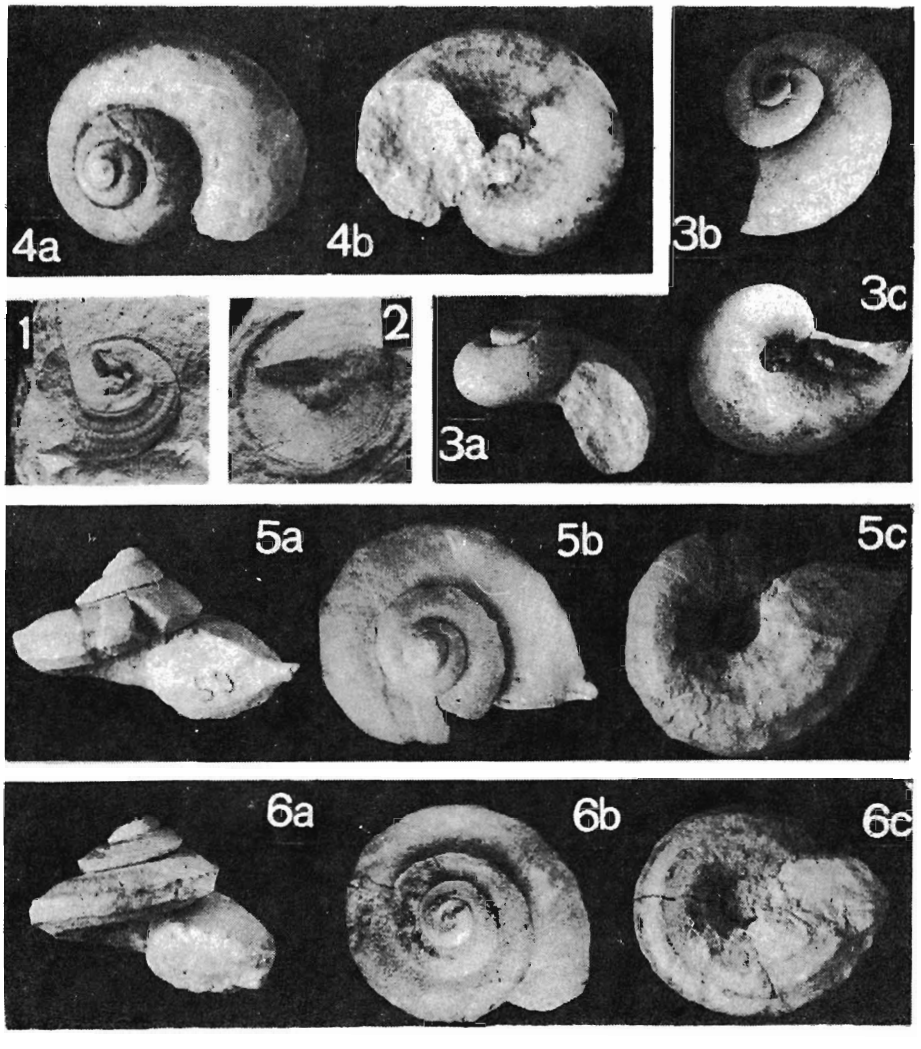
MATERIAL: 1 from Dobre, 10 from Kazimierz, 12 from Nasiłów (10 opoka, 2 hardground).

REMARKS: The studied specimens are characterized by large size and distinct ornate sculpture if compared with the specimens figured by GOLDFUSS (1844) and others. The spines are noticed along the peripheral carina and the basal angulations.

The genus *Trochacanthus* is accepted for this species on the basis of its turbinate form, ornate sculpture and the presence of about six basal angulations as well as of distinct carination.

AGE and DISTRIBUTION: Santonian — Lower Maastrichtian of West Germany, Lower Campanian of the Donbass basin and peri-Caspian basin, Upper Maastrichtian of the Middle Vistula Valley.

Order **Mesogastropoda** THIELE, 1925
Superfamily **Solariacea**
Family **Solariidae** CHENU, 1859
Genus *Architectonica* BOLTEN *in* ROEDING, 1798
Type species: *Trochus perspectiva* LINNAEUS, 1758
Subgenus *Solariaxis* DALL, 1892
Type species: *Solarium elaborata* CONRAD
Architectonica (Solariaxis) granulatocostata (ALTH, 1850)
(PL. 8, Figs 1—2)



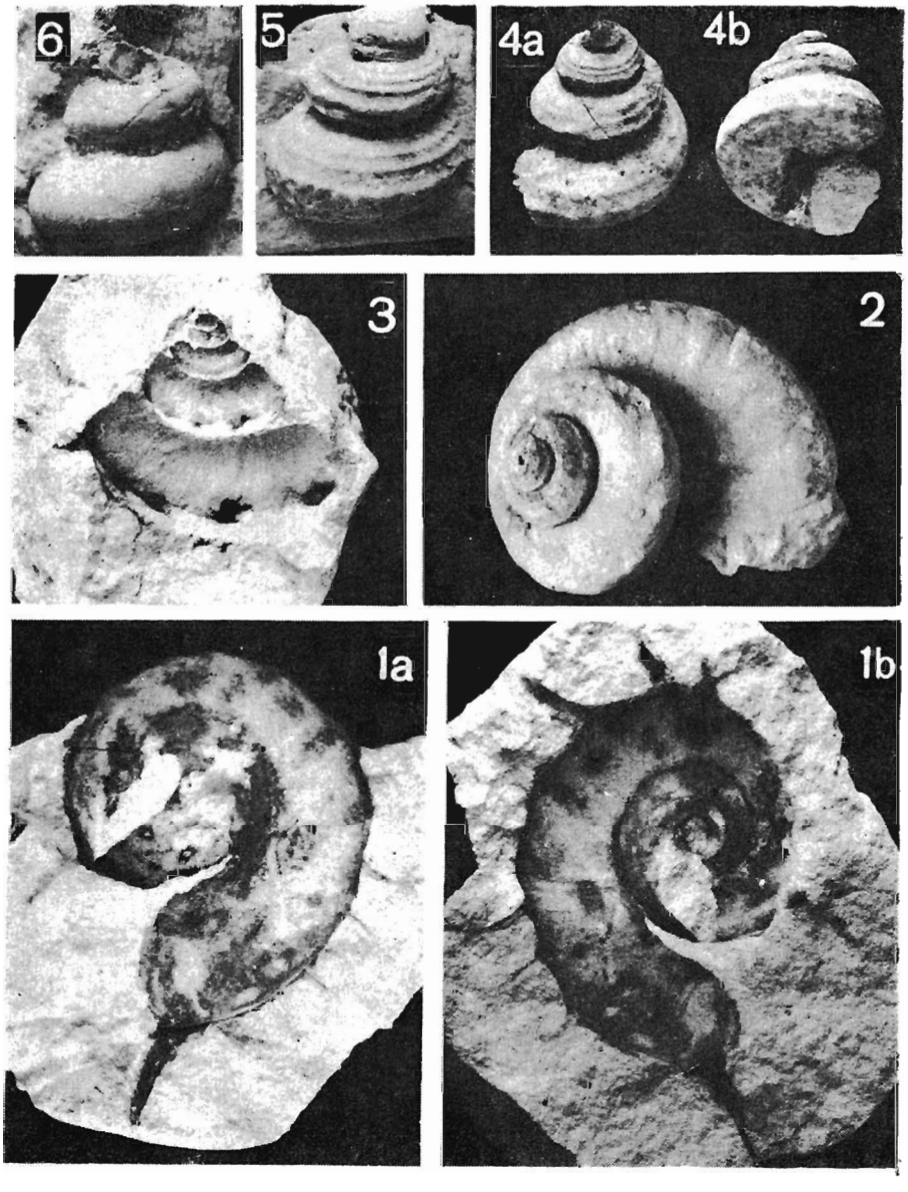
1-2 — *Gibbula (Colliculus) reticulata* (PUSCH); *1* from Kazimierz (incomplete; apical view), *2* from Dobre (incomplete; apical view)

3a-3c — *Margarites*(?) *laevis* (PUSCH); Kazimierz (*3a* apertural, *3b* apical and *3c* basal views)

4a-4b — *"Conotomaria"* sp. indet.; Nasiłów opoka (incomplete, apical and basal views)

5-6 — *Trochacanthus tricarinatus tricarinatus* (ROEMER); Nasiłów opoka (*5a*, *6a* apical; and *5c*, *6c* basal views)

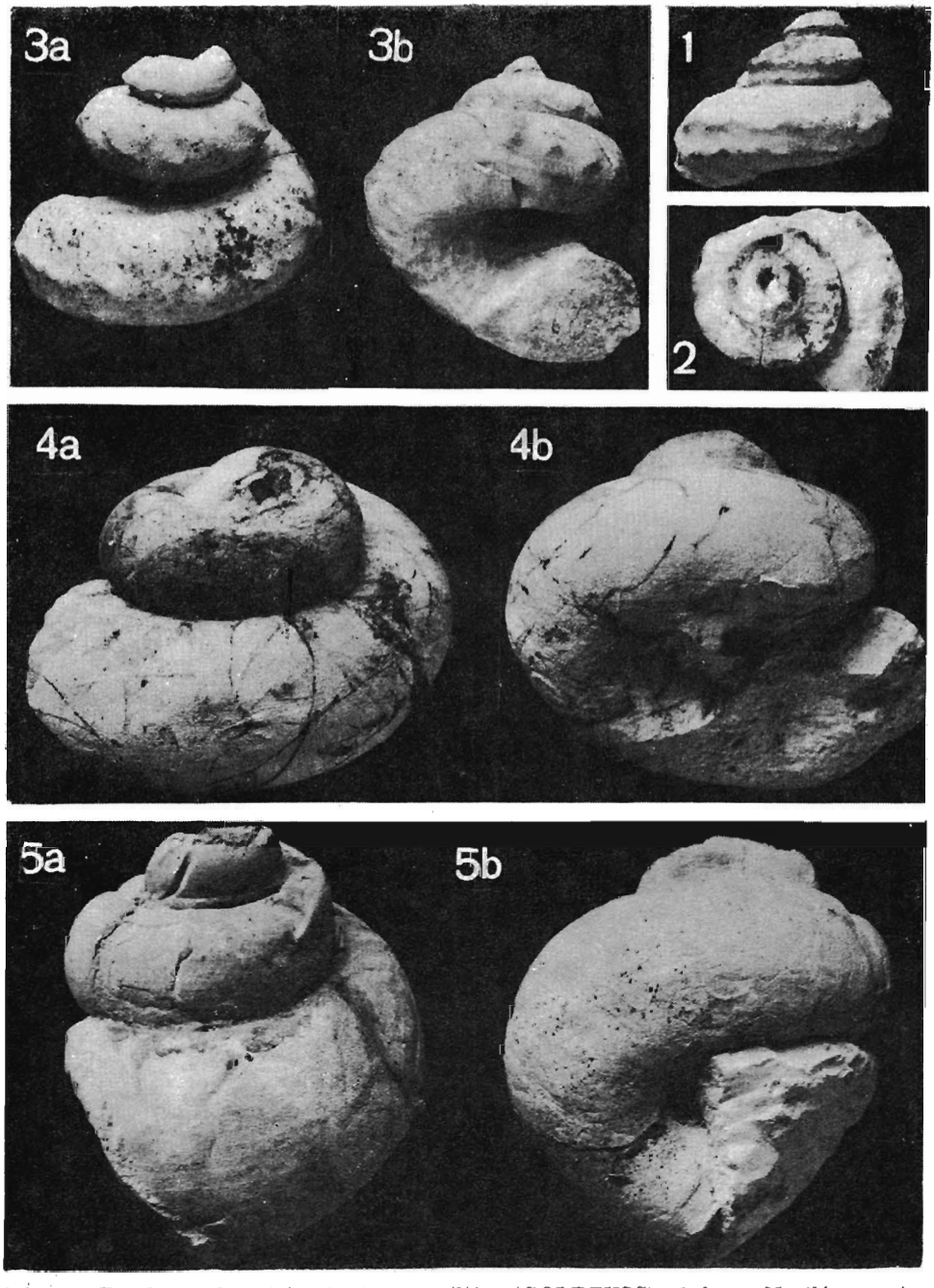
Figs 1—3 taken ×2, Figs. 4—6 in natural size



1-3 — *Trochacanthus tricarinatus tricarinatus* (ROEMER); Nasiłów opoka (*1a, 1b* apical views of incomplete specimen, to show peripheral spines; *2* oblique apical view of slightly open-coiling specimen; *3* external cast, to show ornamentation)

4-6 — *Trochacanthus nilssoni* (v. MÜNSTER); *4* from Nasiłów opoka (*4a* abaperial and *4b* apertural views); *5—6* from Kazimierz (*5* plaster cast, to show ornamentation, *6* steinkern)

All figures in natural size

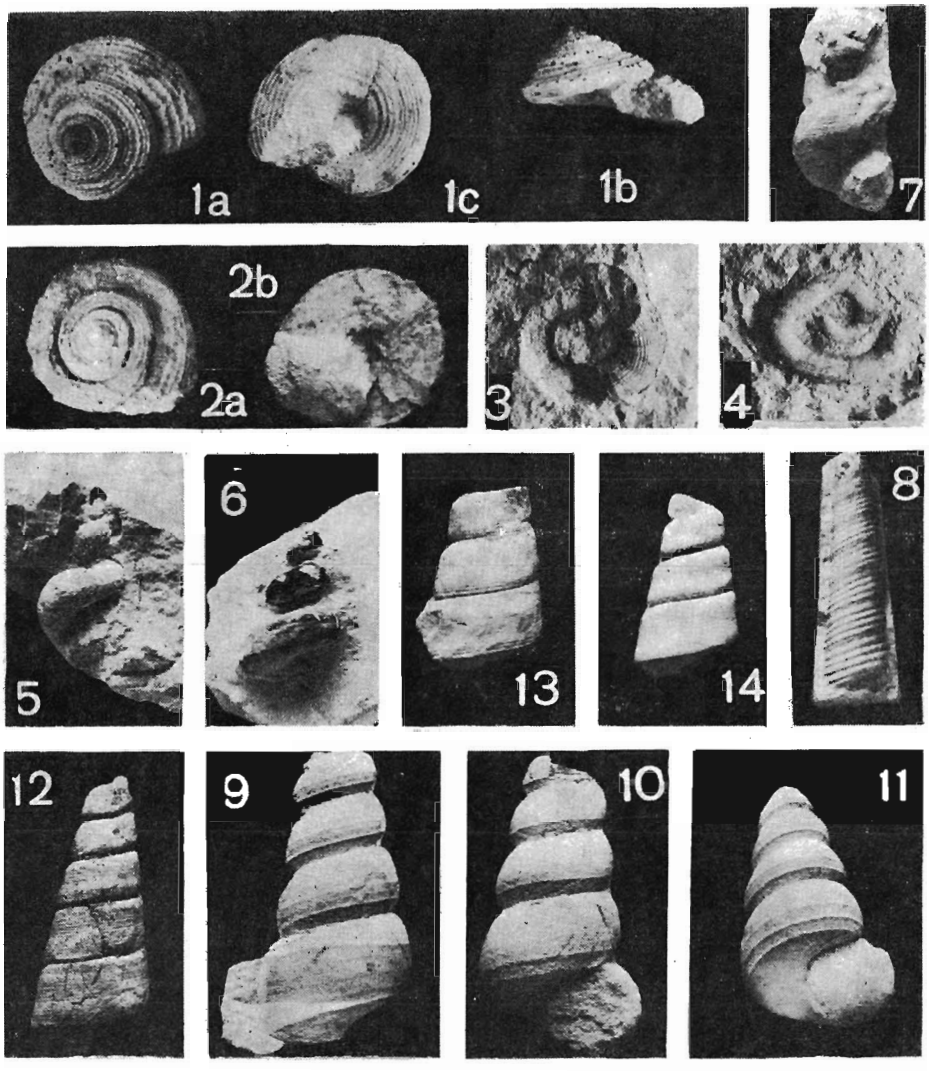


1-2 — *Trochacanthus tricarinatus monilifer* (GOLDFUSS); *1* from Nasiłów opoka (abapertural view); *2* from Piotrawin (incomplete; apical view)

3a-3b — *Trochacanthus tuberculatocinctus* (GOLDFUSS); Kazimierz (abapertural and oblique apertural views of incomplete, open-coiling specimen)

4-5 — *Atria laevis* (NILSSON); 4 from Nasiłów opoka (*4a* oblique abapertural and *4b* oblique basal views of incomplete specimen); *5* from Kazimierz (*5a* slightly oblique side view, *5b* oblique basal view; POŻARYSKA's Coll.)

All figures in natural size



1-2 — *Architectonica (Solariaxis) granulatocostata* (ALTH); Piotrawin (*1a, 2a* apical; *1b* apertural; *1c, 2b* basal views; MZ-Mg. 2544)
3-4 — *Lemintina nodosa* (KAUNHOWEN); Kazimierz (incomplete specimens)
5-7 — *Laxospira cochleiformis* (J. MÜLLER); *5, 7* from Nasiłów hardground (*5* steinkern, *6* incomplete external mold); *6* from Mećmierz (slightly limonitic external mold)
8 — *Turritella* sp.; plaster cast from Kazimierz
9-11 — *Turritella (Turritella) hagenoviana* v. MÜNSTER; *9, 11* from Kazimierz (*9* abapertural, *11* apertural views); *10* from Nasiłów opoka (apertural view)
12-14 — *Turritella (Haustator) plana* (BINKHORST); *12* from Nasiłów opoka (abapertural view); *13—14* from Kazimierz (incomplete, abapertural views)

All figures in natural size except Figs 1—2 taken ×2

1860. *Solarium granulato-costatum* m., ALTH, p. 217, Pl. 11, Fig. 13a—d.
1863. *Solarium granulato-costatum* ALTH; PŁACHETKO, p. 14, Pl. 1, Fig. 8.
1869. *Solarium granulato-costatum* ALTH; FAVRE, p. 70.

MATERIAL: 11 from the Upper Campanian opoka (1 from Ciszyca Kolonia, 10 from Piotrawin), 2 from Kazimierz.

REMARKS: Two badly preserved specimens were collected at Kazimierz and identified by comparison with well preserved specimens coming from the Upper Campanian of the study area (KONGIEL's Coll.).

Specimens from the Maastrichtian of Upper Bavaria described by BÖHM (1891) as "*Solarium* cf. *latetianum* (LEYM.)" are comparable with those of the studied species in ornamentation but they differ in having distinct granular riblets on the basal part.

AGE and DISTRIBUTION: Upper Campanian — Maastrichtian of the Lvov region and of the Middle Vistula Valley.

Superfamily **Turritellacea** CLARK, 1851
Family **Turritellidae** CLARK, 1851
Genus *Turritella* LAMARCK, 1799
Type species: *Turbo terebra* LINNAEUS, 1758
Subgenus *Turritella* LAMARCK, 1799
Turritella (Turritella) hagenoviana v. MÜNSTER, 1844
(PL. 8, Figs 9—11 and PL. 9, Fig. 12)

1844. *Turritella Hagenoviana* MÜNSTER; GOLDFUSS, p. 108, Pl. 192, Fig. 5.
1851. *Turritella Hagenoviana* GOLDF.; J. MÜLLER, p. 28.
1869. *Turritella quadricincta* GOLDFUSS FAVRE, p. 41, Pl. 8, Figs 4—5 (*non* GOLDFUSS).
1931. *Turritella quadricincta* GOLDF.; KRACH, p. 378, Pl. 9, Figs 15, 15a.
(1938) *Turritella quadricincta* GOLDF.; POŻARYSKI, p. 23.
(1942) *Turritella quadricincta* GOLDF.; PUTZER, p. 372.
1951. *Turritella quadricincta* GOLDF.; POŻARYSKI & POŻARYSKI, p. 20, Pl. 6, Fig. 2.
1974. *Turritella hagenoviana* MÜNSTER; BLANK, p. 131, Pl. 45, Fig. 2.

MATERIAL: 24 from Kazimierz, 95 from Nasiłów (85 opoka, 10 hardground).

REMARKS: The species is abundant in the deposits of the Belemnella kazimiroviensis Zone of the study area. The studied specimens are undoubtedly identical with the specimen figured by GOLDFUSS (1844) from the Campanian of Haldem, West Germany. The species was erroneously considered as a synonym of *T. quadricincta* GOLDFUSS by FAVRE (1869), PETHÖ (1906) and KRACH (1931). These two species can be easily distinguished by the strength and the number of the spiral cords. The studied species *T. hagenoviana* is ornamented with 4—6 spiral cords decreasing in strength toward the adapical suture, while *T. quadricincta* is ornamented with four prominent spiral cords of equal strength.

AGE and DISTRIBUTION: Campanian of West Germany, Lower Maastrichtian of the Donbass basin, Upper Maastrichtian of the Middle Vistula Valley.

Subgenus *Haustator* MONTFORT, 1810
Type species: *Haustator gallicus* MONTFORT, 1810
Turritella (Haustator) plana BINKHORST, 1861
(Pl. 8, Figs 12—14 and Pl. 9, Fig. 11)

1861. *Turritella plana* Nobis, BINKHORST, p. 30, Pl. 1, Fig. 5.
v. 1897. *Turritella (Torcula) plana* BINKHORST; KAUNHOWEN, p. 44, Pl. 3, Figs 6—14.
non 1902. *Turritella plana* BINKHORST; WANNER, p. 128.
„ 1902. *Turritella plana* BINKHORST; QUAAS, p. 250, Pl. 26, Figs 3—6.

1923. *Turritella (Torcula) plana* BINKHORST; SYNIEWSKA, p. 296.
1931. *Turritella (Archimediella) plana* BINKHORST; KRACH, p. 377, Pl. 9, Fig. 14.
(1938) *Turritella plana* BINK.; POŻARYSKI, p. 23.
(1942) *Turritella plana* BINK.; PUTZER, p. 372.
1951. *Turritella plana* BINKH.; POŻARYSKI & POŻARYSKI, p. 20, Pl. 6, Fig. 1.
1974. *Haustator plana* (BINKHORST); BLANK, p. 132, Pl. 51, Fig. 1.

MATERIAL: 6 from Męćmierz, 47 from Kazimierz, 1 from Bochotnica, 48 from Nasiłów (40 opoka, 8 hardground).

REMARKS: The species is one of the most predominant gastropods in the uppermost Maastrichtian deposits of the study area. Most of the studied specimens are incomplete. In mature forms, the last whorl is commonly disjunct. The studied specimens coincide with those from the Maastrichtian stratotype, as figured by BINKHORST (1861) and KAUNHOWEN (1897).

The species has been recorded by POŻARYSKI (1938) in the Upper Campanian of the Middle Vistula Valley.

The specimens described by WANNER (1902) and QUAAS (1902) from the Western Desert in Egypt do not belong to this species, because they are completely different both in general form and in ornamentation.

AGE and DISTRIBUTION: The Maastrichtian stratotype, Lower Maastrichtian of the Lvov region and Donbass basin, Upper Campanian — Upper Maastrichtian of the Middle Vistula Valley.

Turritella sp.
(Pl. 8, Fig. 8)

MATERIAL: One specimen from Kazimierz.

REMARKS: An external cast of *Turritella* ornamented with four prominent cords, separated with narrow interspaces and crossed by collabral threads. Suture is obscure. The species *Turritella binkhorsti* KAUNHOWEN has the similar collabral threads crossing the spiral cards, but it differs in having convex whorls ornamented with fine spiral cords.

Family **Vermetidae** d'ORBIGNY, 1840
Genus *Lemintina* RISSO, 1826
Type species: *Serpula arenaria* LINNAEUS, 1766
Lemintina nodosa (KAUNHOWEN, 1897)
(Pl. 8, Figs 3—4)

v. 1897. *Vermetus nodosus* nov. sp., KAUNHOWEN, p. 49, Pl. 4, Figs 6—10.

MATERIAL: 1 from Dziurków, 1 from Dobre, 6 from Kazimierz, 5 from Nasiłów (3 opoka, 2 hardground).

REMARKS: All the studied specimens although frequently incomplete, display well preserved ornamentation, and they agree with those from Kunrade, the Netherlands, as figured by KAUNHOWEN (1897).

AGE and DISTRIBUTION: Maastrichtian of the Netherlands and the Middle Vistula Valley.

Genus *Laxispira* GABB, 1877
Type species: *Laxispira lumbricalis* GABB, 1877
Laxispira cochleiformis (J. MÜLLER, 1851)
(Pl. 8, Figs 5—7)

1851. *Vermetus cochleiformis* J. MÜLLER, p. 6, Pl. 3, Fig. 3.
1888. *Laxispira cochleiformis* MÜLL. sp.; HOLZAPFEL, p. 153, Pl. 15, Figs 20—21.
1889. *Siliquaria cochleiformis* JOS. MÜLLER; GRIEPENKERL, p. 81.

MATERIAL: 1 from Mężmierz, 3 from Kazimierz, 6 from Nasiłów (3 opoka, 3 hardground).

REMARKS: Most of the studied specimens are incomplete, but their shape and ornamentation agree with those of *Laxispira cochleiformis* as figured by J. MÜLLER (1851) and HOLZAPFEL (1888) from the Aachen and Vaals greensands. The species *L. pinguis* HOLZAPFEL and *L. trochleata* BÖHM are closely similar and probably related to the studied species.

AGE and DISTRIBUTION: Campanian of West Germany and the Netherlands, and Upper Maastrichtian of the Middle Vistula Valley.

Superfamily **Scalacea** BRODERIP
Family **Scalidae** BRODERIP
Genus *Confusiscala* BOURY, 1910
Type species: *Scalaria dupiniana* d'ORBIGNY, 1842
Confusiscala decorata (ROEMER, 1841)
(Pl. 9, Figs 6—7)

1841. *Melania decorata* N., ROEMER, p. 82, Pl. 12, Fig. 11.
1844. *Fusus costato-striatus* MÜNSTER; GOLDFUSS, p. 23, Pl. 171, Fig. 16.
1850. *Scalaria Dupiniana* d'ORB.; KNER, p. 14, Pl. 3, Fig. 3.
1869. *Scalaria decorata* ROEMER sp.; FAVER, p. 45, Pl. 8, Figs 8—9.
1875. *Scala decorata* A. ROEMER; GEINTZ, p. 162, Pl. 29, Fig. 4.
1877. *Scala (Scalari) decorata* GEINITZ; FRIČ, p. 104, Text-fig. 41.
1888. *Scalaria* cf. *decorata* ROEMER; HOLZAPFEL, p. 165, Pl. 19, Fig. 1.
1889. *Scalaria decorata* A. ROEMER sp.; GRIEPENKERL, p. 76.
1898. *Scalaria decorata* A. ROEM. sp.; G. MÜLLER, p. 95, Pl. 13, Figs 3, 20.
1905. *Scalaria decorata* ROEM.; DENINGER, p. 28.
p. p. 1934. *Scalaria decorata* A. ROEM. sp.; ANDERT, p. 361, Pl. 17, Fig. 4.
(1938) *Scalaria decorata* ROEM.; POŻARYSKI, p. 23.
(1942) *Scalaria decorata* ROEM.; PUTZER, p. 372.
1974. *Confusiscala decorata* (ROEMER); BLANK, p. 133, Pl. 51, Fig. 6.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 1 from Bochotnica, 4 from Nasiłów (opoka).

REMARKS: The size and the general features of the studies specimens agree with those of the specimens described from the Senonian of West Germany (ROEMER 1841, GRIEPENKERL 1889, G. MÜLLER 1898) and those from the Lvov region (FAVRE 1869). The species *Scalaria haidingeri* BINKHORST from the Maastrichtian of Limburg is closely similar and probably related to the studied species.

AGE and DISTRIBUTION: Middle Turonian — Lower Senonian of West Germany, Lower Maastrichtian of the Lvov region and Donbass basin, Upper Campanian (POŻARYSKI 1938) — Upper Maastrichtian of the Middle Vistula Valley.

Confusiscala cf. *contorta* (KAUNHOWEN, 1897)
(Pl. 9, Fig. 10)

cf. 1897. *Scalaria contorta* nov. sp., KAUNHOWEN, p. 43, Pl. 3, Figs 2—2a.

REMARKS: Only one incomplete specimen collected at Nasiłów is closely similar to that of *Scalaria contorta* KAUNHOWEN from the Maastrichtian of Kunrade, the Netherlands, in highly convex whorls and similar number of axial costae, although the axial costae are smooth in *C. contorta* while they are crossed with spiral lines in the studied specimen.

Superfamily Cerithiacea FLEMING, 1822
Family Cerithiidae
Subfamily Cerithiinae
Genus *Cerithium* BRUGUIÈRE, 1789
Type species: *Cerithium adansonii* BRUGUIÈRE, 1789

DISCUSSION: The genus *Cerithium* is divided into several subgenera, based merely on the apertural characters and the nature of siphonal canal. In the studied material the apertural parts are commonly broken, and thus it might be preferable to accept *Cerithium* (s.l.) for the following species.

Cerithium paucicostatum FAVRE, 1869
(Pl. 9, Figs 1—2)

1869. *Cerithium paucicostatum* FAVRE, p. 39, Pl. 8, Fig. 2.

MATERIAL: 1 from Bochotnica, 2 from Nasiłów (opoka).

REMARKS: The two specimens from Nasiłów are large and almost complete if compared with an incomplete specimen figured by FAVRE (1869) from the Lvov region, while the specimen from Bochotnica is a fragment with well preserved sculpture.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium tectiforme BINKHORST, 1861
(Pl. 10, Fig. 2)

1861. *Cerithium tectiforme* Nobis, BINKHORST, p. 24, Pl. 1, Fig. 3.
1897. *Cerithium tectiforme* BINKHORST; KAUNHOWEN, p. 60.
non 1905. *Cerithium tectiforme* BINKHORST; DENINGER, p. 13, Pl. 2, Figs 1—2, 4.

MATERIAL: One specimen from Kazimierz.

REMARKS: One external cast of well preserved sculpture undoubtedly coincides with the type figured by BINKHORST (1861) from the Maastrichtian stratotype. The specimens illustrated by DENINGER (1905) are quite different in general form and ornamentation; moreover, DENINGER erroneously listed *Cerithium margaretae* GEINITZ and *C. schlueteri* GEINITZ as synonyms of this species, however, the second shows some similarity in turriculate form and ornamentation, but the axial costae are smaller in number and widely spaced.

AGE and DISTRIBUTION: The Maastrichtian statotype and the uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium binodosum ROEMER, 1841
(Pl. 10, Figs 3—4)

1841. *Cerithium binodosum* ROEMER, p. 79, Pl. 11, Fig. 16.
1875. *Cerithium binodosum* A. RÖMER; GEINITZ, p. 176, Pl. 31, Fig. 4.
1888. *Cerithium binodosum* RÖM.; HOLZAPFEL, p. 124, Pl. 10, Figs 10—14; Pl. 21, Fig. 10.
p. p. 1898. *Cerithium binodosum* A. ROEM.; G. MÜLLER, p. 105, Pl. 14, Figs 1, 3.
1921. *Cerithium binodosum* ROEM.; RAVN, p. 33, Pl. 3, Fig. 4.
1930. *Cerithium binodosum* ROEM.; HÄGG, p. 19, Pl. 1, Fig. 6.
1931. *Hemicerithium binodosum* RÖM.; KRACH, p. 379, Pl. 9, Fig. 13.
(1942) *Hemicerithium binodosum* ROEM.; PUTZER, p. 373.

MATERIAL: 28 from the Upper Campanian opoka (5 from Ciszyca Kolonia, 21 from Ciszyca Górna, 2 from Piotrawin), 2 from Kamień, 1 from Okale, 2 from Kazimierz.

REMARKS: The majority of the studied specimens, although incomplete, agree with those described by HOLZAPFEL (1888) from the Campanian of the Vaals and Aachen greensands. The species can be easily distinguished by the sculpture from other Upper Cretaceous species. In the study area, the species is more common in the Upper Campanian deposits than in the Maastrichtian ones. It displays a slight variation in ornamentation, where the Campanian specimens have a more distinct nodular ornamentation while the specimens from the Upper Maastrichtian show more developed obscure costae. Such variability of this species, especially the ornamentation, was illustrated by HOLZAPFEL (1888). Most of the studied Campanian specimens come from the KONGIEL's Collection. KRACH (1931) described this species from Piotrawin (uppermost Campanian).

AGE and DISTRIBUTION: Senonian of the Netherlands, West Germany, Sweden and Denmark, as well as Upper Senonian of the Middle Vistula Valley.

Cerithium decheni v. MÜNSTER, 1844
(Pl. 9, Figs 3—4)

1844. *Cerithium Dechenii* MÜNSTER; GOLDFUSS, p. 34, Pl. 174, Fig. 2.
(1850) *Cerithium Dechenii* MÜNST.; d'ORBIGNY, p. 231.
1888. *Cerithium Dechenii* GLDF.; HOLZAPFEL, p. 126, Pl. 13, Fig. 15.
1889. *Cerithium Dechenii* v. MÜNSTER; GRIEPENKERL, p. 83.

MATERIAL: 7 from Kazimierz, 1 from Janowiec.

REMARKS: This species is characterized by its reticulate ornamentation and shorter compressed whorls. However, *C. reticulatum* SOWERBY, as figured by REUSS (1845), has similar reticulate ornamentation, but its axial costae are smaller in number and widely spaced. The species *C. quadricostatum* KAUNHOWEN (1897) has similar reticulate ornamentation, but its axial costae are more closely spaced than in *C. decheni*. The species *C. subimbricatum* G. MÜLLER (1898) from the Lower Senonian of West Germany is closely allied to the studied species, but it differs in having larger number (about six) of spiral cords.

AGE and BISTRIBUTION: Upper Senonian of West Germany and uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium nerei v. MÜNSTER, 1844
(Pl. 9, Fig. 5)

1844. *Cerithium Nerei* MÜNSTER; GOLDFUSS, p. 34, Pl. 174, Fig. 3.
(1850) *Cerithium Nerei* MÜNSTER; d'ORBIGNY, p. 231.
1889. *Cerithium Nerei* v. MÜNSTER; GRIEPENKERL, p. 83.

MATERIAL: 17 from Kazimierz.

REMARKS: The majority of the studied specimens are badly preserved, with a commonly damaged aperture, and stained by limonitic material.

The species *C. willigeri* SCUPIN, 1913, from the Lower Senonian deposits of Bohemia is similar to *C. nerei*, but its axial costae are more thicker toward the abapical suture.

AGE and DISTRIBUTION: Campanian of West Germany and uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium polystropha ALTH, 1850
(Pl. 9, Fig. 8)

1850. *Cerithium polystropha* ALTH, p. 225, Pl. 11, Fig 26.
1869. *Cerithium polystropha* ALTH; FAVRE, p. 35.
(1911) *Cerithium polystropha* ALTH; ROGALA, p. 491.

MATERIAL: 2 from Kazimierz, 1 from Bochotnica (hardground).

REMARKS: The studied specimens agree with the description and illustration offered by ALTH (1850); they are incomplete, stained with ferruginous material. The species *C. peregrinorsum* d'ORBIGNY, from the Turonian deposits of France, has similar ornamentation but it is more shorter, with a larger pleural angle and four spiral riblets. Moreover, *C. quadricostatum* and *C. distinctum* erected by KAUNHOWEN (1897) from the Maastrichtian stratotype are closely similar to the studied species, but the first has four spiral cords and the second is ornamented with numerous axial riblets crossed by 6-7 spiral riblets.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium griepenkerli G. MÜLLER, 1898
(Pl. 9, Fig. 9)

1898. *Cerithium griepenkerli* n. sp., G. MÜLLER, pp. 106—107, Pl. 14, Figs 4—6.

MATERIAL: 1 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens are incomplete with damaged terminals. The specimen collected at Nasiłów has compressed and convex whorls ornamented with fine numerous spiral lines and faintly cancellated by axial striae. The general shape and outline of the whorls as well as the ornamentation agree with those of *Cerithium griepenkerli* G. MÜLLER from Braunschweig, West Germany.

AGE and DISTRIBUTION: Santonian — Campanian of West Germany and uppermost Maastrichtian of the Middle Vistula Valley.

Cerithium mazureki sp. n.
(Pl. 10, Fig. 14)

HOLOTYPE: The specimen presented in Pl. 10, Fig. 14.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: In the honour of Dr. A. MAZUREK (1885—1944) for his important contribution to the knowledge of the Upper Cretaceous fauna in Central Poland.

DIAGNOSIS: A large cerithiid, with a turret-like spire, and whorls posteriorly shouldered, ornamented with spiral granular ribs.

MATERIAL: 4 from Nasiłów (2 opoka, 1 hardground, 1 greensand).

MEASUREMENTS:	H	D	PA	Location
Holotype (Pl. 10, Fig. 14)	34.0	16.0	30°	Nasiłów opoka)
Paratype	29.0	14.3	34°	„ „

DESCRIPTION: The shell is large, turret-like, with an acute spire. Whorls are shouldered, nearly straight-sided, wider adapically, with step-like profile. They are ornamented with five granular spiral ribs. The ribs are separated by flat and smooth interspaces which are more closer adapically. The last whorl is moderately inflated with convex sides, ornamented with 9-10 granular spiral ribs. Aperture suboval, with a rounded outer lip. The suture is linear and shouldered.

REMARKS: The new species can be easily distinguished from other described cerithiids by the whorls outline and the distinct shoulder. Like other described cerithiid species, the studied specimens are incomplete with their apical part and the siphonal canal damaged.

Genus *Bittium* LEACH *in* GRAY, 1847
Type species: *Strombiformis reticulatus* da COSTA, 1779
Subgenus *Semibittium* COSSMANN, 1896
Bittium (Semibittium) triptychum (KAUNHOWEN, 1897)
(Pl. 10, Fig. 1)

v. 1897. *Cerithium (Bittium) triptychium* nov. sp., KAUNHOWEN, p. 67, Pl. 6, Fig. 18.

MATERIAL: One specimen from Nasiłów (hardground).

REMARKS: Although the studied specimen is an incomplete external cast, its form and size as well as ornamentation coincide with those of the specimen figured by KAUNHOWEN (1897) from the Maastrichtian stratotype. The species *Bittium bicostatum* (KAUNHOWEN) differs from this species in having only two spiral riblets.

AGE and DISTRIBUTION: The Maastrichtian stratotype, and the uppermost Maastrichtian of the Middle Vistula Valley.

Superfamily **Xenophoracea** DESHAYES
Family **Xenophoridae** DESHAYES
Genus *Xenophora* FISCHER v. WALDHEIM, 1807
Type species: *Trochus conchyliophorus* BORN, 1780; *SD* GRAY, 1847
Xenophora onusta (NILSSON, 1827)
(Pl. 12, Fig. 1)

1827. *Trochus onustus* n., NILSSON, p. 12, Pl. 3, Fig. 4.
v. 1844. *Trochus onustus* NILS.; GOLDFUSS, p. 59, Pl. 181, Fig. 10.
1850. *Phorus insignis* KNER, p. 17, Pl. 3, Fig. 10.
1851. *Trochus onustus* NILSSON; J. MÜLLER, p. 44.
v.(1860) *Xenophora onusta* NILSSON; BOSQUET, p. 376.
1861. *Xenophora onusta* Nobis, BINKHORST, p. 38, Pl. 3, Fig. 14.
1869. *Phorus onustus* NILSSON sp.; FAVRE, p. 68, Pl. 9, Fig. 14.
1868. *Xenophora onusta* NILSS. sp.; HOLZAPFEL, p. 152, Pl. 14, Fig. 28.
1880. *Xenophora onusta* NILSSON sp.; GRIEPENKERL, p. 81.
1897. *Xenophora onusta* (NILS); FRIČ, p. 44, Text-fig. 32.
v. 1897. *Xenophora onusta* NILSSON sp.; KAUNHOWEN, p. 50, Pl. 3, Fig. 15.
1934. *Xenophora onusta* NILSS. sp.; ANDERT, p. 364.
1954. *Xenophora onusta* (NILSSON); HÄGG, p. 24.
1974. *Xenophora onusta* (NILSSON); BLANK, p. 134, Pl. 46, Figs 11—12.
1981. *Xenophora onusta* (NILSSON); TZANKOV & MOTEKOVA, p. 64, Pl. 14, Fig. 20.

MATERIAL: 1 from Kamień, 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: The studied specimens coincide with the description and figure presented by NILSSON (1827) and with those described from the Senonian of Europe. The specimen from the Lower Maastrichtian (locality Kamień) is larger than those from the uppermost Maastrichtian.

TZANKOV & MOTEKOVA (1981) considered *Xenophora plicata* (ZEKELI) as a synonym of the studied species. WADE (1926) mentioned that *X. leprosa* (MORTON) from the Maastrichtian Ripley Formation of U.S.A. is very similar to the European studied species.

AGE and DISTRIBUTION: Lower Senonian of Bohemia; Upper Senonian of West Germany, Limburg, Sweden and Austria; Lower Maastrichtian of the Lvov region, Donbass basin, and Bulgaria; Maastrichtian of the Middle Vistula Valley.

Superfamily **Strombacea** SWAINSON, 1840
Family **Aporrhaidae** ADAMS, 1858
Genus *Aporrhais* da COSTA, 1778
Type species: *Strombus pespelecani* LINNAEUS, 1766
Aporrhais pyriformis (KNER, 1850)
(Pl. 10, Figs 5—8)

1850. *Rostellaria pyriformis* m., KNER, p. 19, Pl. 4, Figs 3, 3a.
(1850) *Strombus pyriformis* KNER; GEINITZ, p. 138, Pl. 9, Fig. 3.
1852. *Strombus pyriformis* KNER; KNER, p. 15, Pl. 2, Fig. 9.
1869. *Pterocera piriformis* KNER sp.; FAVRE, p. 72, Pl. 9, Fig. 16.
1886. *Pterocera bicarinata* d'ORB. var. tricarinata; SIEMIRADZKI, p. 67, Pl. 5, Fig. 10.
(1911) *Pterocera pyriformis* KNER; ROGALA, p. 491.
1931. *Aporrhais pyriformis* KNER; KRACH, p. 382, Pl. 9, Figs 6—7.
(1938) *Aporrhais pyriformis* KNER; POŻARYSKI, p. 23.
(1942) *Aporrhais pyriformis* KNER; PUTZER, p. 372.
1951. *Aporrhais pyriformis* KNER; POŻARYSKA & POŻARYSKI, p. 20, Pl. 6, Fig. 4.
1974. *Aporrhais pyriformis* KNER; BLANK, p. 137, Pl. 46, Figs 7—8.

MATERIAL: 4 from Dobre, 3 from Podgórz, 4 from Męćmierz, 68 from Kazimierz, 170 from Nasiłów (40 opoka, 130 hardground).

REMARKS: This species is considered as one of the most predominant gastropods in the Upper Maastrichtian of the study area. It is highly concentrated in the uppermost part of the Belemnella kazimiroviensis Zone, especially in the Nasiłów hardground. No other species as yet described are likely to be confused with this species.

AGE and DISTRIBUTION: Lower Maastrichtian of the Lvov region and Donbass basin, and Upper Maastrichtian of the Middle Vistula Valley.

Aporrhais granulosa (J. MÜLLER, 1851)
(Pl. 10, Figs 9—10)

1851. *Rostellaria granulosa* MÜLLER, p. 21, Pl. 3, Fig. 27.
1888. *Aporrhais granulosa* MÜLL. sp.; HOLZAPFEL, p. 114, Pl. 12, Fig. 10.
1943. *Aporrhais granulosa* (J. MÜLLER); VAN DER WEIJDEN, p. 113, Pl. 12, Fig. 1.

MATERIAL: 5 from the Upper Campanian opoka (1 from Dorotka, 1 from Ciszyca Kolonia, 2 from Ciszyca Górna, 1 from Piotrawin), 3 from Kazimeirz, 1 from Nasiłów (opoka).

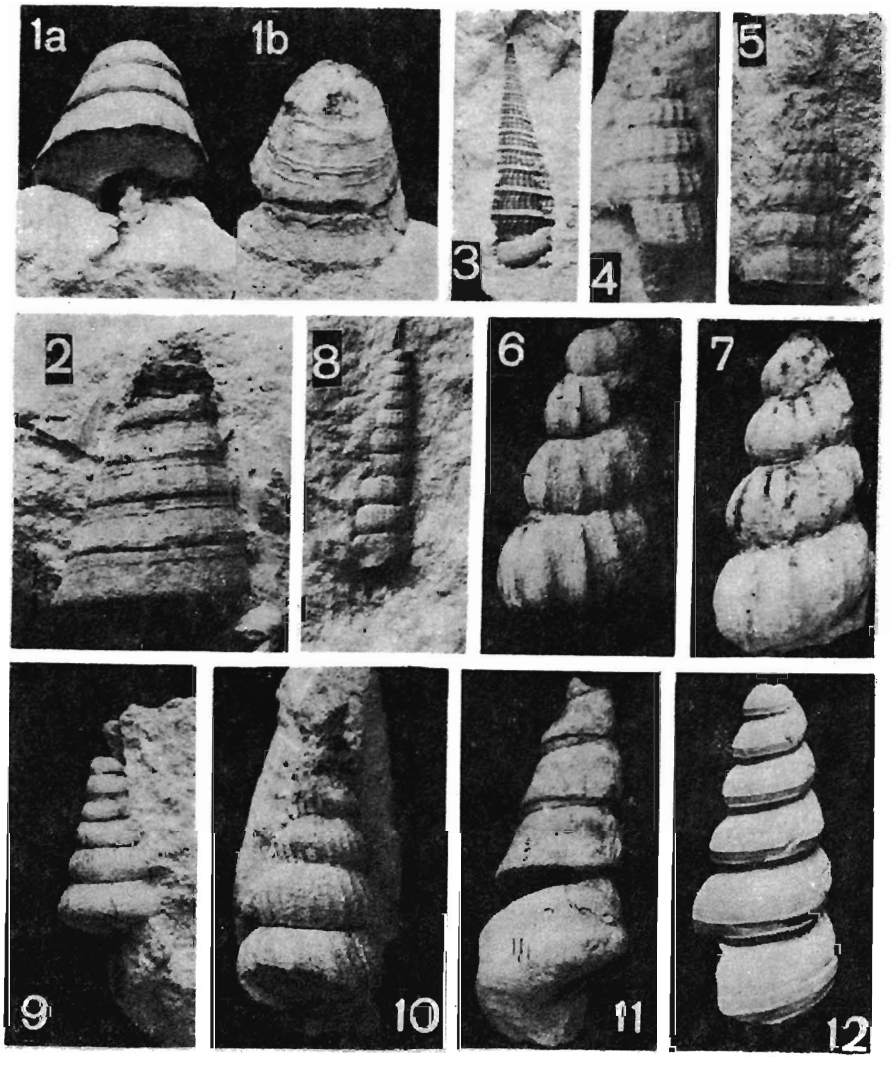
REMARKS: The studied specimens agree in their general form and ornamentation with those described by J. MÜLLER (1851) and HOLZAPFEL (1888) from the Aachen and Vaals greensands, but the granules are more distinct on those from the greensands. The species *A. pyriformis* (KNER) has similar cancellate ornamentation over the spire but it differs from the studied species by the ornamentation of the last whorl. This species is comparable with *A. rapax* BÖHM from the Maastrichtian of Upper Bavaria, West Germany, but the latter differs in having more elongated lateral digitations.

AGE and DISTRIBUTION: Campanian of the Netherlands and West Germany, and Upper Campanian — Maastrichtian of the Middle Vistula Valley.

Aporrhais(?) *luganicus* BLANK, 1972
(Pl. 10, Figs 12—13)

p. p. 1869. *Aporrhais Buchi* MÜNSTER sp.; FAVRE, p. 74, Pl. 9, Fig. 18 (*non* v. MUNSTER).
1972. *Aporrhais luganicus* BLANK, p. 30, Pl. 1, Figs 4—5.
1974. *Aporrhais(?) luganicus* BLANK; BLANK, p. 138, Pl. 46, Figs 5—6.

MATERIAL: 6 from Kazimierz, 2 from Nasiłów (1 opoka, 1 greensand).



1—2 — *Cerithium paucicostatum* FAVRE; Nasiłów opoka (*1a* oblique apertural, *1b* oblique abapertural views of incomplete specimen; **2** abapertural view)

3—4 — *Cerithium decheni* v. MÜNSTER; Kazimierz (3 external cast, MACHALSKI's Coll.; *4* plaster cast of incomplete specimen)

5 — *Cerithium nerei* V. MÜNSTER; Kazimierz (incomplete specimen; MACHALSKI's Coll.)

6—7 — *Confusiscala decorata* (ROEMER); *6* from Bochotnica (incomplete specimen; MZ-Mg. 2545); *7* from Nasiłów opoka (incomplete, abapertural view)

8 — *Cerithium polystropha* ALTH; Bochotnica hardground (incomplete specimen; MACHALSKI's Coll.)

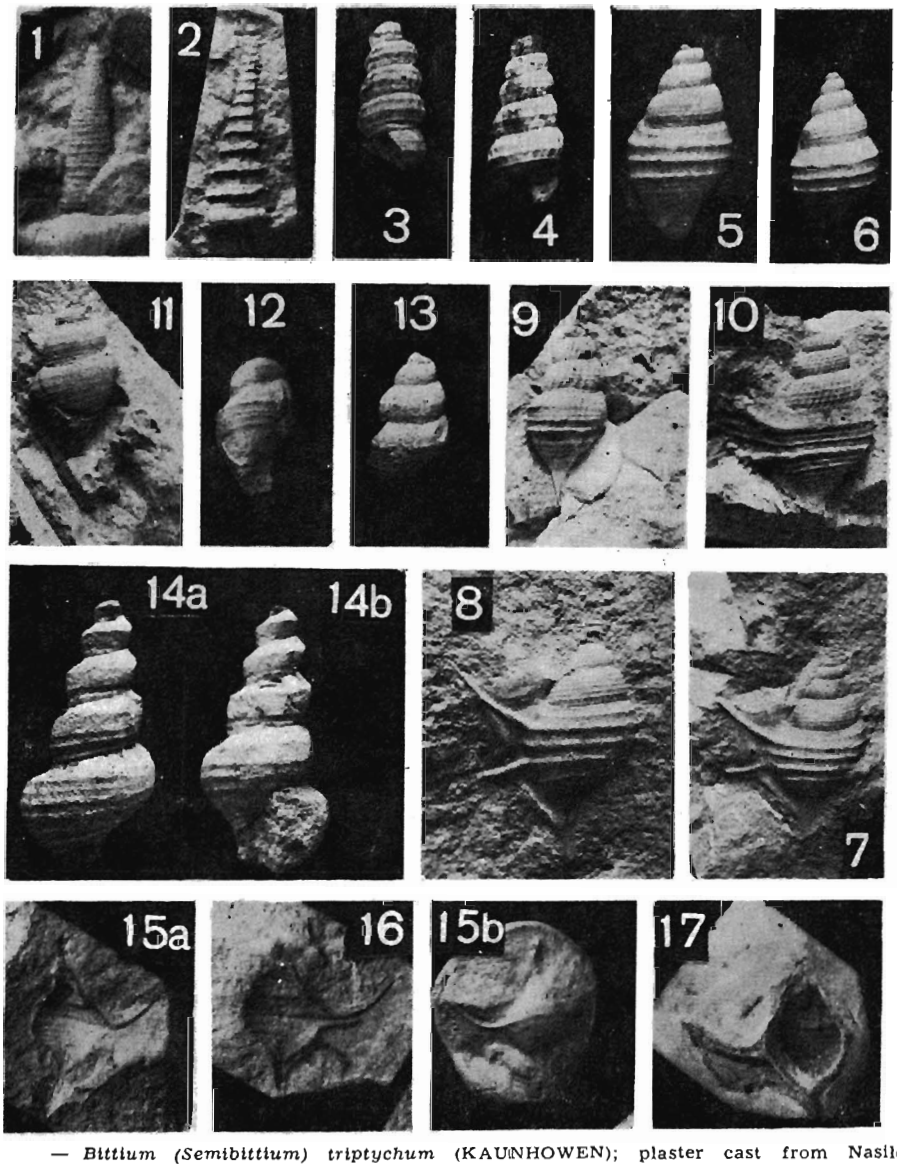
9 — *Cerithium griepenkerli* G. MÜLLER; Nasiłów opoka (incomplete, apertural view)

10 — *Confusiscala* cf. *contorta* (KAUNHOWEN); Nasiłów opoka (incomplete specimen)

11 — *Turritella (Haustator) plana* BINKHORST; Nasiłów opoka (abapertural view of incomplete, compressed specimen)

12 — *Turritella (Turritella) hagenoviana* v. MÜNSTER; Nasiłów opoka (incomplete specimen, to show ornamentation)

All figures in natural size except Figs 4 and 10 taken ×2



1 — *Bittium (Semibittium) triptychum* (KAUNHOWEN); plaster cast from Nasiłów hardground

2 — *Cerithium tectiforme* BINKHORST; plaster cast from Kazimierz

3—4 — *Cerithium binodosum* ROEMER; Piotrawin (incomplete specimens; MZ-MG. 2530)

5—8 — *Aporrhais pyriformis* (KNER); *5—6* from Nasiłów hardground (incomplete, abapertural views); *7—8* from Kazimierz (abapertural views)

9—10 — *Aporrhais granulosa* (J. MÜLLER); Ciszyca Górna (*9* apertural view; *10* incomplete, abapertural view, MZ-Mg. 2535)

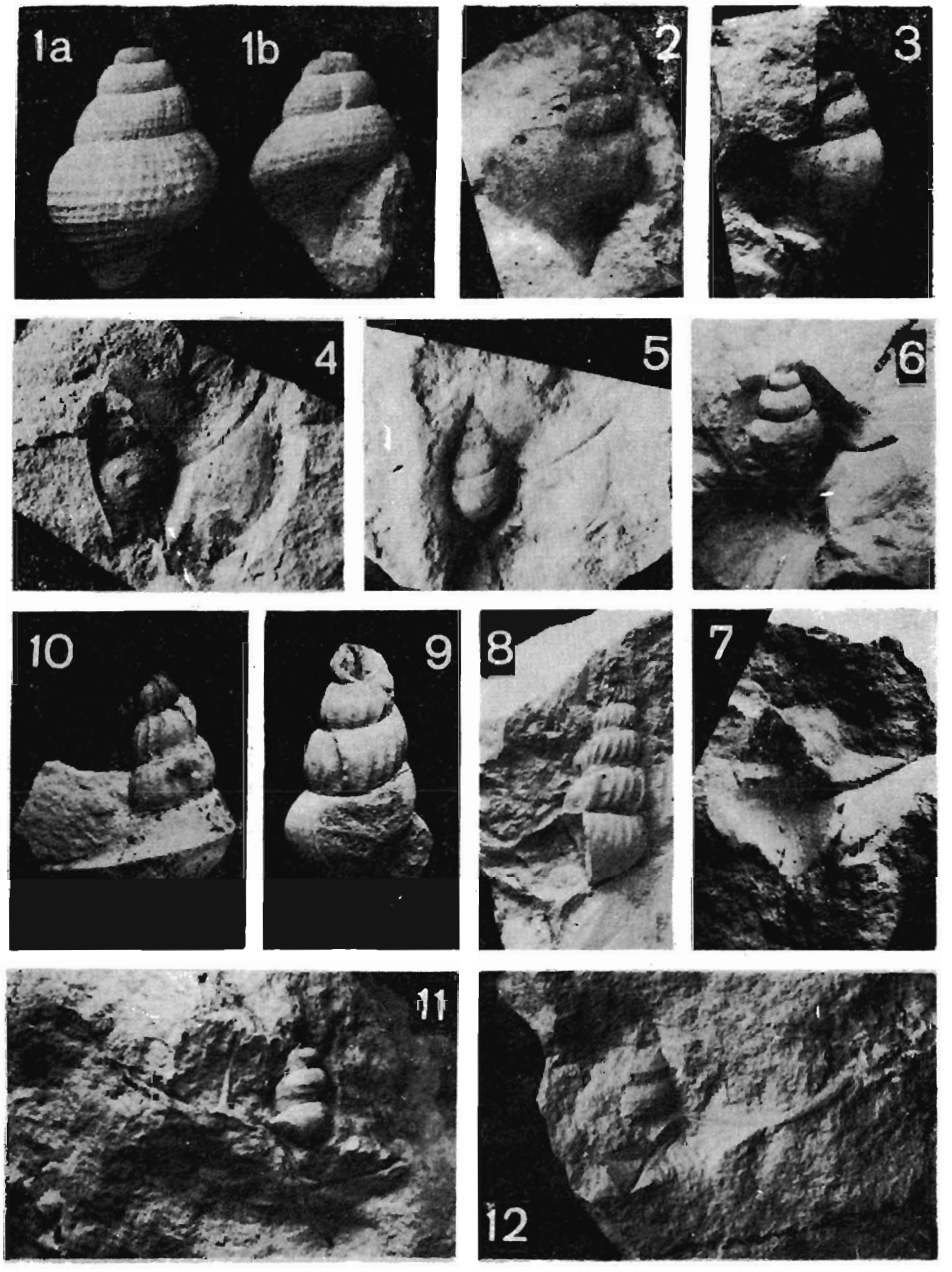
11 — *Aporrhais*(?) *najdini* BLANK; Męćmierz (incomplete, apertural view)

12—13 — *Aporrhais*(?) *luganicus* BLANK; Nasiłów opoka (incomplete specimens; MACHALSKI's Coll.)

14a—14b — *Cerithium mazureki* sp. n.; Nasiłów opoka, holotype (abapertural and apertural views)

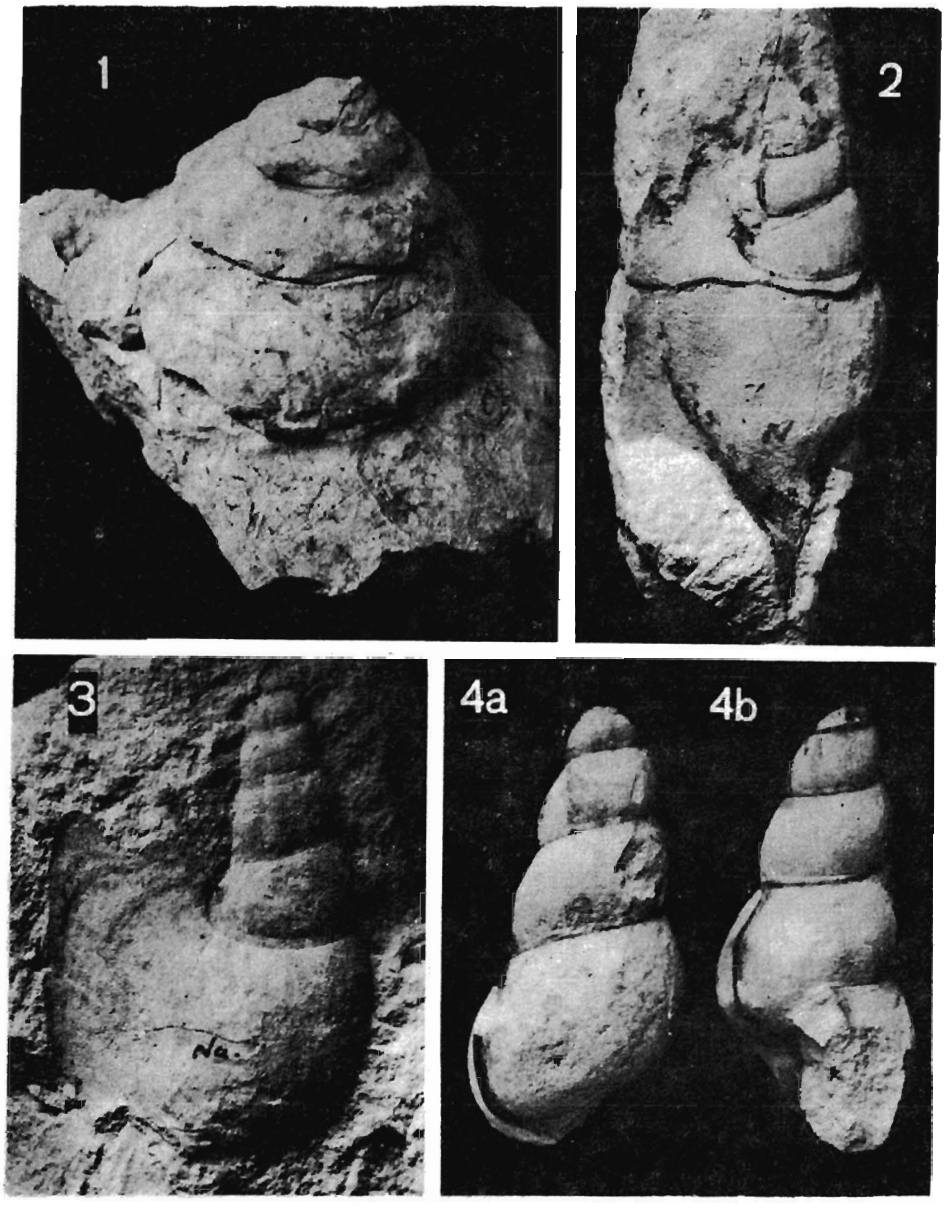
15—17 — *Helicaulax pozaryskii* sp. n.; *17* holotype from Podgórz (incomplete abapical view); *15—16* paratypes from Dobre (*15a* external cast, *15b* plaster cast of abapertural view; *16* external cast with well preserved nodular ornamentation)

All figures in natural size except Fig. 1 taken ×2



1a—1b — *Aporrhais* sp. indet.; Kazimierz (abapertural and apertural views)
2—3 — *Arrhoges (Latiala) pelecyphora* (KAUNHOWEN); Nasiłów opoka (abapertural views)
4—7 — *Kaunhowenia carinifera* (KAUNHOWEN); *4—6* from Kazimierz (apertural views); *7* external cast from Nasiłów opoka
8—10 — *Drepanocheilus substenoptera* (G. MÜLLER); *8* from Kazimierz (incomplete; abapertural view); *9* from Dorotka (incomplete; apertural view, MZ-Mg. 2540); *10* from Bochotnica hardground (incomplete; abapertural view, MZ-Mg. 2540)
11—12 — *Cultrigera arachnoides* (J. MÜLLER); Kazimierz (*11* abapertural view, *12* apertural view); note digitations separated in Fig. 11, and joined by shell webbing in Fig. 12

All figures in natural size except Fig. 1 taken ×2



1 — *Xenophora onusta* (NILSSON); Kamień (abapertural view; MZ-Mg. 2523)
2-3 — *Perissoptera emarginulata* (GEINITZ); Nasiłów opoka (incomplete, abapertural views)
4a-4b — *Tibia (Tibia) laevis* (ALTH); Bochotnica opoka (abapertural and apertural views of specimen with damaged terminals)

All figures in natural size

REMARKS: The majority of the studied specimens ,although incomplete, coincide with those described by BLANK (1972, 1974) from the Lower Maastrichtian of the Donbass basin and the specimen figured by FAVRE (1896) from the Lower Maastrichtian of the Lvov region.

The generic assignement of this species is questionable, when the apertural outer lip is missing.

AGE and DISTRIBUTION: Lower Maastrichtian of the Lvov region and Donbass basin, and uppermost Maastrichtian of the Middle Vistula Valley.

Aporrhais(?) *najdini* BLANK, 1972
(Pl. 10, Fig. 11)

p. p. 1869. *Aporrhais Buchi* MÜNSTER sp.; FAVRE, p. 74, Pl. 9, Fig. 19 (*non* v. MÜNSTER).
1972. *Aporrhais(?) najdini* n. sp., BLANK, p. 29, Pl. 1, Fig. 3.
1974. *Aporrhais(?) najdini* BLANK; BLANK, p. 136, Pl. 46, Fig. 3.

MATERIAL: 1 from Podgórz, 2 from Nasiłów (hardground).

REMARKS: The studied specimens are incomplete, badly preserved, especially those collected from the Nasiłów hardground. In general, they agree with the type specimen figured by BLANK (1972, 1974) from the Lower Maastrichtian of the Lvov region and the Donbass basin. The generic assignment of this species is questionable the same as of the preceding species.

AGE and DISTRIBUTION: Lower Maastrichtian of the Lvov region and Donbass basin, and Upper Maastrichtian of the Middle Vistula Valley.

Aporrhais (?) sp. indet.
(Pl. 11, Fig. 1)

MATERIAL: 10 from Kazimierz, 1 from Bochotnica, 5 from Nasiłów (2 opoka, 3 hardground).

REMARKS: The studied specimens are characterized by small sized, spindle-shaped, high spired shell with three convex whorls, and the inflated last whorl. The sculpture is cancellate, except the basal part of the last whorl which is ornamented only with spiral cords. The inner aperture is lenticular in outline, terminated with a short and narrow siphonal canal.

The general characters of these specimens are comparable with those of the aporrhaids, but unfortunately all of them display their apertural outer lip damaged.

Genus *Helicaulax* GABB, 1868
Type species: *Rostellaria ornata* d'ORBIGNY, 1843; *SD* COSSMANN, 1904

DISCUSSION: Full discussion on *Helicaulax* GABB was given by SOHL (1960) who restricted its stratigraphic range to the Upper Cretaceous (Cenomanian — Senonian) of Europe and North America.

Helicaulax pozaryskii sp. n.
(Text-fig. 13 and Pl. 10, Figs 15—17)

HOLOTYPE: The specimen presented in Pl. 10, Fig. 17.
PARATYPES: Two specimens presented in Text-fig. 13 and Pl. 10, Figs 15—16.
TYPE LOCALITY: Podgórz, ca. 4 km south of Kazimierz.
TYPE HORIZON: Belemnitella junior Zone.
DERIVATION OF THE NAME: In the honour of Professor W. POŻARYSKI, for his contributions to the stratigraphy of the Upper Cretaceous deposits exposed in the Middle Vistula Valley.

DIAGNOSIS: A small *Helicaulax* with moderate spire, carinate last whorl, and nodular ornamentation.

MATERIAL: 2 from Dobre, 1 from Podgórz.

MEASUREMENTS:	H	DW	BH	PA	Location
Holotype (Pl. 10, Fig. 17)	19.0	17.5	11.5	69°	Podgórz
Paratype (Pl. 10, Fig. 15)	18.7	13.5	11.8	93°	Dobre
„ (Pl. 10, Fig.16)	18.0	16.0	11.0	60°	

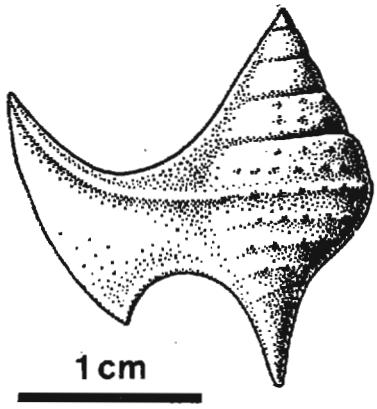


Fig. 13

Helicaulax pozaryskii sp. n.; Dobre, low-Upper Maastrichtian

DESCRIPTION: The shell is small-sized, and spindle-shaped; spire with about three convex whorls. The suture is slightly impressed. The last whorl is carinate, large, moderately inflated, and approximately of a half of the total height. Outer lip is expanded into a broad wing-like lobe, with the upper edge upcurving and tapering into a gently curved spike and the lower margin of outer lip terminating with a blunt anterior lobe. The distinct carina extends to the outer lip, which is reflected as a narrow groove parallelling the upper edge of the wing. The shell is ornamented with spiral nodes or granules, which are absent on the outer lip. Inner aperture narrow, elongate, with a small anterior siphonal canal. The posterior canal elongate and adnate to the spire.

REMARKS: The new species is known only from two external casts and one incomplete external mold (holotype). However, they possess the complete apertural outer lip as well as well preserved ornamentation. The new species can be distinguished from *Helicaulax ornata* (d'ORBIGNY) and *H. granulata* (SOWERBY) by its small size, small spire and nodular ornamentation. The species *H. formosa* STEPHENSON from the Owl Creek Formation, Tennessee and Mississippi, U.S.A., has comparable ornate ornamentation, but it differs in having a large and elongate spire as well as elongate siphonal and adnate posterior canals.

Genus *Kaunhowenia* gen. n.

Type species: *Aporrhais (Helicaulax) carinifera* KAUNHOWEN, 1897

DERIVATION OF THE NAME: In the honour of F. KAUNHOWEN, who described the type species of this genus from the Maastrichtian stratotype.

DIAGNOSIS: An aporrhaid with a corona-like shell-webbing surrounding the spire, and the expanded apertural outer lip which bears a distinct posterior groove and anterior sinus.

REMARKS: This monotypic is proposed for the species "*Aporrhais (Helicaulax carinifera* KAUNHOWEN" described from the Maastrichtian stratotype (KAUN-

HOWEN 1897) and the uppermost Maastrichtian of the Middle Vistula Valley. It is closely similar to *Arrhoges* GABB, *Drepanocheilus* MEEK, and *Helicaulax* GABB in having expanded apertural outer lip with a distinct internal groove corresponding to the carination. However, the new genus possesses a corona-like shell-webbing which extends laterally from the posterior part of the outer lip allaround the spire. It has also a distinct sinus along the basal part of the outer lip (*see* Text-fig. 14).

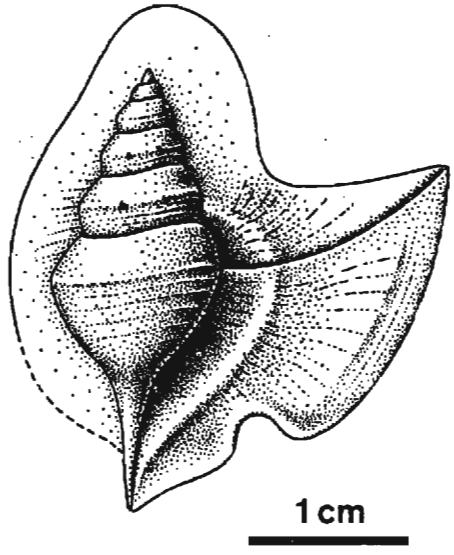


Fig. 14

Kaunhowenia carinifera (KAUNHOWEN); Kazimierz (Town Quarry), uppermost Maastrichtian

Kaunhowenia carinifera (KAUNHOWEN, 1897)
(Text-fig. 14 and Pl. 11, Figs 4—7)

v. 1897. *Aporrhais (Helicaulax) carinifera* nov. sp., KAUNHOWEN, p. 72, Pl. 8, Figs 3—4.

MATERIAL: 4 from Kazimierz, 4 from Nasiłów (1 opoka, 3 hardground).

MEASUREMENTS:	H	D	BH	PA	Location
(Pl. 11, Fig. 4)	23.6	9.3	12.0	36°	Kazimierz
(Pl. 11, Fig. 5)	20.0	9.0	17.0	43°	„
(Pl. 11, Fig. 6)	23.0	8.9	13.5	45°	„
(Pl. 11, Fig. 7)	27.6	11.6	17.8	45°	Nasiłów (hardgr.)
5	22.9	7.3	15.0	54°	Nasiłów (opoka)
6	22.6	10.8	16.4	43°	„ (hardgr.)

DESCRIPTION: The shell is moderately large, spindle-shaped, with an acute spire and about five carinate whorls. The suture is impressed. The last whorl is large inflated, carinate, nearly of a one half of the total height. The aperture is narrow lenticular with the outer lip expanded as a broad wing-shaped lobe. The basal part of the outer lip bears a small anterior sinus and the upper part has a posterior incised groove corresponding to the carination continuous over the outer lip. The siphonal canal is short and narrow. The shell webbing extends from the outer lip, posteriorly surrounding the spire and the last whorl, and forming a corona-like structure. The shell is ornamented with spiral riblets and striae crossed by fine growth lines. In well preserved specimens, small nodes are observed, particularly along the carination.

REMARKS: The studied specimens coincide with those from the Maastrichtian stratotype as illustrated by KAUNHOWEN (1897). However, the nodes which developed along the carination are less distinct in most of the studied specimens, certainly due to their bad preservation.

AGE and DISTRIBUTION: The Maastrichtian stratotype and the uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Arrhoges* GABB, 1869
Type species: *Chenopus occidentalus* BECK, 1847; *OD*
Subgenus *Latiala* SOHL, 1960
Type species: *Anchura lobata* WADE, 1926; *OD*

DISCUSSION: The subgenus *Latiala* was introduced by SOHL (1960, p. 101) for the Late Cretaceous forms similar to *Arrhoges occidentalis* (BECK), the type species, but discriminated by the presence of a broad, thick outer lip, which is thickened and bilobed at the terminus, and by a lack of any internal grooving of the lip.

The time-range of *Latiala* is at least the Turonian through the Maastrichtian, and this subqenus is widely distributed in North America (SOHL 1960, POPENOE 1983). In the author's opinion, the following Upper Cretaceous species from Europe belong to this subgenus: *"Rostellaria" papilionacea* GOLDFUSS, 1844; *Aporrhais (Arrhoges)" palecyphora* KAUNHOWEN, 1897; *"Rostellaria" pauperata* d'ORBIGNY, 1843; *"Rostellaria" coarctata* GEINITZ (*sensu* REUSS 1845); *"Lispodeshes" zekelii* (GÜMBEL, 1861).

Arrhoges (Latiala) pelecyphora (KAUNHOWEN, 1897)
(Pl. 11, Figs 2—3)

1861. *Rostellaria papilionacea* GOLDFUSS, variété; BINKHORST, p. 1, Pl. 1 Fig. 11; Pl. 5a, Fig. 10 (*non* GOLDFUSS).
v. 1897. *Aporrhais (Arrhoges) pelecyphora* nov. nom., KAUNHOWEN, p. 70, Pl. 8, Fig. 2.

MATERIAL: 7 from Kazimierz, 2 from Bochotnica, 25 from Nasiłów (17 opoka, 8 hardground).

REMARKS: Most of the studied specimens are incomplete with their apertural outer lip damaged. The studied specimens agree with the original specimens of KAUNHOWEN (1897). This species closely resembles *Arrhoges (Latiala) papilionacea* (GOLDFUSS) in general form, quadrate apertural outer lip and axial ornamentation, but it differs in having 7-9 spiral lines crossing the axial riblets, especially near the suture. The subgenus *Latalia* SOHL is accepted for this species on the basis of the apertural features which agree with those of the type species *A. (Latiala) lobata* (WADE).

AGE and DISTRIBUTION: The Maastrichtian stratotype and the uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Drepanocheilus* MEEK, 1864
Type species: *Rostellaria americana* EVANS & SHUMARD, 1857;
OD (= *D. evansi* COSSMANN, 1904)
Drepanocheilus substenoptera (G. MÜLLER, 1898)
(Pl. 11, Figs 8—10)

1869. *Aporrhais stenoptera* GOLDFUSS, sp.; FAVRE, p. 76, Pl. 10, Figs 2—3 (*non* GOLDFUSS).
1898. *Aporrhais (Dimorphosoma) substenoptera* n. sp., G. MÜLLER, p. 114, Pl. 15, Figs 1—2.
1931. *Aporrhais substenoptera* MÜLL.; KRACH, p. 381, Pl. 9, Fig. 4.
(1938) *Aporrhais substenoptera* MÜLL.; POŻARYSKI, p. 23.
(1942) *Aporrhais substenoptera* MÜLL.; PUTZER, p. 372.

(1951) *Aporrhais substenoptera* MÜLL.; POŻARYSKI & POŻARYSKI, p. 20.
1974. *Drepanocheilus substenoptera* (MÜLLER); BLANK, p. 139, Pl. 47, Fig. 11.

MATERIAL: 1 from Dorotka (low-Upper Campanian), 3 from Piotrawin (uppermost Campanian), 1 from Podgórz, 9 from Kazimierz, 1 from Bochotnica, 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: The majority of the studied specimens are incomplete, with their spur and terminals damaged. Generally, they agree with the specimens figured by MÜLLER (1898) from the Lower Senonian of Braunschweig, West Germany.

The species *Drepanocheilus stenoptera* (GOLDFUSS) from the Aachen and Vaals greensands resembles the studied species in general features, but it differs in having less distinct carination and granular costae over the last whorl which continue to the basal part. On the other hand, *D. calcarata* (SOWERBY) can be distinguished from the studied species by the absence of axial costae on the last whorl and by the presence of more distinct carinae.

AGE and DISTRIBUTION: Santonian of West Germany, and Upper Senonian of the Lvov region and Donbass basin, and of the Middle Vistula Valley.

Genus *Perissoptera* TATE, 1865

Type species: *Rostellaria reussi* TATE, 1865 *(non* GEINITZ 1875) *Perissoptera emarginulata* (GEINITZ, 1850)

(Pl. 12, Figs 2—3)

1850. *Rostellaria emarginulata* GEINITZ, p. 136, Pl. 9, Figs 7—8.
1862. *Rostellaria emarginulata* GEINITZ; KNER, p. 15, Pl. 2, Fig. 8.
1869. *Aporrhais emarginulata* GEINITZ; FAVRE, p. 75, Pl. 10, Fig. 1.
v. 1897. *Aporrhais (Lispodesthes) emarginulata* GEINITZ sp.; KAUNHOWEN, p. 71, Pl. 8, Figs 5—7.
1931. *Aporrhais* cf. *Schlotheimi* ROEM.; KRACH, p. 380, Pl. 9, Fig. 10.
(1938) *Aporrhais emarginulata* GEIN.; POŻARYSKI, p. 23.
1974. *Perissoptera emarginulata* (GEINITZ); BLANK, p. 139, Pl. 47, Figs 6, 9.

MATERIAL: 35 from Nasiłów (31 opoka, 4 hardground).

REMARKS: The three varieties of the apertural outer lip of this species are encountered in Nasiłów specimens, which agree with the illustrations presented by GEINITZ (1850). The species *Perissoptera schlotheimi* (ROEMER), as figured by HOLZAPFEL (1888) from the Campanian of the Aachen and Vaals greensands, is closely similar to the studied species and most probably related, but the original figured of ROEMER (1841) is incomplete and not decisive in comparison. This species, discussed by HOLZAPFEL (1888), was regarded by BLANK (1974) as a synonym of the studied species. Moreover, BLANK (1974) erected a new species from the Upper Senonian of the Donbass basin, *P. mentchicurika,* which is closely similar to the studied species but it differs in having numerous fine weakly distinct axial riblets.

AGE and DISTRIBUTION: Upper Senonian of West Germany, the Netherlands, the Lvov region and Donbass basin; and Maastrichtian of the Middle Vistula Valley.

Genus *Cultrigera* J. BÖHM, 1885

Type species: *Aporrhais cinggulata* PICTET & ROUX, 1853

DISCUSSION: The genus *Cultrigera* was introduced by BÖHM (1885), and listed as a synonym of *Tridactylus* GARDNER, 1875, by COSSMANN (1904) and WENZ (1940). However, according to SOHL (1960) the genus *Tridactylus* is not applicable, being preoccupied before GARDNER's use three times, *viz.* for an insect, a reptile, and a bird. Therefore, the name *Cultrigera* BÖHM is accepted

for *Rostellaria arachnoides* J. MÜLLER and other related forms. The genus *Cultrigera* is close to *Pterocerella* MEEK, 1864, in general character but it differs in the number and arrangement of digitations and in some features of the aperture (*see* SOHL 1960).

Cultrigera arachnoides (J. MÜLLER, 1851)
(Pl. 11, Figs 11—12)

1850. *Strombus archnoides* MÜLLER; GEINITZ, p. 138, Pl. 9, Fig. 5.
1851. *Rostellaria arachnoides* MÜLLER, p. 22, Pl. 3, Fig. 28.
1869. *Aporrhais arachnoides* MÜLL.; FAVRE, p. 78.
1888. *Aporrhais arachnoides* MÜLL. sp.; HOLZAPFEL, p. 122, Pl. 13, Figs 3—9.
1893. *Aporrhais arachnoides* MÜLLER; FRIČ, p. 86, Text-fig. 80.
1897. *Aporrhais arachnoides* MÜLLER; FRIČ, p. 45.
1898. *Aporrhais (Cultrigera) arachnoides* J. MÜLL. sp.; G. MÜLLER, p. 108, Pl. 14, Fig. 19.

MATERIAL: 1 from Męćmierz, 2 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens coincide with those of the Aachen greensand, and figured by J. MÜLLER (1851) and HOLZAPFEL (1888). The species *Cultrigera nilssoni* (J. MÜLLER) can be distinguished from this species by its sharp carination and ornamentation, but generally they both are quite similar.

AGE and DISTRIBUTION: Upper Turonian — Lower Coniacian of Bohemia, Santonian — Campanian of West Germany, Upper Senonian of the Lvov region, Upper Maastrichtian of the Middle Vistula Valley.

Cultrigera(?) *nagorzanyensis* (FAVRE, 1869)
(Pl. 13, Fig. 7)

1869. *Aporrhais nagorzanyensis* E. FAVRE, p. 78, Pl. 10, Fig. 4.
1889. *Aporrhais Nagorzaniensis* E. FAVRE; GRIEPENKERL, p. 89.
1898. *Aporrhais (Dimorphosoma) Nagorzanyensis* FAVRE; G. MÜLLER, pp. 113—114. Pl. 15, Fig. 5.

REMARKS: Only two incomplete specimens collected at Kazimierz and Nasiłów with an almost complete last whorl and posterior and anterior canals. Generally, they agree with the specimen figured by FAVRE (1869) from the Upper Senonian of the Lvov region. This species can be easily distinguished by its bicarinate last whorl. Upper carina runs along the spire and it is stopped at the outer lip, while the lower carina extends to the posterior canal. The two carinae are separated by a flat interspace with fine spiral cords developed in the middle. Because the apertural features as well as the expanded digitations are incomplete in the studied specimens and also in the specimen figured by FAVRE (1869), it is a risk to accept the genus *Cultrigera*, but it might be better to employ the generic name with question.

AGE and DISTRIBUTION: Senonian of West Germany, Upper Senonian of the Lvov region, uppermost Maastrichtian of the Middle Vistula Valley.

Cultrigera turriformis sp. n.
(Pl. 14, Fig. 8)

HOLOTYPE: The specimen presented in Pl. 14, Fig. 8.
TYPE LOCALITY: Kazimierz.
TYPE HORIZON: Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: Latin *turriformis* — reference to its turret-like spire.

DIAGNOSIS: A large-sized *Cultrigera* with a turret-like spire, ornamented with five spiral cords; apertural digitations small.

MATERIAL: 2 from Kazimierz.

MEASUREMENTS: The holotype displays H = 40.2 mm, D = 11.6 mm, and PA = 18°.

DESCRIPTION: The shell is large, with a turret-like, and elevated high spire. The whorls are in number about eight, convex, regularny increasing in size, and spirally ornamented with five cords. The suture is slightly impressed. The last whorl is ornamented with six spiral cords. The basal part is smooth. The aperture is not completely preserved, and only four small digitations are preserved which are joined with the shell-webbing.

REMARKS: The new species is characterized by its elevated, high spire, turret--like, and ornamented with five spiral cords and small-sized apertural digitations. These features make the confusion with other species of European Upper Cretaceous *Cultrigera* unlikely. Only two specimens represent this new species, one almost complete, collected at Kazimierz, and the other, incomplete (KONGIEL's Collection) which was collected also at Kazimierz.

Family **Columbellariidae** FISCHER
Genus *Columbellaria* ROLLE, 1861
Type species: *Cassis corallina* QUENSTEDT, 1858
Columbellaria tuberculosa (BINKHORST, 1861)
(Pl. 13, Figs 1—4)

1861. *Pyrula tuberculosa* Nobis, BINKHORST, p. 8, Pl. 3, Fig. 5.
1861. *Avellana ventricosa* Nobis, BINKHORST, p. 63, Pl. 5a2, Fig. 5; Pl. 5a3, Fig. 12.
v. 1897. *Columbellaria tuberculosa* BINKHORST sp.; KAUNHOWEN, p. 79, Pl. 9, Figs 7—8.
1898. *Columbellaria tuberculosa* BINKHORST sp.; G. MÜLLER, p. 118, Pl. 15, Fig. 16.
1923. *Columbellaria tuberculosa* BINKHORST; SYNIEWSKA, p. 298.

MATERIAL: 2 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 1 from Janowiec.

REMARKS: The studied specimens coincide with those described by KAUNHOWEN (1897) and MÜLLER (1898) from Kunrade (the Netherlands) and West Germany, respectively. The species *C. granulata* KAUNHOWEN differs from this species in having a relatively elevated spire and granular ornamentation. The studied specimens from Piotrawin and Janowiec come from the KONGIEL's Collection.

AGE and DISTRIBUTION: Lower Senonian of West Germany, Maastrichtian of Kunrade (the Netherlands), Upper Senonian of the Lvov region and of the Middle Vistula Valley.

Columbellaria cf. *granulata* KAUNHOWEN, 1897
(Pl. 13, Fig. 1)

cf. 1897. *Columbellaria granulata* nov. sp., KAUNHOWEN, p. 80, Pl. 9, Figs 5—6.

REMARKS: Only one badly preserved specimen with an incomplete spire, collected from Kazimierz marly opoka, and displaying the granular ornamentation as well as moderately elevated spire, is closely comparable with that of *C. granulata* KAUNHOWEN from the Maastrichtian stratotype.

Columbellaria laevicostata sp. n.
(Pl. 13, Figs 5—6 and Pl. 14, Fig. 1)

HOLOTYPE: The specimen presented in Pl. 13, Fig. 5.
PARATYPES: The specimens presented in Pl. 13, Fig. 6 and Pl. 14, Fig. 1.
DERIVATION OF THE NAME: Latin *laevicostata* — after its smooth spiral cords.
TYPE LOCALITY: Piotrawin.
TYPE HORIZON: Nostoceras pozaryskii Zone (uppermost Campanian).

DIAGNOSIS: A *Columbellaria* ornamented with smooth spiral cords, three of which are distinct.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 1 from Nasiłów (opoka).

MEASUREMENTS:	H	D	PA	Location
Holotype (Pl. 13, Fig. 5)	12.5	13.8	140°	Piotrowin
Paratype (Pl. 13, Fig. 6)	10.4	10.6	127°	Kazimierz
„ (Pl. 14, Fig. 1)	8.0	7.9	—	Nasiłów (opoka)

DESCRIPTION: The shell is small-sized, and low-spired. The spire contains about two slightly convex whorls. The suture is slightly impressed. The last whorl is large, inflated, measures more than three fourths of the total height. The sculpture is expressed dominantly by spiral cords. The spiral cords are smooth, rounded, numbering about 20, almost equal and equally spaced; three cords are more distinct over the body whorl, separated by three smaller cords; the upper distinct cord runs along the middle of the earlier whorls. The aperture is lanceolate, posteriorly narrow; outer lip damaged, but dentition can be noticed on both outer and inner lips.

REMARKS: The new species can be distinguished from *C. tuberculosa* (BINKHORST) and *C. granulata* KAUNHOWEN by its smooth rounded spiral cords.

Family **Strombidae**
Genus *Tibia* RÖDONG, 1798 (= *Rostellaria* LAMARCK, 1799)
Type species: *Murex fusus* LINNAEUS, 1758; *SD* DALL, 1906
Subgenus *Tibia* RÖDING, 1798
Tibia (Tibia) laevis (ALTH, 1850)
(Pl. 12, Fig. 4 and Pl. 13, Fig. 9)

1850. *Rostellaria laevis* m., ALTH, p. 220, Pl. 11, Fig. 17a-b.
1869. *Aporrhais laevis* ALTH; FAVRE, p. 79.

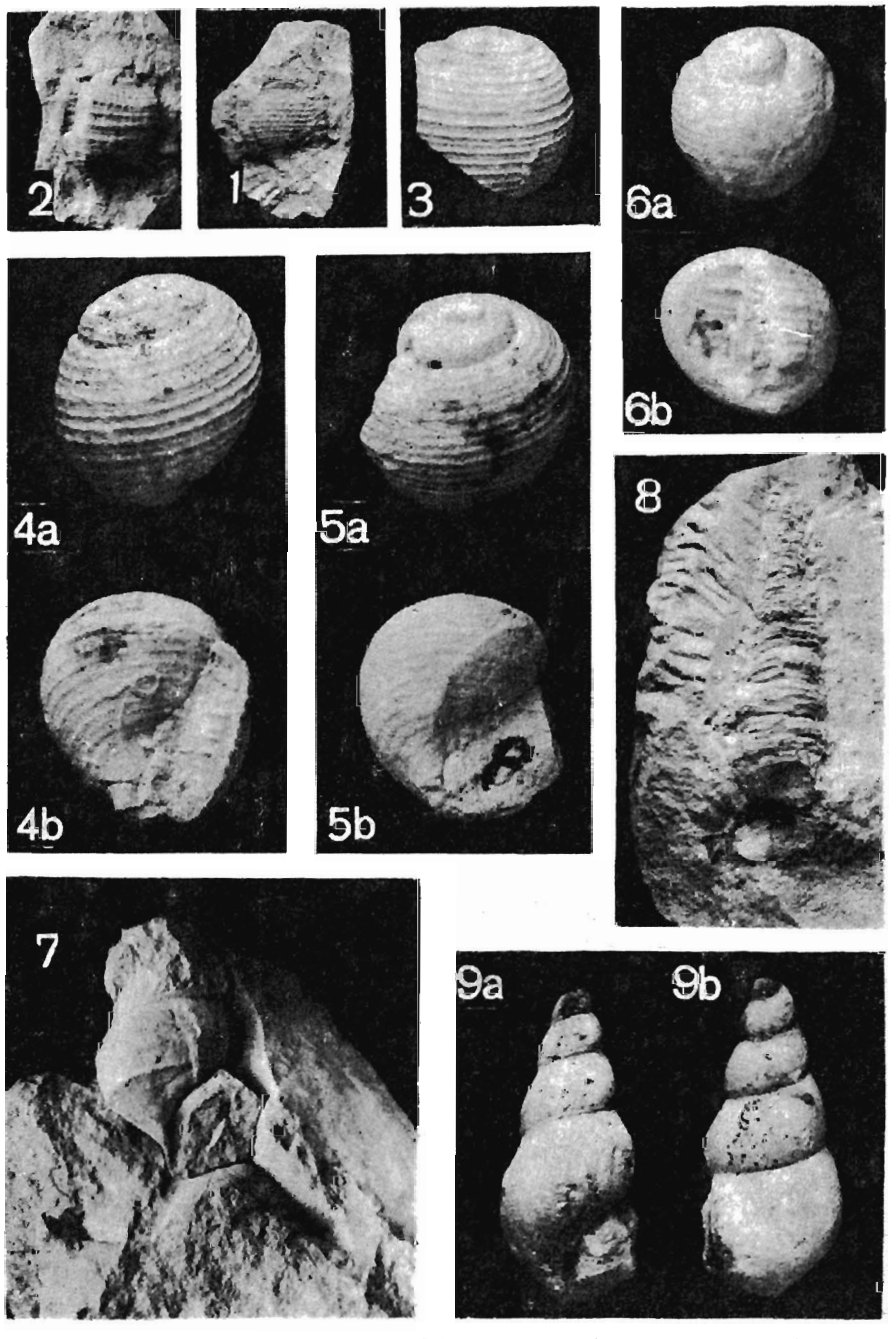
MATERIAL: 1 from Kazimierz, 1 from Bochotnica, 12 from Nasiłów (10 opoka, 2 hardground).

REMARKS: The studied specimens agree with the description and figure presented by ALTH (1850). The studied species is similar in general form to *"Rostellaria" arenosa* (REUSS) from the Turonian of Bohemia (REUSS 1846, Pl. 10, Fig. 7), which is ornamented with fine spiral lines, as figured by G. MÜLLER (1898, Pl. 15, Figs. 11—15) from the Lower Senonian of West Germany.

AGE and DISTRIBUTION: Maastrichtian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

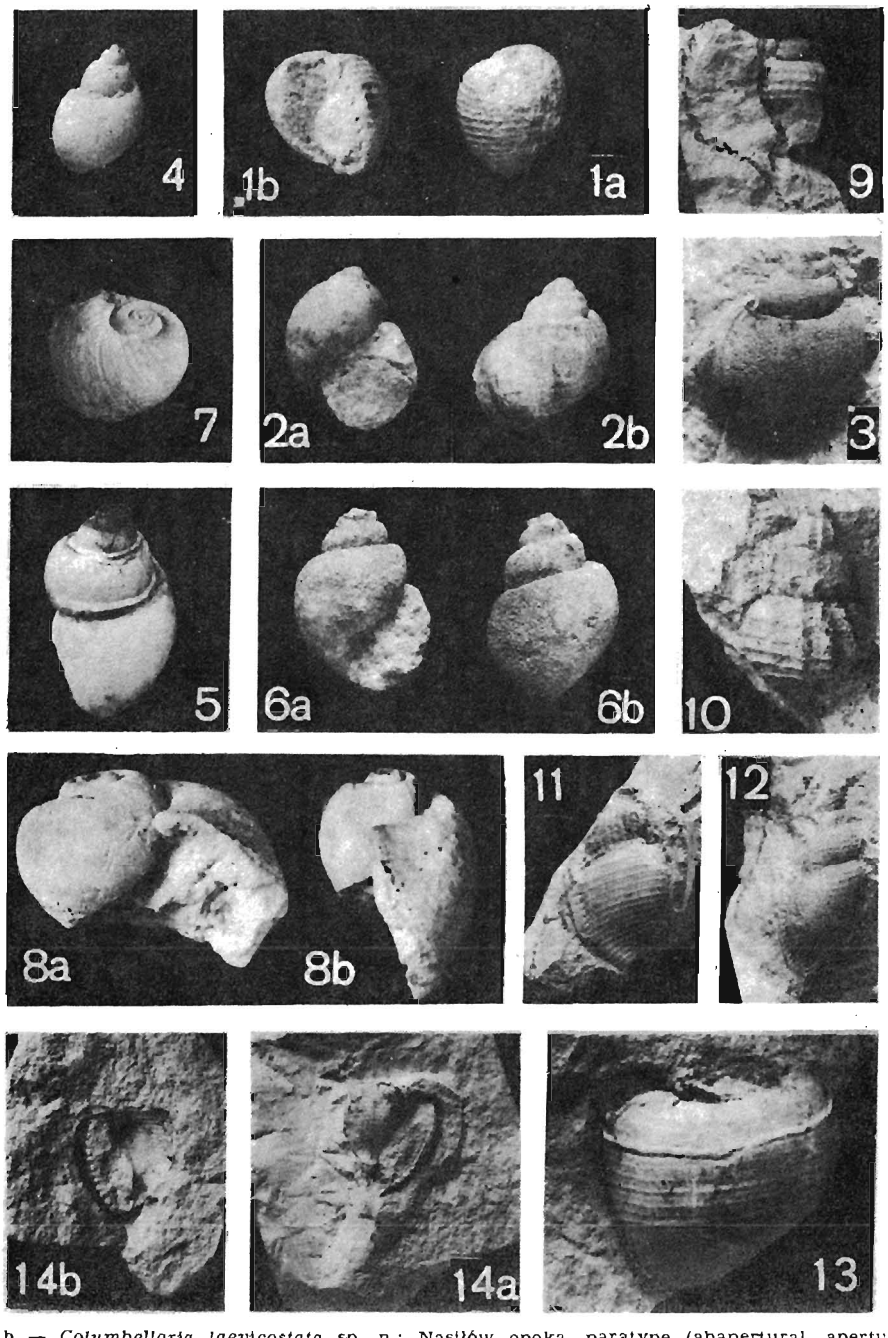
Superfamily **Naticacea** FORBES, 1838
Family **Naticidae** FORBES, 1838
Subfamily **Naticinae**
Genus *Natica* SCOPOLI, 1777
Type species: *Natica vitellus* LINNAEUS, 1758
Natica(?) *cretacea* GOLDFUSS, 1844
(Pl. 14, Figs 2—3)

v. 1844. *Natica cretacea* nobs., GOLDFUSS, p. 119, Pl. 199, Fig. 12.
1868. *Natica cretacea* GODF.; HOLZAPFEL, p. 143, Pl. 14, Figs 19—21.
1889. *Natica cretacea* GOLDFUSS; GRIEPENKERL, p. 82.
v. 1897. *Natica cretacea* GOLDFUSS; KAUNHOWEN, p. 54, Pl. 5, Figs 7—11.



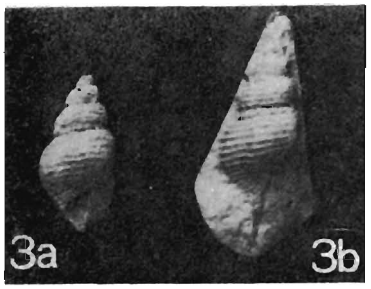
1 — *Columbellaria* cf. *granulata* KAUNHOWEN; Kazimierz (abapertural view)
2—4 — *Columbellaria tuberculosa* (BINKHORST); *2* from Piotrawin (abapertural view; MZ-Mg. 2524); *3* from Janowiec (incomplete; abapertural view of specimen with well preserved sculpture; MZ-Mg. 2524); *4* from Kazimierz (*4a* oblique abapertural, *4b* oblique apertural views with damaged outer lip)
5—6 — *Columbellaria laevicostata* sp. n.; *5* from Piotrawin, holotype (*5a* oblique abapertural, *5b* oblique apertural views); *6* from Kazimierz, paratype (*6a* oblique abapertural, *6b* apertural views)
7 — *Cultrigera*(?) *nagorzanyensis* (FAVRE); Kazimierz (incomplete; apertural view)
8 — *Cultrigera terriformis* sp. n.; Kazimierz, holotype (incomplete apertural digitations)
9a—9b — *Tibia (Tibia) laevis* (ALTH); Nasiłów hardground (*9a* apertural, *9b* abapertural views)

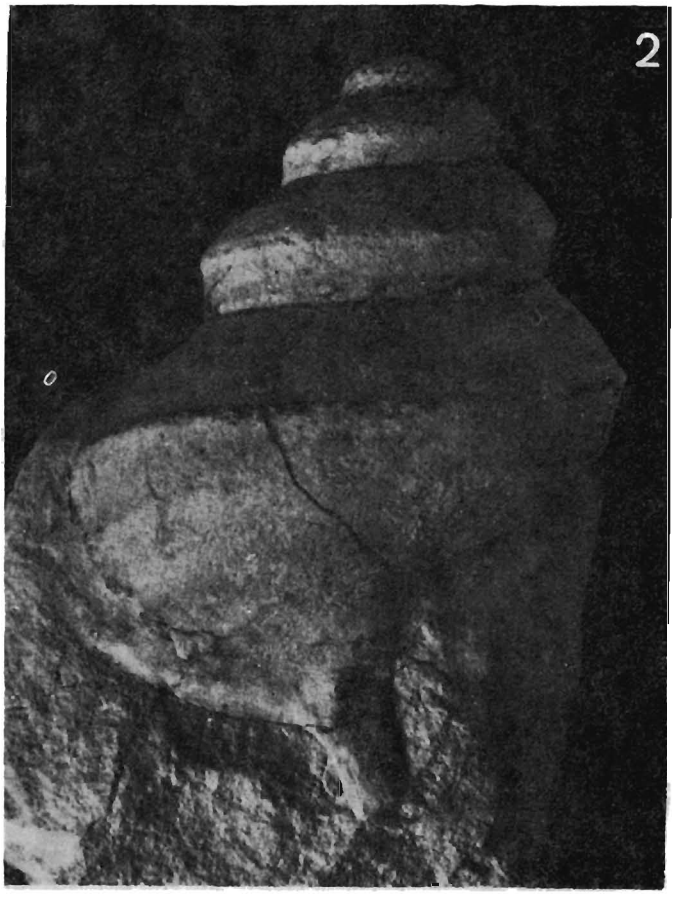
All figures in natural size except Figs 4—6 taken ×2

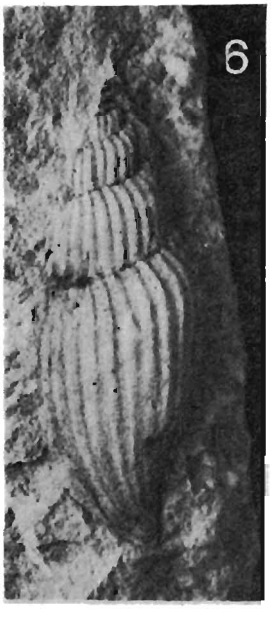


1a—1b — *Columbellaria laevicostata* sp. n.; Nasiłów opoka, paratype (abapertural, apertural views)
2—3 — *Natica*(?) *cretacea* GOLDFUSS; Nasiłów (*2a* apertural, *2b* abapertural views of specimen from hardground; *3* abapertural view of specimen from opoka)
4—6 — *Natica*(?) *exaltata* GOLDFUSS; Nasiłów opoka (*4*, *5*, *6b* abapertural, *6a* apertural views)
7—8 — *Gyrodes hoernesi* (FAVRE); Piotrawin (*7* oblique abapertural view, *8a* apertural, *8b* side views); note plastic deformation in specimen presented in Fig. 8.
9—10 — *Charonia (Sassia) tuberculosa* (KAUNHOWEN); *9* from Kazimierz (incomplete specimen); *10* from Sulejów (abapertural view; MZ-Mg. 2566)
11—12 — *Charonia multicostata* (FAVRE); Kazimierz (abapertural views)
13—14 — *Cassidaria truncata* sp. n.; Kazimierz; *13* holotype (oblique side view); *14* paratype (*14a*, *14b* apertural views of the same specimen; outer lip is stained by limonitic material)

All figures in natural size except Fig. 1 taken ×2





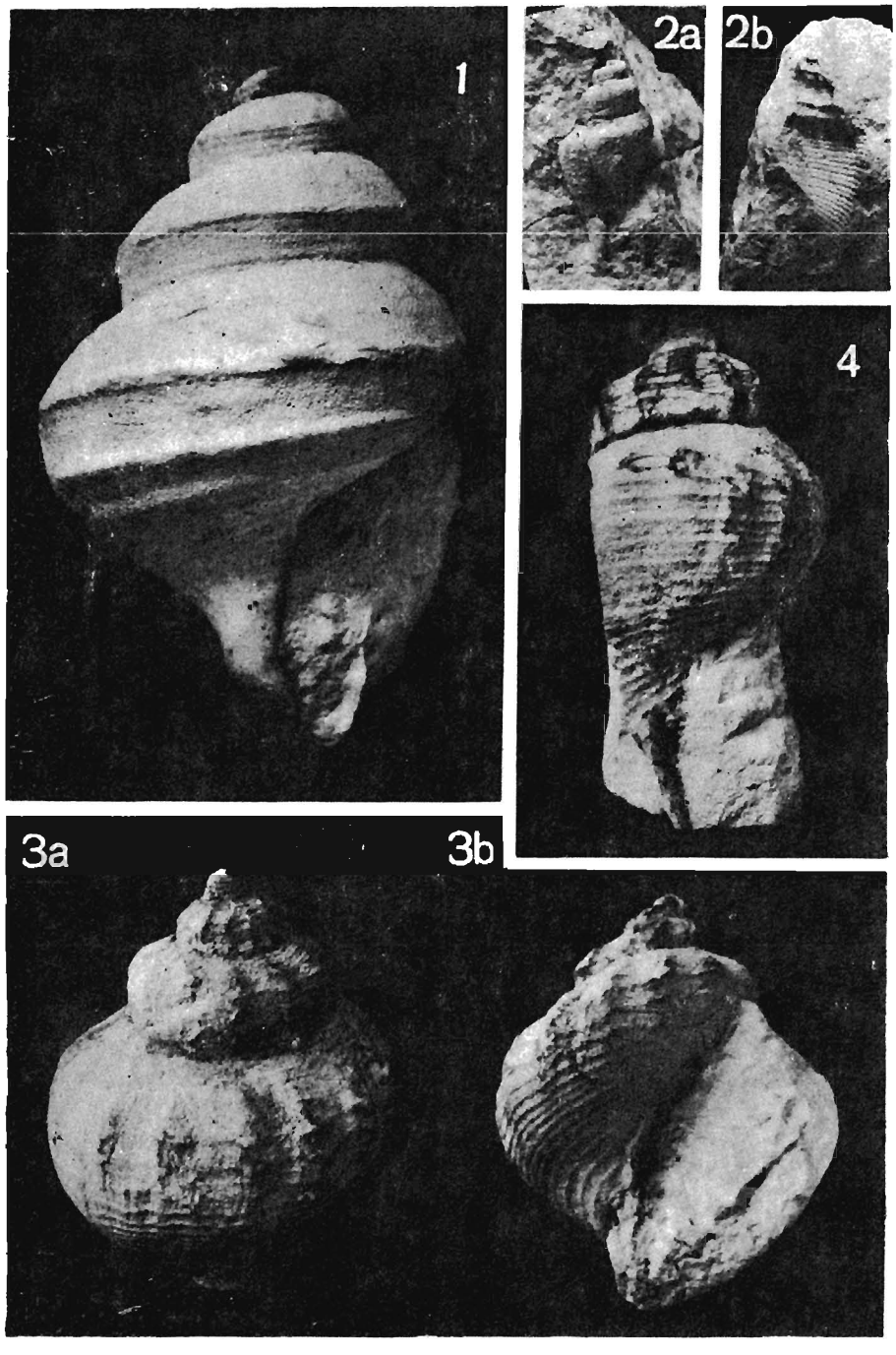


1 — *Beplix cretaceus* sp. n.; Nasiłów hardground, holotype (abapertural view; MACHALSKI's Coll.)

2 — *Buccinum (Buccinum) giganteum* sp. n.; Nasiłów opoka, holotype (abapertural view)

3a—3b — *Graphidula* aff. *plicata* (ROEMER); Kazimierz (*3a* incomplete; apertural, *3b* abapertural views of plaster cast of the same specimen)

4—6 — *Rostellana aequecostata* (FAVRE); Nasiłów opoka (*4, 5* apertural views; MACHALSKI's Coll.; *6* abapertural view)

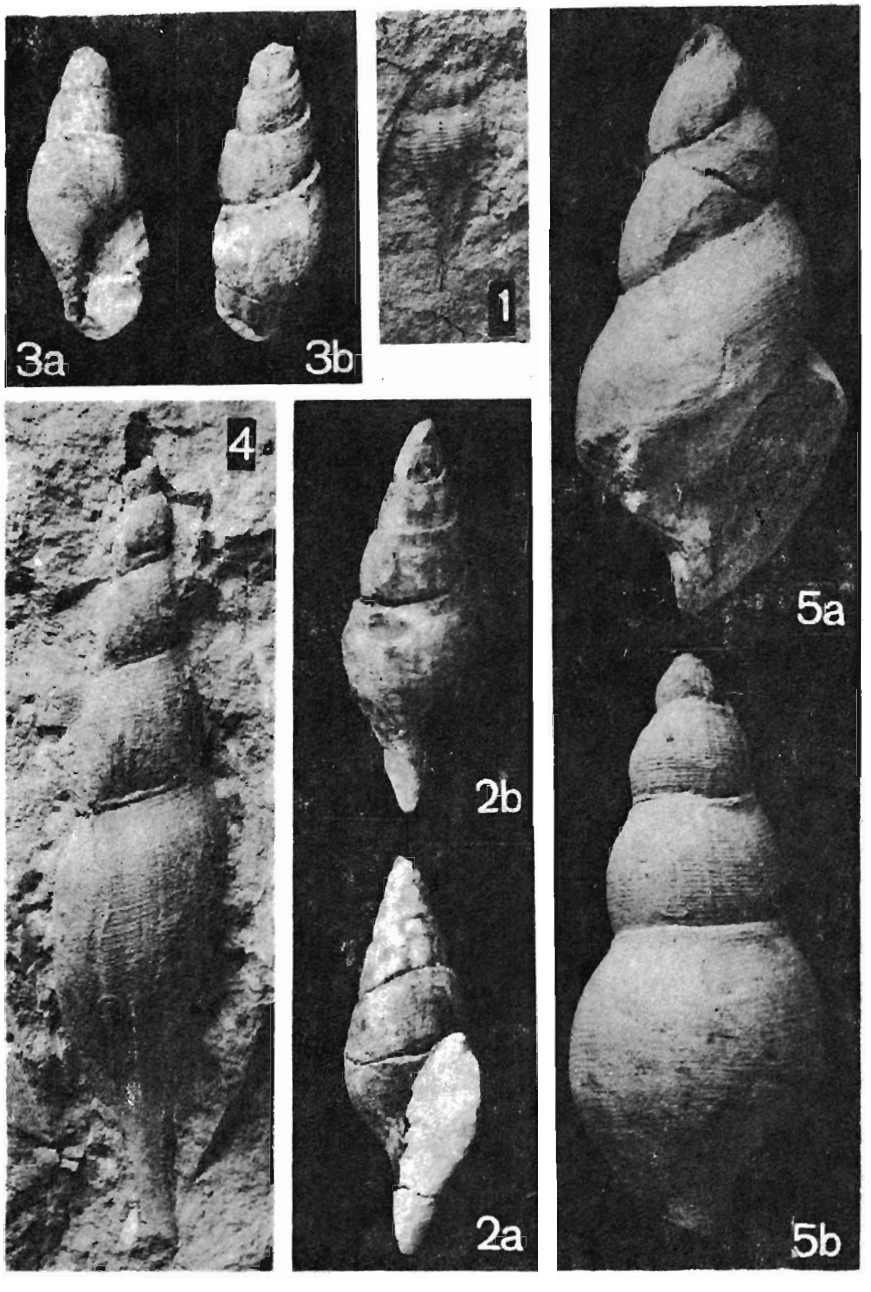


1 — *Buccinum (Buccinum) giganteum* sp. n.; Nasiłów opoka, paratype (incomplete, apertural view; MACHALSKI's Coll.)

2a—2b — *Volutilithes kneri* (FAVRE); Kazimierz (abapertural view, and external cast of the same specimen showing spiral ornamentation)

3—4 — *Euthriofusus nereidiformis* (KAUNHOWEN); Nasiłów opoka (*3a* oblique abapertural, *3b* oblique apertural views of specimen with damaged siphonal canal; *4* incomplete; abapertural view)

All figures in natural size

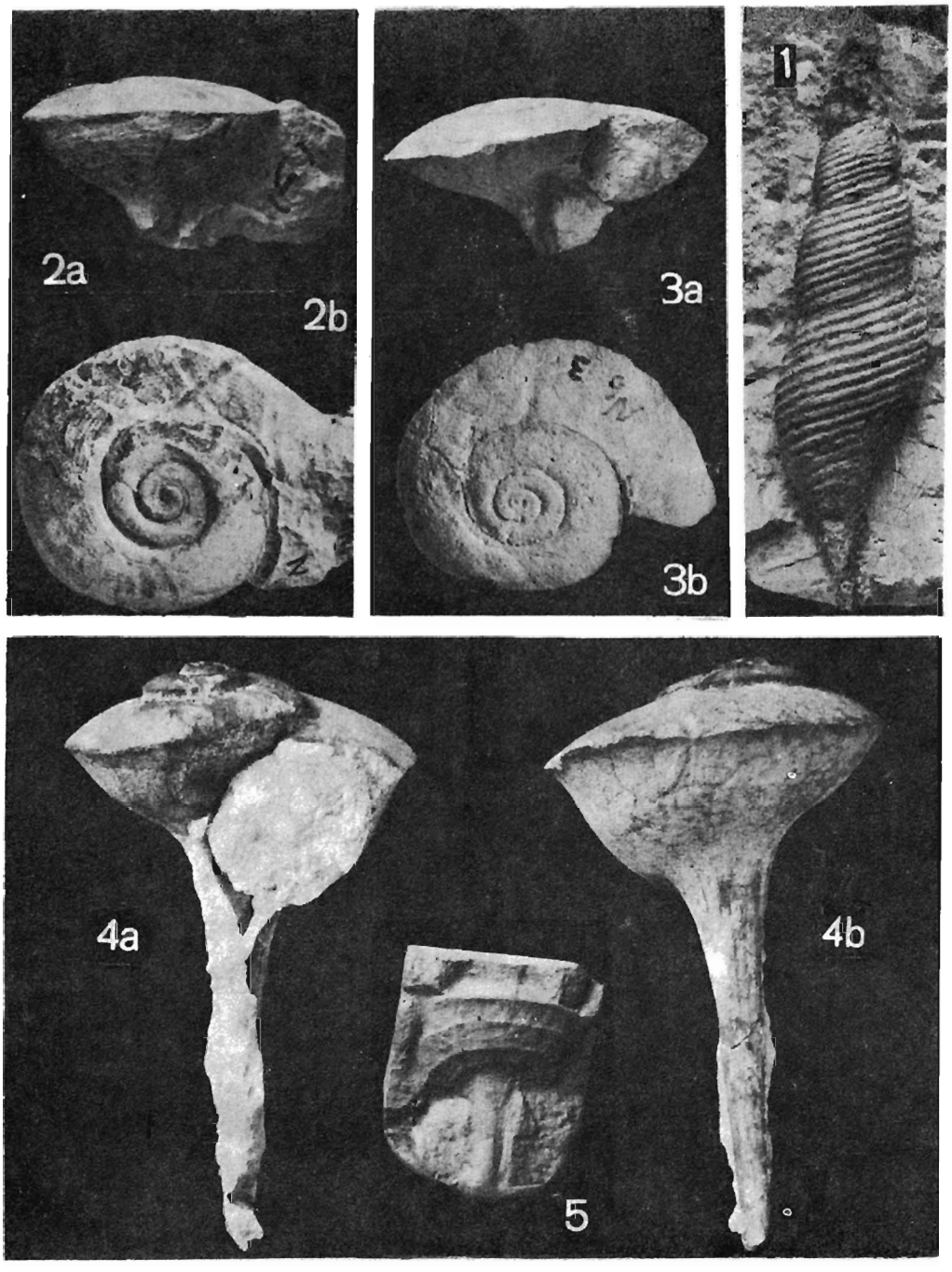


1 — *Bellifusus septemcostatus* (FAVRE); Kazimierz (side view; MACHALSKI's Coll.)

2-3 — *Graphidula radwanskii* sp. n.; Nasiłów opoka, *2* holotype (*2a* apertural, *2b* abapertural views); *3* paratype (*3a* incomplete, apertural; *3b* incomplete, abapertural views)

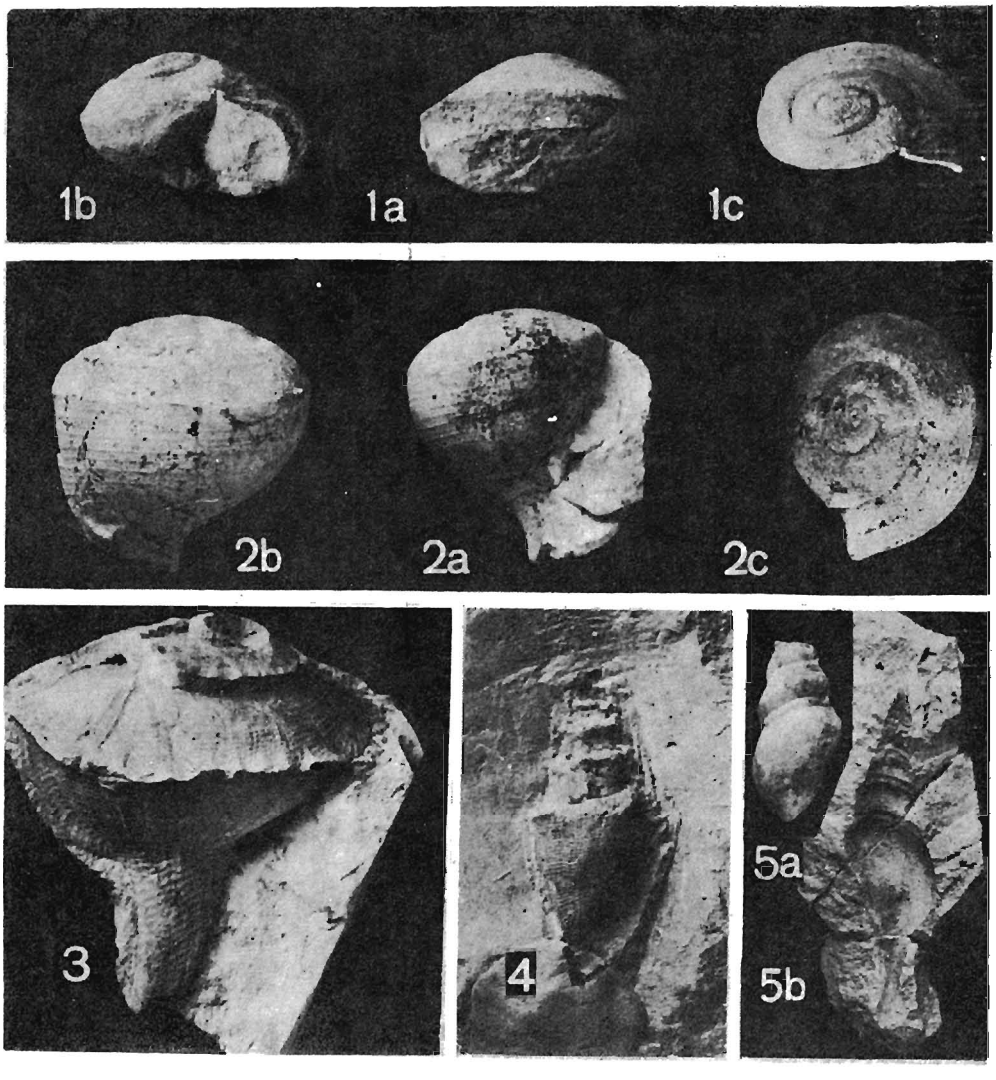
4-5 — *Graphidula procera* (KNER); Nasiłów opoka (*5a, 5b* apertural and abapertural views of specimen with damaged siphonal canal; *4* abapertural view of almost complete specimen)

All figures in natural size



1 — *Graphidula vistulensis* sp. n.; Nasiłów, holotype (side view)
2-4 — *Tudicla (Tudicla) carinata* (v. MÜNSTER); *2* from Janowiec (BŁASZKIEWICZ's Coll.); *3* (incomplete), *4* (complete) from Nasiłów opoka (*2a*, *3a*, *4a* apertural; *2b*, *3b* apical; and *4b* abapertural views)
5 — *Tudicla* sp.; plaster cast from Kazimierz (incomplete; abapertural view)

All figures in natural size



1a-1c — *Tudicla (Tudicla) althi* (KNER); Nasiłów opoka (*1a, 1b, 1c* apertural, abapertural and apical views of specimen with damaged siphonal canal; MACHALSKI's Coll.)

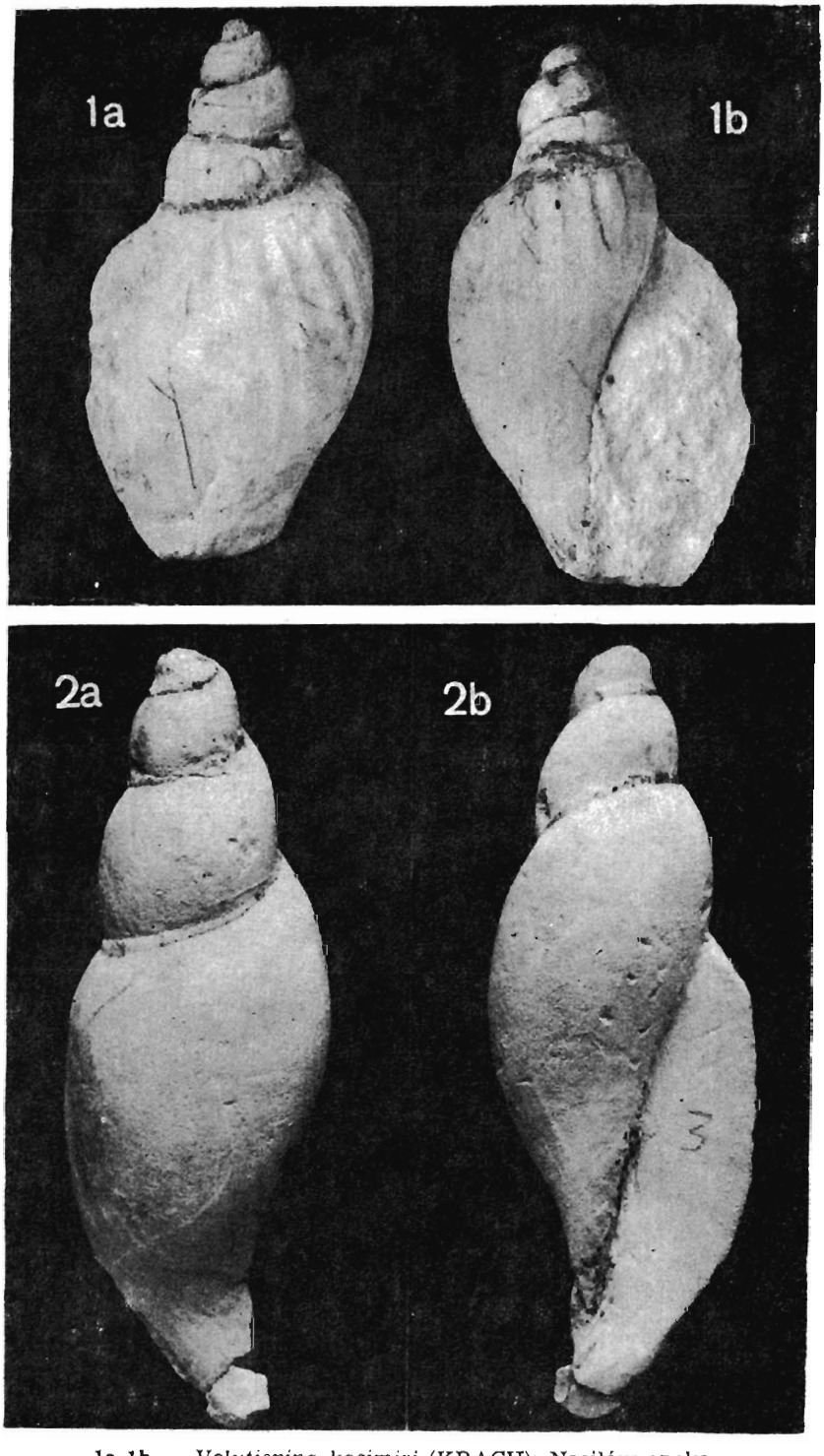
2a-2c — *Tudicla (Tudicla) globosa* sp. n.; Nasiłów hardground, holotype (*2a, 2b, 2c* apertural, abapertural and apical views; JELINOWSKA's Coll.)

3 — *Tudicla (Tudicla) carinata* (v. MÜNSTER); Piotrawin (incomplete; abapertural view)

4 — *Turricula (Turricula)* sp. *1*; Nasiłów opoka (apertural view)

5a-5b — *Turricula (Turricula)* sp. *2*; Kazimierz (*5a* incomplete external mold, abapertural view; *5b* complete external cast of the same specimen)

All figures in natural size



1a-1b — *Volutispina kasimiri* (KRACH); Nasiłów opoka
2a-2b — *Scaphella* sp. *2*; Nasiłów opoka

All figures in natural size

1898. *Natica cretacea* GOLDF.; G. MÜLLER, p. 102, Pl. 13, Figs 14—17.
1921. *Natica cretacea* GOLDF.; RAVN, p. 31, Pl. 1, Fig. 8; Pl. 3, Fig. 3.
1931. *Natica cretacea* GOLDF.; KRACH, p. 378, Pl. 8, Figs 5—5a.
1934. *Natica cretacea* GOLDF.; ANDERT, p. 357.
(1938) *Natica cretacea* DOLDF.; POŻARYSKI, p. 23.
1943. *Natica cretacea* GOLDFUSS; VAN DER WEIJDEN, p. 110.
(1951) *Natica cretacea* GOLDF.; POŻARYSKA &POŻARYSKI, p. 20.
1954. *Natica cretacea* GOLDFUSS; HÄGG, p. 22, Pl. 1, Fig. 9.
1974. *Natica? cretacea* GOLDFUSS; BLANK, p. 135, Pl. 44, Fig. 11.

MATERIAL: 4 from the Upper Campanian opoka (2 from Ciszyca Kolonia, 1 from Kaliszany, 1 from Piotrawin), 3 from Kazimierz, 1 from Janowiec, 23 from Nasiłów (13 opoka, 10 hardground).

REMARKS: The size and general shape of the investigated specimens agree with the type of GOLDFUSS (1844) and those described from different sections in Central Europe, the studied area including (*see* KRACH 1931).

WRIGLEY (1949, *fide* SOHL 1960) mentioned the difficulties in generic assignment of hte Tertiary naticids, due to such factors as the absence of sculpture and the sexual dimorphism. Such difficulties are also evident in the Mesozoic species (*see* SOHL 1960, ERICKSON 1974), Generally, the difference between the naticid genera *Euspira*, *Polinices*, *Lunatia*, and *Natica* depends mainly on the shape of the umbilicus and operculum. Because the studied specimens are preserved as steinkerns, it might be better to employ the generic name with question.

AGE and DISTRIBUTION: Lower Senonian of Bohemia, Upper Senonian of West Germany, the Netherlands, Denmark, Sweden, the Lvov region and Donbass basin; Santonian — Upper Maastrichtian (POŻARYSKI 1938) of the Middle Vistula Valley.

Natica(?) *exaltata* GOLDFUSS, 1844
(Pl. 14, Figs 4—6)

1841. *Natica lamellosa* N., ROEMER, p. 83, Pl. 12, Fig. 13 (*nomen oblitum*).
v. 1844. *Natica exaltata* GOLDFUSS, p. 119, Pl. 199, Fig. 13.
1851. *Natica exaltata* GOLDF.; J. MÜLLER, p. 15.
1888. *Amauropsis exaltata* GOLDF.; HOLZAPFEL, p. 139, Pl. 14, Figs 22, 25.
1889. *Natica exaltata* GOLDFUSS; GRIEPENKERL, p. 82.
v. 1897. *Natica laevis* nov. sp. KAUNHOWEN, p. 55, Pl. 5, Figs 12—13.
1898. *Natica (Amauropsis) exaltata* GOLDF.; G. MÜLLER, p. 103, Pl. 13, Figs 12—13.
1943. *Natica (Amauropsis) exaltata* GOLDFUSS; VAN DER WEIJDEN, p. 109.

MATERIAL: 17 from Nasiłów (14 opoka, 3 hardground).

REMARKS: The studied specimens agree with the specimens figured by GOLDFUSS (1844) and HOLZAPFEL (1888) in their general form, a relatively high spire, but the aperture and umbilicus are not well preserved in the studied material. The species *Natica laevis* KAUNHOWEN carries the main features of the studied species, therefore it is considered herein without doubt as a synonym of the studied species. The author agrees with GRIEPENKERL (1889) in considering *N. lamellosa* ROEMER, 1841, as a synonym of this species.

AGE and DISTRIBUTION: Upper Senonian of West Germany and the Netherlands, and uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Gyrodinae**
Genus *Gyrodes* CONRAD, 1860
Type species: *Rapa supraplicata* CONRAD, 1858;
(= *Natica (Gyrodes) crenata* CONRAD, 1860)
Gyrodes hoernesi (FAVRE, 1869)
(Pl. 14, Figs 7—8)

1869. *Natica Hoernesi* E. Favre, p. 48, Pl. 8, Figs. 11—12.
1889. *Natica Hoernesi* E. FAVER; GRIEPENKERL, p. 81.
(1911) *Natica Hoernesi* E. FAVRE; ROGALA, p. 491.

MATERIAL: 1 from Sulejów (low-Upper Campanian), 2 from Piotrawin (uppermost Campanian), 1 from Mięćmierz, 1 from Kazimierz.

REMARKS: Two specimens collected from the Upper Maastrichtian of the study area, being badly preserved steinkerns, are identified by comparison with somewhat better preserved specimens from the Upper Campanian of the same area (KONGIEL's Collection). Generally, the studied specimens are of medium- to large-sized, subglobose, low-spired shell, with a wide and deep umbilicus, of angulated margins, and with a subovate aperture. These features coincide with those of the specimens described and figured by FAVRE (1869). The studied species resembles *Gyrodes brunsvicensis* (G. MÜLLER) from the Lower Senonian of West Germany, but the latter has a flat, depressed spire. The species *G. acutimargo* (ROEMER) from the Vaals greensand also resembles the studied species, but it has a deeply channeled suture.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region, West Germany, and the Middle Vistula Valley.

Superfamily **Doliacea** (= **Tonnacea**)
Family **Cassididae** HERRMANNSEN, 1845
Genus *Cassidaria* LAMARCK, 1815
Type species: *Buccinum echinophorum* LINNAEUS, 1766
Cassidaria truncata sp. n.
(Pl. 14, Figs 13—14)

HOLOTYPE: The specimen presented in Pl. 14, Fig. 13.
PARATYPE: The specimen presented in Pl. 14, Fig. 14.
TYPE LOCALITY: Kazimierz.
TYPE HORIZON: Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: Latin *truncata* — referring to its truncate spire.

DIAGNOSIS: A cassidid with the truncated spire, subglobose last whorl, and spiraly ornamented.

MATERIAL: 2 from Kazimierz.

MEASUREMENTS:	H	D	DW	Location
Holotype (Pl. 14, Fig. 13)	40.0	30.9	33.0	Kazimierz
Paratype (Pl. 14, Fig. 14)	17.9	—	12.4	,,

DESCRIPTION: The shell is medium- to large-sized, subglobose, with the spire truncated, and with compressed whorls. The last whorl is large, inflated, gradually narrower toward the siphonal canal; and it is ornamented with spiral riblets. Three spiral riblets are more distinct and located on the adapical half of the last whorl. The aperture is lanceolate, narrow posteriorly, and ended with a short and narrow siphonal canal. The outer lip is dentate, rather straight medially, rounded posteriorly and higher than the truncated spire; the inner lip is smooth.

REMARKS: Only two specimens represent the new species, collected in the basal part of the Kazimierz quarry. From the available literature, the cassidids are quite rare in the Cretaceous deposits. However, the studied specimens possess a dentate apertural outer lip as well as a short siphonal canal closely similar to the Recent and Tertiary *Cassidaria*. Therefore, this new species represents the first record of *Cassidaria* in the Cretaceous strata.

Family Cymatiidae
Genus *Biplex* PERRY, 1811
Type species: *Biplex perca* PERRY, 1811
Biplex cretaceus sp. n.
(Pl. 15, Fig. 1)

HOLOTYPE: The specimen presented in Pl. 15, Fig. 1.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Topmost part of the Belemnella kazimiroviensis Zone (hardground).
DERIVATION OF THE NAME: Latin *cretaceus* — referring to the first occurrence of this genus in the Cretaceous strata.

DIAGNOSIS: A *Biplex* of high spire, with two laterally expanded spinose varices; last whorl bicarinate with a relatively long siphonal canal.

MATERIAL: 3 from Nasiłów (1 opoka, 2 hardground).

MEASUREMENTS:	EH	D	PA	Remarks
Holotype (Pl. 15, Fig. 1)	43.23	19.0	39°	(hardground)
Paratype	22.5	10.8	42°	(hardground)
"	38.0	18.3	41°	(opoka)

DESCRIPTION: The shell is large, fusiform, with a high spire. The spire contains about five carinate whorls, with expanded spinose varices on both sides. The suture is impressed. The last whorl is bicarinate, and relatively inflated with a faint spiral cord developed on its basal part and forming the faint lower carination. The shell is ornamented with obscure nodular axial costae crossed by numerous spiral lines. The siphonal canal is moderately elongated. The aperture is unknown.

REMARKS: The new species displays an elongated spire with laterally expanded varices and nodular axial costae. These features agree with those of the genus *Biplex* PERRY, particularly of the Recent species *Biplex perca* PERRY and *B. aculeatus* (SCHEPMAN) from the Indo-Pacific (*see* HABE 1968). The genus *Biplex* has not yet been reported in the Cretaceous strata; it is known from the Miocene of Japan to the Recent Indo-Pacific, as mentioned by WE p. 1061).

Genus *Charonia* GISTEL, 1848
Type species: *Murex tritonis* LINNAEUS, 1757; *OD*
Subgenus *Sassia* BELLARDI, 1872
Type species: *Triton apenninica* SASSI
Charonia (Sassia) tuberculosa (KAUNHOWEN, 1897)
(Pl. 14, Figs 9—10)

v. 1897. *Tritonium tuberculosum* nov. sp., KAUNHOWEN, p. 77, Pl. 9, Fig. 3.
?1902. *Triton tuberculosum* KAUNHOWEN; WANNER, p. 135, Pl. 19, Figs 3—4.
1931. *Tritonium tuberculosum* KAUNHOWEN; KRACH, p. 384, Pl. 9, Figs 8—9.

MATERIAL: 1 from Sulejów (low-Upper Campanian), 3 from Kazimierz, 1 from Nasiłów (hardground).

REMARKS: The studied specimens are badly preserved, but their general shape and ornamentation agree with the type specimen presented by KAUNHOWEN (1897). The species can be easily distinguished by its coarse rounded tubercles developed along the varicose axial costae. The specimen from Sulejów (low-Upper Campanian) comes from the KONGIEL's Collection.

AGE and DISTRIBUTION: The Maastrichtian stratotype, and the Upper Senonian of the Middle Vistula Valley.

Charonia multicostata (FAVRE, 1869)
(Pl. 14, Figs 11—12)

1869. *Triton multicostatum* E. FAVRE, p. 89, Pl. 10, Fig. 15.
1931. *Tritonium multicostatum* FAVRE; KRACH, p. 383, Pl. 7, Fig. 12.

MATERIAL: 1 from Kazimierz, 4 from Nasiłów (2 opoka, 2 hardground).

REMARKS: This species is characterized by a relatively high-spired shell, with whorls marked with strong axial varices, and by a lanceolate aperture with a dentate outer lip; it is ornamented with axial riblets nodded at points of intersection with spiral lines (*see* FAVRE 1869, Pl. 10, Fig. 15c). Both ornamentation as well as general features of the studied specimens coincide with the description and figures given by FAVRE (1869).

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Order **Neogastropoda** WENZ, 1938
Superfamily **Buccinacea**
Family **Buccinidae** LATREILLE, 1825
Genus *Buccinum* LINNAEUS, 1758
Type species: *Buccinum undulatum* LINNAEUS, 1758
Subgenus *Buccinum* LINNAEUS, 1758
Buccinum (Buccinum) giganteum sp. n.
(Pl. 15, Fig. 2 and Pl. 16, Fig. 1)

(1838) *Buccinum* cf. *bicarinatum* MÜN.; POŻARYSKI, p. 23.
(1942) *Buccinum* cf. *bicarinatum* MÜNST.; PUTZER, p. 372.

HOLOTYPE: The specimen presented in Pl. 15, Fig. 2.
PARATYPE: The specimen presented in Pl. 16, Fig. 1.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: Latin *giganteum* — after its large size, if compared with other Cretaceous buccinids.

DIAGNOSIS: A large buccinid ornamented with spiral ribbons, and having the last whorl inflated, bicarinate, and terminated by a short siphonal canal.

MATERIAL: 9 from Nasiłów (opoka).

MEASUREMENTS	EH	D	PA
Holotype (Pl. 15, Fig. 2)	110.0	79.0	68°
Paratype (Pl. 16, Fig. 1)	112.0	62.6	65°
"	108.0	63.7	64°
"	103.0	73.0	63°
"	—	63.0	75°
"	—	68.0	80°

DESCRIPTION: The shell is large, bucciniform, with a moderate spire whorls of the spire are inflate, carinate, with flat upper and outer faces, ornamented with spiral ribbons. The upper face bears five equal ribbons, the outer face (below carina) bears three rounded ribbons, separated by shallow interspaces. The suture is impressed. The last whorl is large, inflated, measures about two thirds of the total height, and bicarinate. Upper carina is rounded, distinct, and continuous to the spire whorls. Lower carina is separated from the upper one by a flat intercarinal area (outer face), and it continues with a spiral cord situated at the suture of the preceding whorls. The last whorl is ornamented with spiral

ribbons, five on upper face, three on outer face and five inequal ribbons on the basal part below the lower carina. The aperture is relatively large, almost ovoid, with the rounded outer lip and callused inner lip. The siphonal canal is short and broad.

REMARKS: The new species resembles *Bussinum bicarinatum* v. MÜNSTER from the Campanian of Haldem, West Germany, in shape and size, but the latter differs in having two distinct carinae continuing to the spire whorls, and in having numerous spiral elements covering the shell.

Family **Fasciolaridae**
Subfamily **Fasciolarinae**
Genus *Bellifusus* STEPHENSON, 1941
Type species: *Odontofusus curvicostata* WADE 1926; *OD*
Bellifusus septemcostatus (FAVRE, 1869)
(Pl. 17, Fig. 1)

1869. *Fusus septemcostatus* E. FAVRE, p. 84, Pl. 10, Figs 9—10.
1931. *Fusus septemcostatus* FAVRE; KRACH, p. 385, Pl. 9, Fig. 17.
(1942) *Fusus septemcostatus* FAVRE; PUTZER, p. 373.
1974. *Volutilithes septemcostatus* (FAVRE); BLANK, p. 145, Pl. 48, Fig. 3.

MATERIAL: 4 from Kazimierz, 5 from Nasiłów (3 opoka, 2 hardground).

REMARKS: The majority of the studied specimens are incomplete, but the identification is relatively easy because they display well preserved sculpture.

The species is similar to *"Fusus" renauxianus* d'ORBIGNY from the Turonian of France, but the latter has coarse and widely spaced spiral cords. The species *"Fusus" gracilis* BÖHM, as described by HOLZAPFEL (1888) from the Campanian Vaals and Aachen greensands, closely resembles the studied species, but it differs in having more distinct spiral cords.

The genus *Bellifusus* STEPHENSON is accepted for the studied species, which is closely comparable in its shape and ornamentation to the type species and to *Bellifusus angulicostatus* SOHL, 1964, from the Maastrichtian Ripley Formation, U.S.A.

AGE and DISTRIBUTION: Lower Maastrichtian of the Lvov region and Donbass basin, and uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Graphidula* STEPHENSON, 1941
Type species: *Graphidula terebreformis* STEPHENSON, 1941; *OD*

DISCUSSION: The genus *Graphidula* is characterized by medium- to large--sized shells, slender, elongate, fusiform with the spire usually longer than the aperture. The aperture is lanceolate, posteriorly elongate; the siphonal canal is elongate and straight or curved slightly out of the aperture. Pleural angle is 20—35°. The columella is straight, bearing one plait at maturity, not visible at the aperture. The sculpture ornate to plain, composed either of ribs or ribbons, or both (SOHL 1964, 1967; ERICKSON 1974). This is a common genus in the Campanian-Maastrichtian of the Gulf and Atlantic Costal Plains and the Western Interior, U.S.A., but it has not as yet been reported from the Upper Cretaceous of Europe.

The species *"Fusus" procerus* KNER and *"Fusus" plicatus* ROEMER from the Senonian of North Europe are assigned herein to the genus *Graphidula*, together with two newly described species. Moreover, *"Voluta (Volutilithes) wollemanni"* G. MÜLLER, 1898, and *"Voluta granulosa"* FAVRE are most probably belonging also to this genus.

Graphidula procera (KNER, 1850)
(Pl. 17, Figs 4—5)

1850. *Fus.? procerus* KNER, p. 21, Pl. 4, Fig. 6.
1869. *Voluta semilineata* FAVRE, p. 92, Pl. 10, Figs 18—19.
1974. *Volutilithes(?) procerus* (KNER); BLANK, p. 146, Pl. 51, Figs 7—8.

MATERIAL: 1 from Kazimierz, 7 from Nasiłów (opoka).

REMARKS: The studied specimens coincide with those from the Lower Maastrichtian of the Lvov region and Donbass basin described by KNER (1850), FAVRE (1869), and BLANK (1974). The species is similar to *Graphidula alleni* (WHITE), as figured by SOHL (1967). The species *"Voluta" granulosa* FAVRE is similar to the studied species in general features, but it has a distinct cancellate sculpture.

AGE and DISTRIBUTION: Lower Maastrichtian of the Lvov region and Donbass basin, and uppermost Maastrichtian of the Middle Vistula Valley.

Graphidula radwanskii sp. n.
(Pl. 17, Figs 2—3)

HOLOTYPE: The specimen presented in Pl. 17, Fig. 2.
PARATYPE: The specimen presented in Pl. 17, Fig. 3.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: In the honour of Professor A. RADWAŃSKI for his continuous contributions to the stratigraphy and fauna of the Tertiary and Mesozoic deposits of Poland.

DIAGNOSIS: A *Graphidula* with a tapering spire, and inflated last whorl, and with canaliculated suture; sculpture fine with numerous spiral lines; aperture lenticular, angulated posteriorly, siphonal canal of moderate length.

MATERIAL: 5 from Nasiłów (opoka).

MEASUREMENTS:	EH	D	BH	AH	PA
Holotype (Pl. 17, Fig. 2)	51.6	17.8	27.5	30.5	32°
Paratype (Pl. 17, Fig. 3)	—	15.4	—	—	28°
,,	57.0	15.0	—	—	27°
,,	54.0	14.0	—	—	25°

DESCRIPTION: The shell is large, fusiform, with a tapering spire consisting of 5—6 slightly convex whorls gradually increasing in size. The suture is canaliculate. The last whorl is broadly rounded. Ornamentation composed mainly of numerous spiral lines. Growth lines prosoclinal with an adapertural sinus. The aperture is lenticular, posteriorly angulated, and produced anteriorly to a moderately narrow elongate siphonal canal that is inclined slightly outwards of the aperture and somewhat bent; the outer lip is broadly curved, the inner lip is smooth. The columella is smooth.

REMARKS: All the studied specimens were collected from Nasiłów, only two of them are almost complete and the rest have their terminal parts damaged. The new species can be easily distinguished from *Graphidula procera* (KNER) by its canaliculate suture as well as the outline of whorls.

Graphidula vistulensis sp. n.
(Pl. 18, Fig. 1)

HOLOTYPE: The specimen presented in Pl. 18, Fig. 1.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: After the Vistula River, Central Poland.

DIAGNOSIS: A large-sized *Graphidula* ornamented with spiral ribbons and obscure axial undulations or costae; the ribbons as wide as interspaces, numbering eight on the penultimate whorl.

MATERIAL: One specimen from Nasiłów (opoka).

MEASUREMENTS: The holotype displays EH = 84.0 mm, D = 21.0 mm, PA = 22°

DESCRIPTION: The shell is large, elongate fusiform, with a high spire. The spire is acute, attaining nearly a half of the total height. The whorls are almost convex, and gradually increasing in size. The suture is slightly impressed. The last whorl is moderately inflated. The shell is ornamented with distinct spiral ribbons with obscure axial undulations on the earlier whorls. Ribbons are as wide as interspaces. Penultimate whorl bears eight ribbons. Siphonal canal is narrow and straight.

REMARKS: The new species is known only from one specimen, with damaged apical part and unknown aperture. However, it has a fusiform shell, with a small apical angle and spiral ornamentation closely similar to those of *Graphidula culbertsoni* (MEEK & HAYDEN) and *G. cancellata* (WADE) from the Maastrichtian formations of the U.S.A., as figured by SOHL (1964, 1967) and ERICKSON (1974), but it differs in having the smaller number of nearly equal spiral ribbons and wider interspaces.

The new species resembles *"Voluta (Volutilithes)" wollemanni* G. MÜLLER, from the Lower Senonian of West Germany, in their general form and ornamentation, but the latter species possesses more distinct axial costae crossed by closely spaced spiral ribbons, more distinct over the spire.

Graphidula aff. *plicata* (ROEMER, 1841)
(Pl. 15, Fig. 3)

MATERIAL: One specimen from Kazimierz.

REMARKS: The studied specimen is moderately large, ornamented with spiral cords crossed by 4—5 broadly rounded axial costae. It resembles *Graphidula plicata* (ROEMER) from the Lower Senonian of West Germany (*see* ROEMER 1841, p. 79, Pl. 11, Fig. 15) in a general form, but this species is ornamented with the smaller number of spiral ribbons.

Subfamily **Fusininae**
Genus *Euthriofusus* COSSMANN, 1901
Type species: *Fusus burdigalensis* BASTEROT, 1825; *OD*
Euthriofusus nereidiformis (KAUNHOWEN, 1897)
(Pl. 16, Figs 3—4)

?1861. *Pyrula fusiformis* Nobis, BINKHORST, p. 9, Pl. 5a, Fig. 7.
1897. *Fusus (Hemifusus) nereidiformis* nov. nom., KAUNHOWEN, p. 88, Pl. 13, Fig. 13.
(1938) *Fusus (Hemifusus)* cf. *nereidiformis* KAUN.; POŻARYSKI, p. 23.

MATERIAL: 1 from Kazimierz, 1 from Janowiec, 6 from Nasiłów (5 opoka, 1 hardground).

REMARKS: The studied specimens agree in their general shape with the species described by KAUNHOWEN (1897) from the Maastrichtian of Kunrade, the Netherlands. However, the specimen figured by BINKHORST (1861) and considered as a synonym of the studied species by KAUNHOWEN (1897) is quite different from the studied specimens, as well as from the specimen figured by KAUNHOWEN, in having a shorter spire and weakly distinct ornamentation.

The species *Euthriofusus? convexus* (WADE) from the Maastrichtian Ripley Formation, U.S.A., due to its shape and ornamentation is closely comparable to the studied species.

Family Vasidae
Genus *Tudicla* BOLTEN, 1798
Type species: *Murex spirillus* LINNAEUS, 1758
Subgenus *Tudicla* BOLTEN, 1798
Tudicla (Tudicla) carinata (v. MÜNSTER, 1844)
(Pl. 18, Figs 2—4 and Pl. 19, Fig. 3)

1844. *Pyrula carinata* MÜNSTER; GOLDFUSS, p. 27, Pl. 172, Fig. 11a-b.
1850. *Pyrula carinata* GOLDF.; KNER, p. 22, Pl. 4, Figs 7, 7a.
1869. *Fusus carinatulus* d'ORBIGNY; FAVRE, p. 86, Pl. 10, Figs 12—13.
1889. *Pyrula carinata* v. MÜNSTER; GRIEPENKERL, p. 92.
1931. *Tudicla carinata* MÜNSTER; KRACH, p. 385, Pl. 9, Figs 2—3.
(1938) *Tudicla carinata* MÜNS.; POŻARYSKI, p. 24.
(1942) *Tudicla carinata* MÜNST.; PUTZER, p. 372.
(1951) *Tudicla carinata* MÜNST.; POŻARYSKA & POŻARYSKI, p. 20.
p. p. 1974. *Euthriofusus carinata* (MÜNETER); BLANK, p. 142, Pl. 47, Fig. 4.
1974. *Tudicla (Pyropsis) carinata* (KNER); BLANK, p. 148, Pl. 52, Fig. 8.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 4 from Kazimierz, 1 from Janowiec, 16 from Nasiłów (13 opoka, 3 hardground).

REMARKS: The variability in the strength of the spiral ornamentation and in the development of the outer face of the earlier whorls is an important feature of the studied specimens. Some specimens display a moderately low-spired shell with elevated earlier whorls (Pl. 19, Fig. 3) and distinct ornamentation which coincide with those of the specimen figured by GOLDFUSS (1844, Pl. 172, Fig. 11a). Other specimens have a compressed, nearly flat spire with less distinct spiral ornamentation (Pl. 18, Figs 2—4), and these are identical with another specimen figured by GOLDFUSS (1844, Pl. 178, Fig. 11b). The largest specimen collected by M. MACHALSKI at Kazimierz, measuring 72.5 mm in diameter, bears axial riblets over the upper face of the early two whorls.

AGE and DISTRIBUTION: Upper Senonian of West Germany, the Lvov region, the Donbass basin, and the Middle Vistula Valley.

Tudicla (Tudicla) althi (KNER, 1852)
(Pl. 19, Fig. 1)

1852. *Fusus Althii* m. KNER, p. 17, Pl. 2, Fig. 13.
?1869. *Fusus Althi* KNER; FAVRE, p. 87, Pl. 10, Fig. 14.

MATERIAL: 4 from Nasiłów (3 opoka, 1 hardground).

REMARKS: All the studied specimens are incomplete, with their siphonal canal damaged. The species *"Pyrula" sulcata* KNER, 1850 was considered as a synonym of the studied species by KNER (1852). It is clear from the specimens figured by KNER (1850, Pl. 4, Fig. 8; *and* 1852) that these species differ in the development of the lower carination, as well as in the ornamentation. The studied specimens agree well with the specimen figured by KNER (1852) under the specific name *althi* which is therefore used in the present paper. This species closely resembles *Tudicla planulata* (NILSSON) figured by ROEMER (1841) and *T. planissima* (BINKHORST) in having a truncated outer face, but the last two species

differ in having an almost flat spire and possessing distinct spiral angulations on the basal part of the last whorl.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Tudicla (Tudicla) globosa sp. n.
(Pl. 19, Fig. 2)

HOLOTYPE: The specimen presented in Pl. 19, Fig. 2.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Topmost part of the Belemnella kazimiroviensis Zone.
DERIVATION OF THE NAME: Latin *globosa* — after its globular shape.

DIAGNOSIS: A *Tudicla* with a very low spire and a moderately angulated carina, a well inflated globose last whorl and a slim siphonal canal; ornamented mainly by spiral cords alternated with spiral lines.

MATERIAL: One specimen from Nasiłów (hardground).

MEASUREMENTS: The holotype displays H = 34.0 mm, D = 32.0 mm, Pa ca. 145°.

DESCRIPTION: The shell is large, globose, pyriform with a very low spire, and a moderately angulated carina. The whorls are depressed with a slightly convex upper surface, laterally expanded, and numbering three. The suture is adpressed. The whorl is globose, inflated, with almost rounded periphery and less distinct carina. The ornamentation consists mainly of spiral cords alternated with spiral lines; a distinct spiral cord is running on the mid-upper face of the whorls. The aperture is large, lanceolate, more wider at the beginning of the siphonal canal, and posteriorly angulated. The outer lip is broadly curved with mild posterior angulation, the inner lip is gently curved; the columella is smooth. The siphonal canal is slim and short.

REMARKS: The new species is only represented by one complete and well preserved external mold. The species *Tudicla althi* (KNER) shows some similarity with the new species in its general form, but it is quite different in the apertural outline, and in ornamentation.

Tudicla (Tudicla) sp.
(Pl. 18, Fig. 5)

MATERIAL: 1 from Kazimierz, 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: Three incomplete specimens collected from the uppermost Maastrichtian marly opoka are similar to those of *T. althi* (KNER), but they differ in having two or sometimes three spiral cords below the sharp carina, and in having numerous spiral lines.

Family **Volutidae**
Subfamily **Volutoderminae**
Genus *Rostellana* DALL, 1907
Type species: *Voluta bronni* ZEKELI, 1852
Rostellana aequecostata (FAVRE, 1869)
(Pl. 15, Figs 4—6)

1850. *Voluta costata* m., ALTH, p. 221, Pl. 11, Fig. 18.
1869. *Fusus aequecostatus* E. FAVRE, p. 83, Pl. 10, Fig. 7.
1869. *Voluta difficilis* E. FAVRE, p. 94, Pl. 10, Fig. 21.

(1911) *Fusus aequecostatus* E. FAVRE; ROGALA, p. 491.
1931. *Voluta* cf. *difficilis* FAVRE; KRACH, p. 368, Pl. 9, Fig. 1°
(1942) *Voluta* cf. *difficilis* FAVRE; PUTZER, p. 372.

MATERIAL: 37 from Nasiłów (35 opoka, 2 hardground).

REMARKS: The studied specimens coincide with those described by ALTH (1850) and FAVRE (1869) from the Upper Senonian of the Lvov region.

Two varieties of this species are noticed in the studied specimens, the first bearing a slightly elevated spire, and pleural angle 30—43° (Pl. 15, Fig. 6), and the second with a shorter spire, highly convex whorls, pleural angle 49—65° and a swollen last whorl (Pl. 15, Figs 4—5). Between these extremes there occur, however, numerous intermediate forms. One of these extremes corresponds to *Fusus aequecostatus* of FAVRE (1869) and the second to *Voluta difficilis* of FAVRE (1869).

The species *"Fusus" gasparini* d'ORBIGNY from the Turonian of France has similar ornamentation, but it differs in a more elevated spire and a smaller number of axial costae. The species *"Voluta" orbigniana* J. MÜLLER from the Campanian Vaals greensand shows some similarity in its general outline and axial ornamentation to the studied species, but it displays a better developed spiral ornamentation which covers the whole shell.

The genus *Rostellana* DALL is accepted for the first time for the studied species, because it carries all the diagnostic generic characters indicated by DALL (1907) and WENZ (1943, p. 1313).

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Volutinae**

Genus *Volutispina* NEWTON, 1906

Type species: *Voluta spinosa* LAMARCK

Volutispina kasimiri (KRACH, 1931)

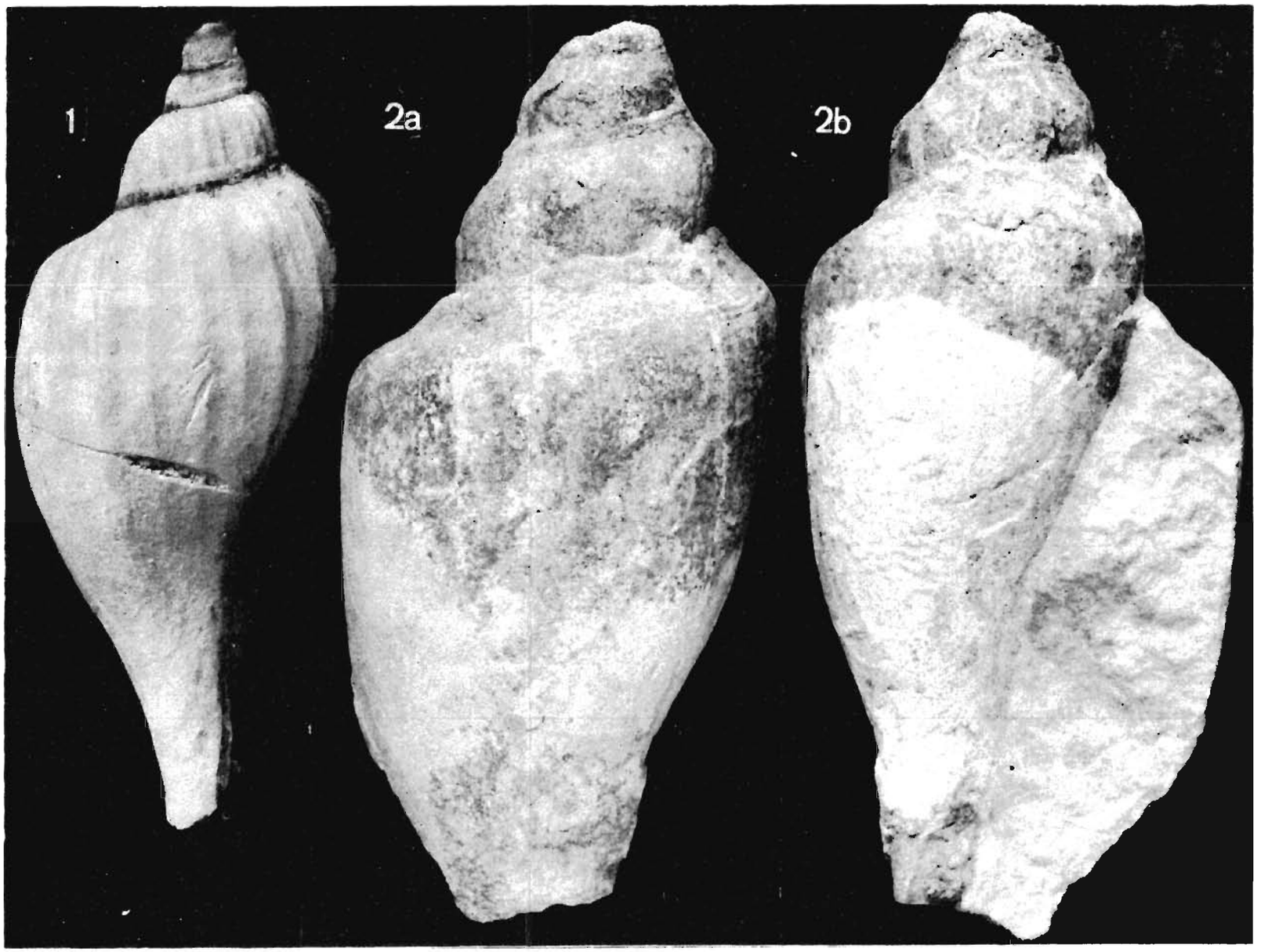
(Pl. 20, Fig. 1 and Pl. 21, Figs 1—2 and Pl. 22, Figs 1—2 and Pl. 23, Figs 2—3)

1886. *Fusus* (*Palaeatractus* GABB) sp.; SIEMIRADZKI, p. 68, Pl. 5, Fig. 13.
1911. *Voluta* (*Scapha*) *deperdita* GOLF.; ROGALA, p. 495, Fig. 1 (*non* GOLDFUSS).
1931. *Voluta* (*Scapha*) *deperdita* GOLDF. var. *kasimiri* MAZUREK; KRACH, p. 387, Pl. 6, Fig. 11.
(1938) *Voluta* (*Scapha*) *deperdita* v. *kazimiri* MAZ.; POŻARYSKI, p. 24.
(1942) *Voluta deperdita* GLDF, var. *kazimiri* MAZ.; PUTZER, p. 372.
1951. *Voluta deperdita* GOLDF. var. *kazimiri* MAZUREK; POŻARYSKA & POŻARYSKI, p. 20, Pl. 6, Fig. 3.
1968. *Athleta* (*Volutispina*) *monstra, krymica, luganensis, bodrakiensis* and *doneziana*; BLANK, pp. 53—67, Pl. 1, Figs 1—3; Pl. 2, Figs 1—2.
1974. *Athleta* (*Volutispina*) *monstra, luganensis, bodrakiensis* and *doneziana* BLANK; BLANK, pp. 143—144, Pl. 48, Fig. 1; Pl. 49, Fig. 1; Pl. 50, Figs 1—3.

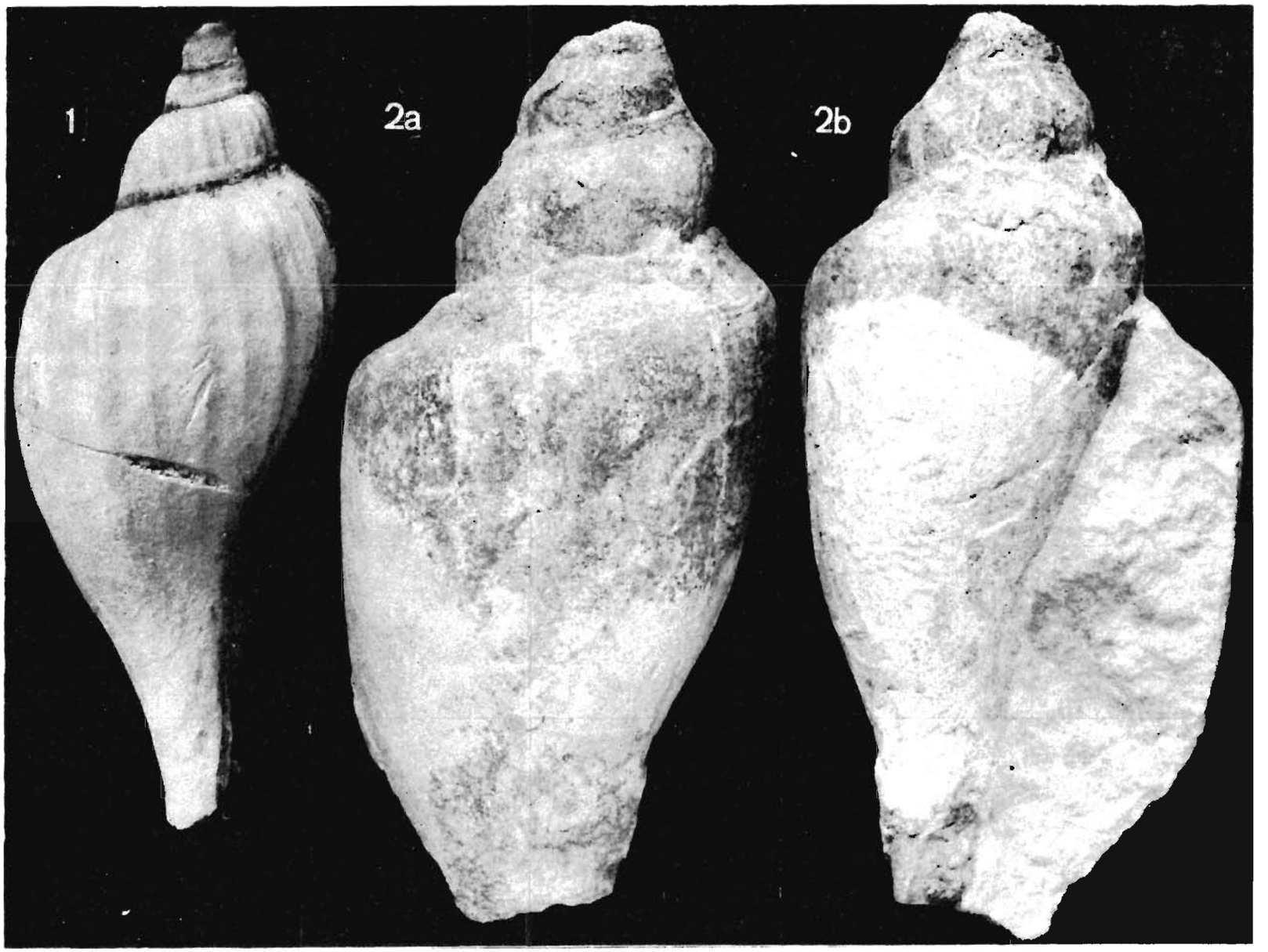
MATERIAL: 4 from Kazimierz, 45 from Nasiłów (40 opoka, 5 hardground).

MEASUREMENTS:	EH	D	PA	Location
(Pl. 22, Fig. 1)	156.0	53.0	63°	Nasiłów (opoka)
(Pl. 23, Fig. 2)	93.5	34.5	63°	„ (hardground)
(Pl. 21, Fig. 2)	300.0	125.0	69°	„ (opoka)
4	265.0	118.3	103°	„ „
5	180.0	103.0	70°	Kazimierz

PA varies from 59° to 103°; av. 80°, n = 14.



1-2 — *Volutispina kasimiri* (KRACH); Nasiłów, large forms (*1* abapertural view, from opoka; *2a*, *2b* abapertural and apertural views, from hardground), note variation in the strength of axial ornamentation; nat. size



1-2 — *Volutispina kasimiri* (KRACH); Nasiłów, large forms (*1* abapertural view, from opoka; *2a*, *2b* abapertural and apertural views, from hardground), note variation in the strength of axial ornamentation; nat. size

DESCRIPTION: The shell is unusually very large and elongate. The spire is commonly moderately low, about one fourth of the total height or less, particularly in larger forms. The earlier whorls are slightly deviated, inflated, and ornamented with faint spiral lines, apparently smooth (Pl. 20, Fig. 1 and Pl. 23, fig. 2). The whorls are posteriorly constricted to a subsutural collar, and posteriorly pevelled. The last whorl is large, elongate with a strong broad shoulder, along which the last whorl is rapidly inflated. The ornamentation is expressed by dominant axial costae crossed by spiral cords. These axial costae vary in strength and number; they are more developed over the spire and the upper part of the last whorl, and they are diminshed under the subsutural collar and on the basal part of the last whorl. Growth lines are gently opithocline, more distinct on the shoulder and near the apertural outer lip. Spiral lines are conspicuous over the spire and the upper part of the last whorl. The aperture is elongate, posteriorly angulate, in harmony with the collar; the outer lip is broadly curved and the inner lip is smooth. The siphonal canal is broad and short.

VARIABILITY: The species exhibits a wide range of variability, in both strength and in the number of axial costae, associated with an increase of the shell size. The shell is fusiform and slim in younger forms, but large and broadly inflated along the shoulder in the mature forms. This variability is perfectly illustrated by the five species of BLANK (1968) from the Upper Maastrichtian of the Donbass basin and Crimea in the Soviet Union. All these varieties are recorded in the studied specimens from the Middle Vistula Valley.

REMARKS: This species is one of the most important gastropods, both with regard to its frequency as well as its paramount size, characterizing the uppermost Maastrichtian deposits of the study area. KRACH (1931) described this species from the collection of Dr. A. MAZUREK, and considered it as a variety of *Voluta deperdita* GOLDFUSS (1844). Indeed, this species closely resembles the GOLDFUSS' species, but the latter displays a regular cone-shaped spire, and a lack of a distinct shoulder and of a subsutural collar. According to the ICZN Articles 9 (5), 11 (*ii*), 12 and 16a (*ii*), the specific name *kasimiri* appears to be related to KRACH (1931) who first described and figured this species.

Recently, BLANK (1968) introduced the five new species of *Volutispina*, viz. *monstra*, *krimica*, *doneziana*, *luganensis*, and *bodrakiensis*, which all fall perfectly within the range of variability of the studied species. Unfortunately, BLANK (1968, *and* 1974) did not compare his new five species with the work of KRACH (1931), as well as with the famous species *Voluta deperdita* of GOLDFUSS (1844) from the "Tuffkreide" of St. Pietersberg, Maastricht (the Netherlands).

AGE and DISTRIBUTION: Upper Maastrichtian of Crimea, Donbass basin and the Lvov region; uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Volutilithes* SWAINSON, 1829
Type species: *Voluta muricinus* LAMARCK, 1802
Volutilithes kneri (FAVRE, 1869)
(Pl. 16, Fig. 2)

1850. *Fusus Dupinianus* d'ORB.; KNER, p. 21, Pl. 4, Fig. 5 (*non* d'ORBIGNY).
1869. *Voluta Kneri* E. FAVRE, pp. 95—96, Pl. 11, Fig. 2.
(1911) *Voluta Kneri* E. FAVRE; ROGALA, p. 491.
(1938) *Voluta kneri* FAVRE; POŻARYSKI, p. 24.

MATERIAL: 8 from Kazimierz, 4 from Nasiłów (3 opoka, 1 hardground).

REMARKS: The majority of the studied specimens are incomplete, but with well preserved ornamentation. They undoubtedly agree with the specimens figured and described by FAVRE (1869) from the Upper Senonian opoka of the Lvov region. POŻARYSKI (1938) recorded this species from the Lower Maastrichtian deposits of the study area.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and Maastrichtian of the Middle Vistula Valley.

Subfamily **Scaphellinae**

Genus *Scaphella* SWAINSON, 1832

Type species: *Voluta junonia* CHEMNTIZ; *SD* HERRMANNSEN, 1848

Scaphella sp. *1*

(Pl. 23, Fig. 1)

MATERIAL: 1 from Janowiec, 1 from Nasiłów (opoka).

REMARKS: The studied specimens are badly preserved, but their general shape and smoothness of the shell agree with the diagnosis of the genus *Scaphella* SWAINSON.

Scaphella sp. *2*

(Pl. 20, Fig. 2)

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 7 from Nasiłów (6 opoka, 1 hardground).

REMARKS: These specimens are fusiform, high-spired, and smooth shells. They are distinguished from the preceding species by their acute spire and slim shells. Although the columellar plications are less distinct, the general features agree with those of the Recent and Tertiary forms of *Scaphella*.

Superfamily **Conacea**

Family **Turridae**

Genus *Turricula* SCHUMACHER, 1817

Type sppecies: *Turricula flammea* SCHUMACHER, 1817; *M*

Subgenus *Turricula* SCHUMACHER, 1817

Turricula sp. *1*

(Pl. 19, Fig. 4 and Pl. 24, Fig. 1)

MATERIAL: 1 from Kazimierz, 1 from Nasiłów (opoka).

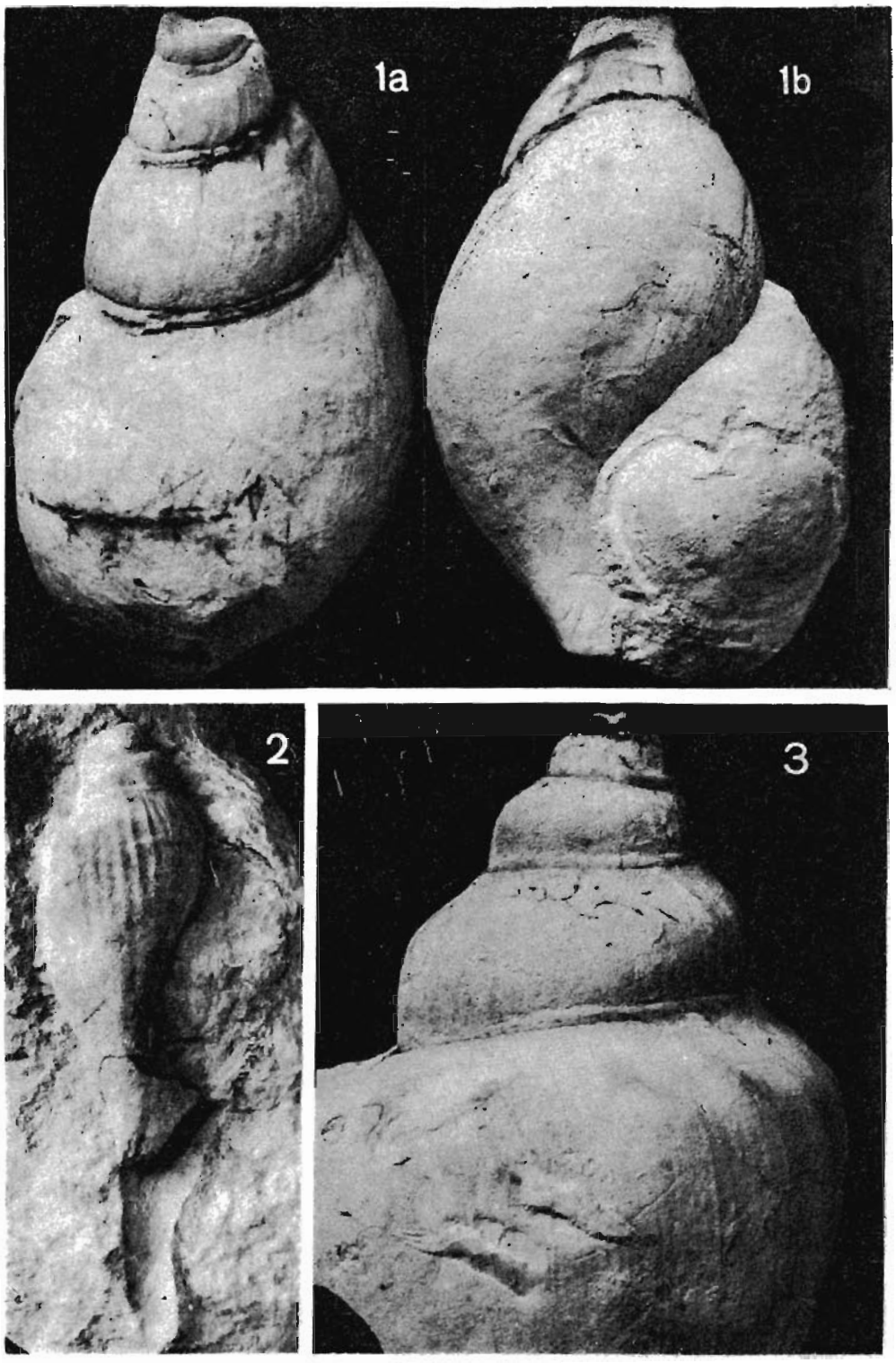
REMARKS: Two badly preserved specimens displaying a spindle shape, turriculate spire and the characteristic sculpture are well comparable with those of *Turricula formosa* (BINKHORST), as illustrated by KAUNHOWEN (1897) from the Maastrichtian of Kunrade. Its aperture is however different, being narrow lanceolate in KAUNHOWEN's specimen, and somewhat larger and wider in the studied specimens.

Turricula sp. *2*

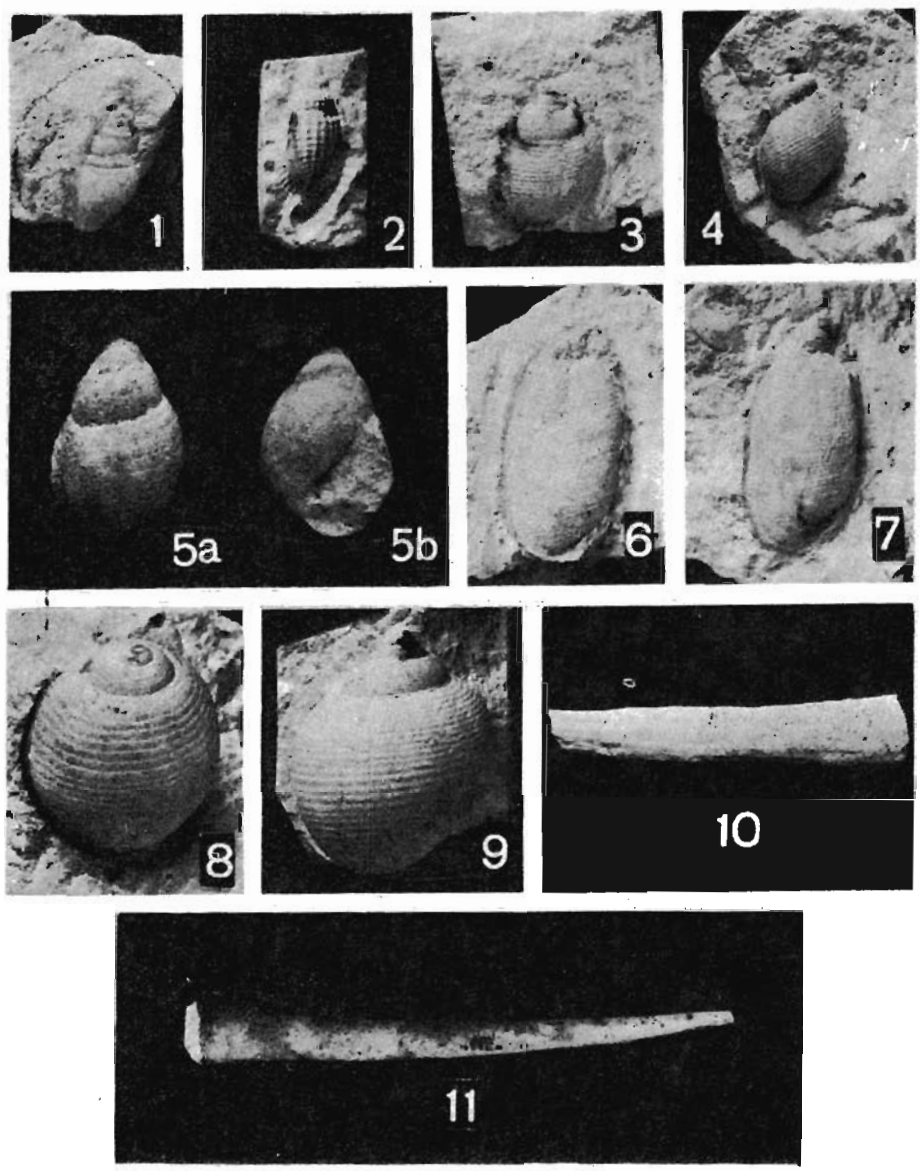
(Pl. 19, Fig. 5)

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Kazimierz.

REMARKS: Two specimens (one external cast from Piotrawin, and one incomplete specimen from Kazimierz) are undoubtedly similar to the Tertiary examples of *Turricula*. The species differs from the preceding one in having more convex whorls, finer spiral ornamentation and a more distinct posterior sinus.



1a-1b — *Scaphella* sp. *1*; Janowiec (MZ-Mg. 2558); nat. size
2-3 — *Volutispina kasimiri* (KRACH); Nasiłów (*2* small form from hardground, *3* incomplete large form from opoka); nat. size



1 — *Turricula Turricula)* sp. *1*; Kazimeirz (abapertural view), × 1
2 — *Cancellaria nitidula* (J. MÜLLER); plaster cast from Kazimierz (apertural view), × 1
3—4 — *Avellana*(?) sp. *2*; Nasiłów opoka (abapertural views), × 1
5a—5b — *Tornatellaea kongieli* sp. n.; Nasiłów hardgriund, holotype (abapertural and apertural views), × 2
6—7 — *Cylichna faba* (KNER); Nasiłów opoka (abapertural views), × 2
8 — *Avellana*(?) sp. *1*; Nasiłów opoka (oblique abapertural view; MACHALSKI's Coll.), × 1
9 — *Avellana*(?) *inversestriata* KNER; Kazimierz (abapertural view; MACHALSKI's Coll.), × 1
10—11 — *Dentalium (Dentalium) multicostatum* FAVRE; *10* external mold from Kazimierz MACHALSKI's Coll.), *11* steinkern from Nasiłów hardground, × 1

Family **Cancellariidae** ADAMS
Genus *Cancellaria* LAMARCK, 1799
Type species: *Voluta reticulata* LINNAEUS, 1767
Cancellaria nitidula (J. MÜLLER, 1851)
(Pl. 24, Fig. 2)

1851. *Voluta nitidula* J. MÜLLER, p. 41, Pl. 5, Fig. 25.
1888. *Cancellaria nitidula* MÜLLER; HOLZAPFEL, p. 92, Pl. 9, Figs 4—6; Pl. 216, Figs 9—10.
1889. *Cancellaria nitidula* MÜLLER; GRIEPENKERL, p. 94.
1931. *Cancellaria (Admete) nitidula* MÜLL.; KRACH, p. 388, Pl. 7, Fig. 13.
(1942) *Cancellaria nitidula* MÜLL.; PUTZER, p. 375.

MATERIAL: 3 from Kazimierz.

REMARKS: The studied specimens agree with those described by MÜLLER (1851) and HOLZAPFEL (1888) from the Campanian Vaals greensand, West Germany.

AGE and DISTRIBUTION: Santonian — Campanian of West Germany and uppermost Maastrichtian of the Middle Vistula Valley.

Subclass **Opisthobranchia** MILNE-EDWARDS, 1848
Order **Cephalaspidea** FISCHER, 1883
Superfamily **Acteonacea**
Family **Acteonidae** d'ORBIGNY, 1842
Subfamily **Acteoninae**
Genus *Tornatellaea* CONRAD, 1860
Type species: *Tornatellaea belle* CONRAD, 1860; *M*
Tornatellaea kongieli sp. n.
(Pl. 24, Fig. 5)

HOLOTYPE: The specimen presented in Pl. 24, Fig. 5.
TYPE LOCALITY: Nasiłów.
TYPE HORIZON: Uppermost part of the Belemnella kazimirovlensis Zone.
DERIVATION OF THE NAME: In the honour of Professor R. KONGIEL (1904—1960) for his contrubtions on the stratigraphy of the Upper Cretaceous deposits in the Middle Vistula Valley.

DIAGNOSIS: A subovate tornatellaeid, with incised spiral grooves widely spaced on the adapical half of whorls.

MATERIAL: 2 from Nasiłów (hardground).

MEASUREMENTS:	H	D	PA
Holotype (Pl. 24, Fig. 5)	12.2	8.3	57°
Paratype	13.0	8.1	50°

DESCRIPTION: The shell is small, subovoid, with a moderately high spire. The spire contains three convex whorls and measures one third of the total height. The suture is slightly impressed. The last whorl is large, inflated, with its basal part incomplete. Shell is ornamented with incised spiral grooves which are widely spaced on the adapical half of the last whorl. The aperture is pear-shaped with two columellar folds.

REMARKS: Two incomplete specimens with their outer lip damaged agree with the diagnosis of the genus *Tornatellaea* CONRAD. The new species can be easily distinguished by its ornamentation from such Lower Cretaceous species

described by d'ORBIGNY (1842), as *Tornatellaea affinis* (SOWERBY), *T. albensis* (d'ORBIGNY) and *T. vibrayeana* (d'ORBIGNY), as well as from those from the Maastrichtian of U.S.A., described by WADE (1926) and SOHL (1964).

Family **Ringiculidae**

Genus *Avellana* d'ORBIGNY, 1842

Type species: *Auricula incrassata* SOWERBY, 1817

DISCUSSION: The ringiculids globose genera *Avellana* d'ORBIGNY, 1843, *Cinulia* GRAY, 1847, and *Oligoptycha* MEEK, 1876, are a matter of discussion by different workers. MEEK (1876) introduced *Oligoptycha* as a subgenus of *Cinulia* GRAY along with *Avellana* d'ORBIGNY. On the other hand, STEWART (1927), STEPHENSON (1941), POPENAE (1957), and SOHL (1964) preferred to consider them as separate genera. SOHL (1964) pointed out that *Avellana* d'ORBIGNY differs from *Oligoptycha* MEEK by having one columellar and generally two parietal folds, and in having a denticulate outer lip. The genus *Oligoptycha* bears a strong anterior fold with none to two weaker parietal folds.

The Upper Senonian opoka of the study area yields badly preserved specimens where the apertures are damaged or masked by rock material. The three species described herein are assigned to the genus *Avellana* d'ORBIGNY, tentatively because their apertural features remain not available.

Avellana(?) *inversestriata* KNER, 1852

(Pl. 24, Fig. 9)

1852. *Avellana inversestriata* ? m, KNER, p. 11, Pl. 2, Fig. 4.
1863. *Avellana cassis* d'ORB.; PŁACHETKO, p. 13, Pl. 1, Fig. 6.
1869. *Avellana inversestriata* KNER; FAVRE, p. 32, Pl. 7, Figs 7—8.
1889. *Avellana inversestriata* KNER; GRIEPENKERL, p. 98.
1891. *Cinulia inversestriata* KNER sp.; BÖHM, p. 54.
(1911) *Avellana inversestriata* KNER sp.: ROGALA, p. 491.
1931. *Cinulia (Avellana) inversestriata* KNER; KRACH, p. 388, Pl. 7, Fig. 7.
(1938) *Cinulia (Avellana) inversestriata* KNER; POŻARYSKI, p. 24.
(1942) *Cinulia inversestriata* KNER; PUTZER, p. 372.
(1951) *Cinulia inversestriata* KNER; POŻARYSKA & POŻARYSKI, p. 20.
1974. *Avellana(?) inversestriata* KNER; BLANK, p. 151, Pl. 52, Fig. 4.

MATERIAL: 2 from Dorotka (low-Upper Campanian), 3 from Kaliszany (uppermost Campanian), 1 from Męćmierz, 2 from Kazimierz, 2 from Bochotnica, 2 from Nasiłów (opoka).

REMARKS: Although the aperture of the studied specimens is distroyed or masked, their shape and ornamentation coincide with those of the specimens figured by KNER (1852) and PŁACHETKO (1863) from the Lvov region. The species *Avellana incrassata* d'ORBIGNY from the Albian bears similar ornamentation but its axial lines are more closely spaced than those in *A. inversestriata*. Similar sculpture is also noted in *A. cassis* d'ORBIGNY from the Turonian, but its axial elements are closely spaced and the spiral lines are widely spaced in the anterior end of last whorl. The studied species is also comparable in ornamentation with *Cinulia bistriata* (GÜMBEL), as figured by BÖHM (1891), from the Maastrichtian of Upper Bavaria, West Germany.

AGE and DISTRIBUTION: Upper Senonian of West Germany, the Lvov region, the Donbass basin, and the Middle Vistula Valley.

Avellana (?) sp. *1*

(Pl. 24, Fig. 8)

MATERIAL: 3 from Nasiłów (opoka).

REMARKS: The studied specimens are closely similar in their form and ornamentation to those of *Avellana inversestriata* KNER, 1852, but they differ in having a smaller of widely speced and spirally incised grooves over the spire and over the adapical part of the last whorl.

Avellana (?) sp. 2
(Pl. 24, Figs 3—4)

MATERIAL: 4 from Kazimierz, 3 from Nasiłów (2 opoka, 1 hardground).

REMARKS: The studied specimens are similar to those of *Avellana humboldti* J. MÜLLER, 1851 in their form, size and ornamentation, but the apertural features of the studied specimens are not sufficiently preserved for the specific identification. These specimens can be easily distinguished from those of the preceding species by their moderately elevated spire, smaller apical angle (66-87°) and ornamentation (numerous spiral cords).

Family **Acteocinidae**
Genus *Cylichna* LOVEN, 1846
Type species: *Bulla cylindracea* PENNANT, 1777; *SD* HERRMANNSEN, 1852

Cylichna faba (KNER, 1850)
(Pl. 24, Figs 6—7)

1850. *Acteonella faba* ? KNER, p. 15, Pl. 3, Fig. 4.
1850. *Volvaria cretacea* ALTH, p. 213, Pl. 11, Fig. 7.
1850. *Volvaria faba* ? KNER; ALTH, p. 213.
1852. *Volvaria faba* KNER, p. 11.
1869. *Bulla faba* KNER sp.; FAVRE, p. 31, Pl. 7, Fig. 6.
1889. *Bulla faba (Cylichna)* KNER sp.; GRIEPENKERL, p. 96.
1891. *Cylichna faba* KNER sp.; BÖHM, p. 53.
(1911) *Bulla faba* KNER; ROGALA, p. 491.
(1938) *Bulla faba* KNER; POŻARYSKI, p. 24.
(1966) *Actaeonella? faba* (KNER); SOHL & KOLLMANN, p. 79.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 6 from Kazimierz, 1 from Janowiec, 1 from Bochotnica (hardground), 5 from Nasiłów (3 opoka, 2 hardground).

REMARKS: Most of the studied specimens are badly preserved, but their diagnostic ornamnetation and smaller apical perforation allow easily to distinguish this species from the other European Upper Cretaceous *Cylichna*. The species *C. tenus* (REUSS), as figured by BÖHM (1891), doffers in having a broad apical perforation and the exposed spiral whorls.

AGE and DISTRIBUTION: Upper Senonian of West Germany, the Lvov region, and the Middle Vistula Valley.

Class **Bivalvia** LINNAEUS, 1758

The terminology for the bivalves follows the glossary presented by COX (1969) in the *Treatise on Invertebrate Paleontology*, Part **N** (Bivalvia).

All linear measurements (taken with vernier calipers) are given in millimeters.

Abbreviation used are: **RV** — right valve, **LV** — left valve, **L** — length, **H** — height, **EL** — estimated length, **W** — maximum thickness, **No. R** — number of radial ribs or costae.

Subclass **Paleotaxodonta** KOROBKOV, 1954
Order **Nuculoida** DALL, 1889
Superfamily **Nuculacea** GRAY, 1824
Family **Nuculidae** GRAY, 1824
Genus *Nucula* LAMARCK, 1799
Type species: *Arca nucleus* LINNAEUS, 1758
Subgenuus *Nucula* LAMARCK, 1799
Nucula (Nucula) truncata NILSSON, 1827
(Pl. 25, Figs 1—2)

1827. *Nucula truncata* n., NILSSON, p. 16, Pl. 5, Fig 6.
1850. *Nucula pectinata* SOW.; ALTH, p. 321, Pl. 12, Fig. 10.
1869. *Nucula truncata* NILSSON; FAVRE, p. 120, Pl. 12, Fig. 10.
(1911) *Nucula truncata* NILSS.; ROGALA, p. 942.
1935. *Nucula truncata* NILSSON; HÄGG, p. 18.
(1938) *Nucula truncata* NILS.; POŻARYSKI, p. 22.
(1942) *Nucula truncata* NILS.; PUTZER, p. 371.
1954. *Nucula truncata* NILSSON; HÄGG, p. 28.
1968. *Nucula truncata* Nillsson; PASTERNAK, p. 88, Pl. 12, Figs 5—6.
1977. *Nucula truncata* NILSSON; SOBETSKI, p. 13, Pl. 1, Fig. 2.
1982. *Nucula truncata* NILSSON; SOBETSKI, p. 72, Pl. 6, Fig. 2.

MATERIAL: 2 from Piotrawin (uppermost Campanian), 7 from Kazimierz, 6 from Nasiłów (5 opoka, 1 hardground).

REMARKS: The studied specimens are of medium-sized, substrigonal shells, ornamented with numerous fine radial striae, and with the inner ventral margin densely crenulated. These characters as well as the hinge line agree with those of *N. truncata* NILSSON from the Upper Senonian. The species *N. pectinata* SOWERBY differs from this species by its coarses radial ribs as well as by coarser inner crenulations.

AGE and DISTRIBUTION: Upper Senonian of Sweden, the Lvov region, Crimea, peri-Caspian basin, and the Middle Vistula Valley.

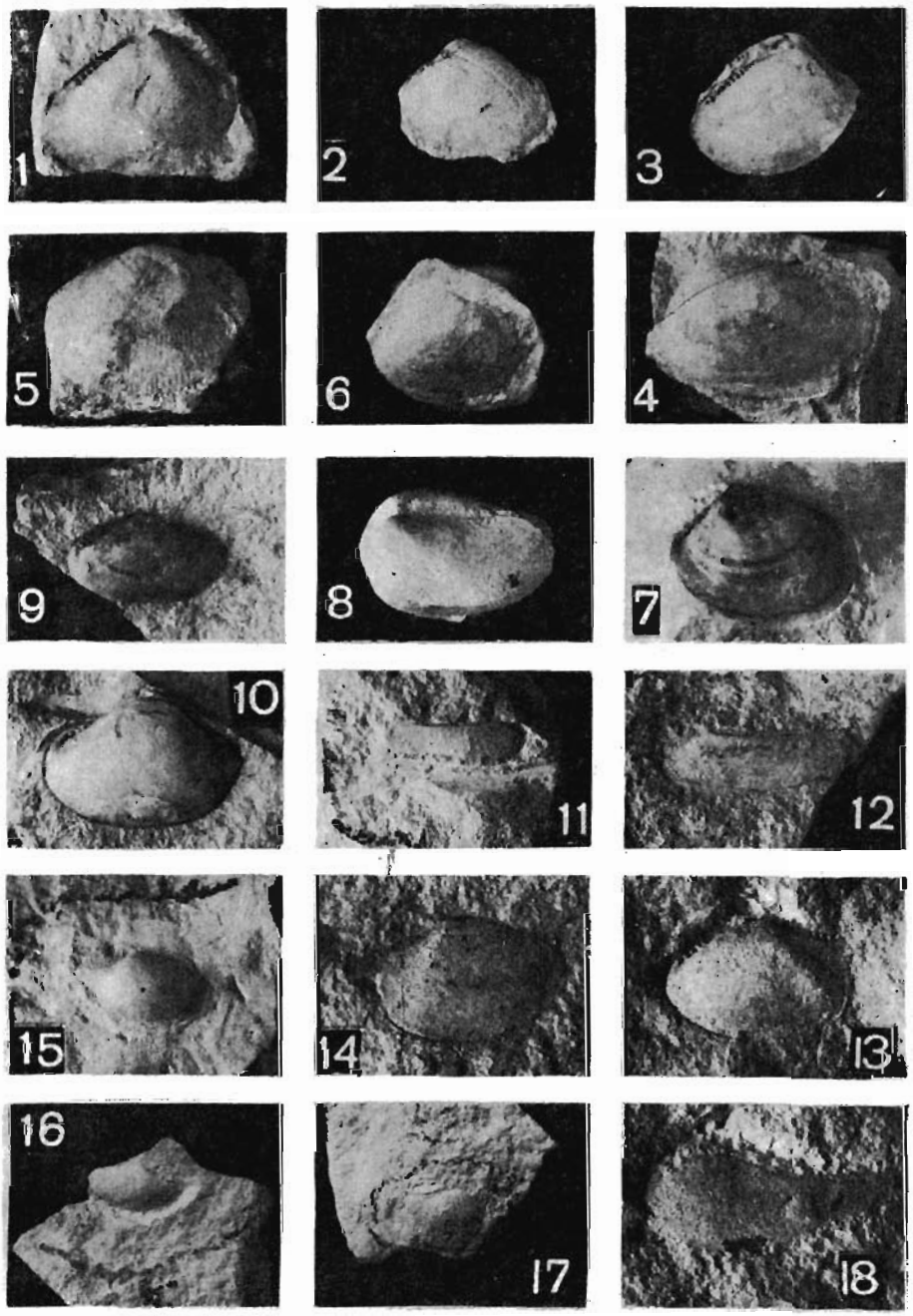
Nucula (Nucula) ascendens ALTH, 1850
(Pl. 25, Figs 3—4)

1850. *Nucula ascendens* m., ALTH, p 231, Pl. 12, Fig. 11.
1968. *Nucula ascendens* ALTH; PASTERNAK, p. 90, Pl. 7, Figs 11—12.
1982. *Nucula ascendens* ALTH; SOBETSKI, p. 73, Pl. 6, Fig. 3.

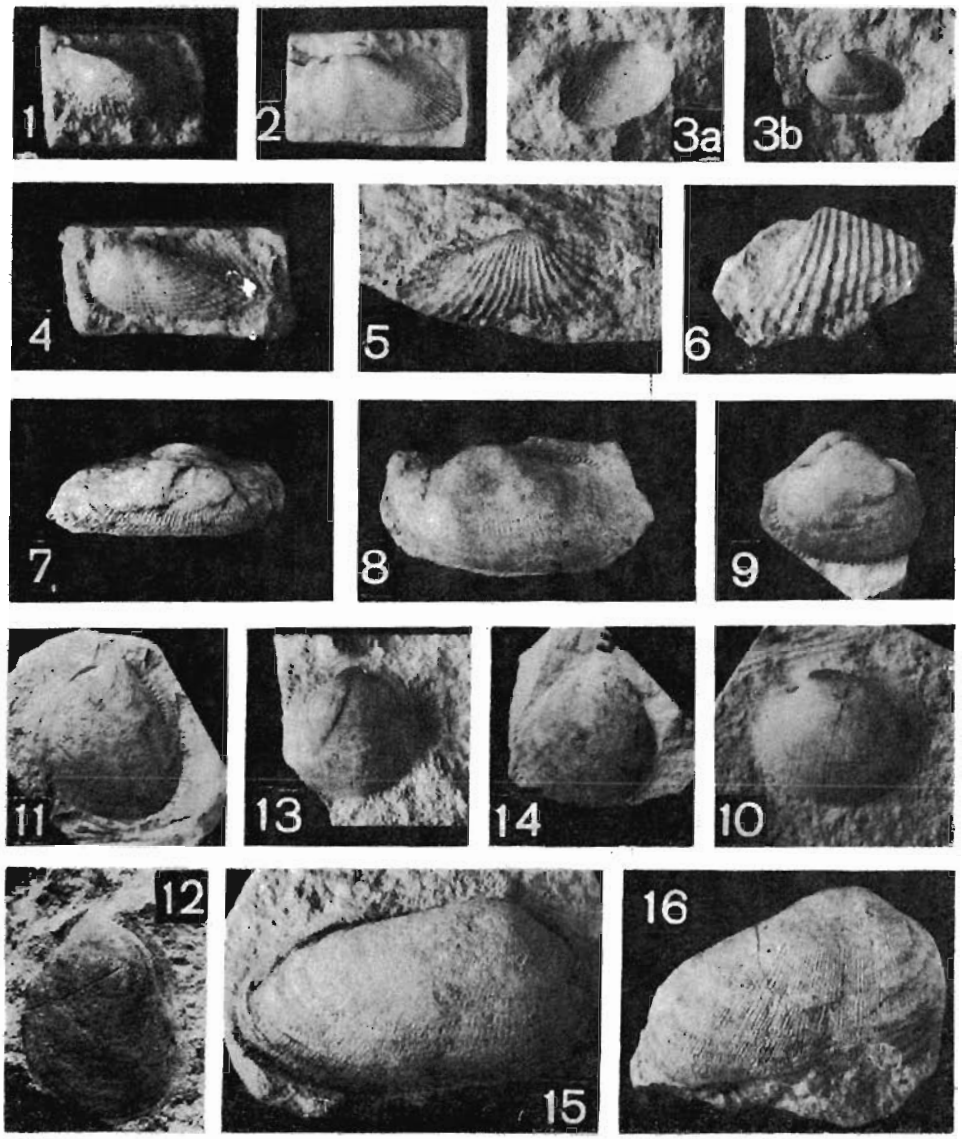
MATERIAL: 11 from Kazimierz, 6 from Nasiłów (opoka).

REMARKS:The studied specimens are of medium- to large-sized, trigonally ovate shells, with their posterior end somewhat rostrated, with a long hinge line; they are radially ornamented with numerous fine striae, and with the inner maring densely crenulated. Most of the studied specimens are internal molds which, however, agree with the specimen figured by ALTH (1850) from the Upper Senonian of the Lvov region.

AGE and DISTRIBUTION: Upper Campanian — Maastrichtian of the Lvov region and peri-Caspian basin, uppermost Maastrichtian of the Middle Vistula Valley.



1—2 — *Nucula (Nucula) truncata* NILSSON; Kazimierz (*1* steinkern of RV, *2* steinkern of LV), × 1
3—4 — *N. (Nucula) ascendens* ALTH; Kazimierz (*3* steinkern of RV, *4*, steinkern of LV), × 1
5 — *N. (Nucula) tenera* J. MÜLLER; Kazimierz (external mold of RV), × 1.5
6 — *N. (Nucula)* sp.; Kazimierz (external mold of LV), × 2
7 — *N. (Nucula) ovata* NILSSON; Dobre (external mold of LV), × 2
8 — *Nuculana (Nuculana) puschi* (ALTH); Kazimierz (steinkern of both valves), × 2
9—10 — *Nuculana (N.) producta* (NILSSON); *9* from Piotrawin (steinkrn of LV), *10* from Kazimierz (steinkern of RV), × 1
11—12 — *Nuculana (N.) siliqua* (GOLDFUSS); *11* from Kazimierz (steinkern of RV), *12* from Nasiłów opoka (steinkern of LV), × 1.5
13—15 — *Nuculana (?Nuculana) brevirostris* (ALTH); *13—14* from Kazimierz (*13* steinkern of LV, *14* external mold of RV), *15* from Piotrawin (steinkern of RV), × 2
16—17 — *Nuculana (N.) foersteri* (J. MÜLLER); Kazimierz (*16* steinkern of LV, *17* steinkern of RV), × 2
18 — *Nuculana (N.)* aff. *carinta* (ANDERT); Kazimierz (external mold of LV), × 4



1 — *Arca (Eonavicula) granulatoradiata* ALTH; plaster cast of LV from Nasiłów opoka, × 3

2 — *Barbatia (Barbatia) forchammeri* (LUNDGREN); plaster cast of LV from Kazimierz, × 2

3a—3b — *Pseudogrammatodon lornae* HEINBERG; Nasiłów opoka (external cast and internal mold of LV), × 3

4 — *Barbatia (Acar) hennigi* HEINBERG; plaster cast of LV from Solec, × 3

5—6 — *Arca (Eonavicula) propinqua* REUSS; Kazimierz (5 external mold of RV, × 2; 6 fragment of external mold, × 1)

7—8 — *Barbatia (Barbatia) geinitzi* (REUSS); 7 from Kazimierz (external mold of RV), 8 from Nasiłów hardground (external mold of LV), × 1

9—10 — *Cucullaea (Cucullaea) leopoliensis* (ALTH); 9 from Nasiłów opoka (steinkern of LV), × 1; 10 from Podgórz (steinkern of LV), × 2

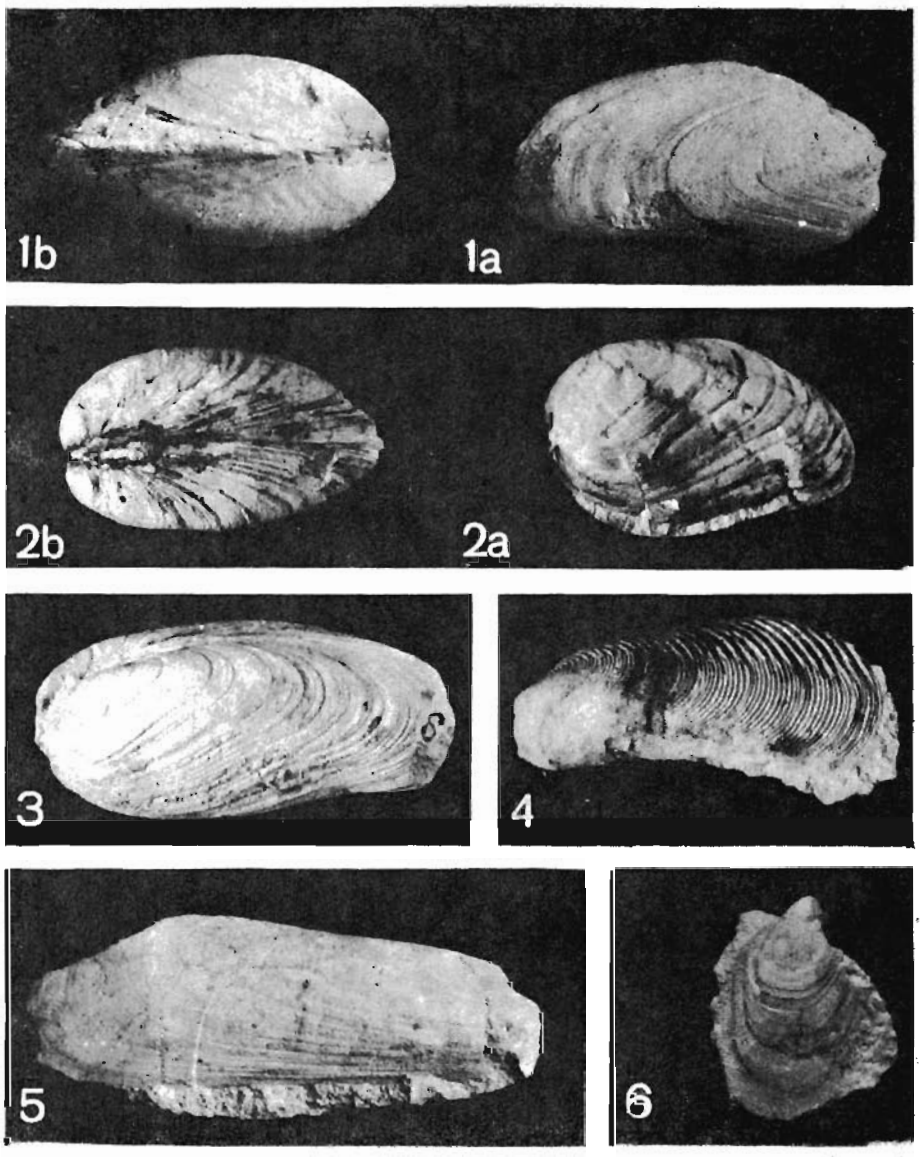
11 — *Limopsis (Limopsis) sacheri* ALTH; Kazimierz (steinkern of LV), × 1

12 — *Limopsis (Limopsis) aff. helenae* HEINBERG; Nasiłów opoka (steinkern of LV), × 1

13 — *Limopsis (Limopsis) rhomboidalis* ALTH; Kazimierz (steinkern of RV), × 1

14 — *Limopsis (Limopsis) radiata* ALTH; Kazimierz (steinkern of RV), × 1

15—16 — *Barbatia (Barbatia) tenuistriata* (v. MÜNSTER); Nasiłów opoka (external molds of RV), × 1



1a-1b — *Modiolus (Modiolus) radiatus* (v. MÜNSTER); Nasiłów opoka (lateral and dorsal views of steinkern)

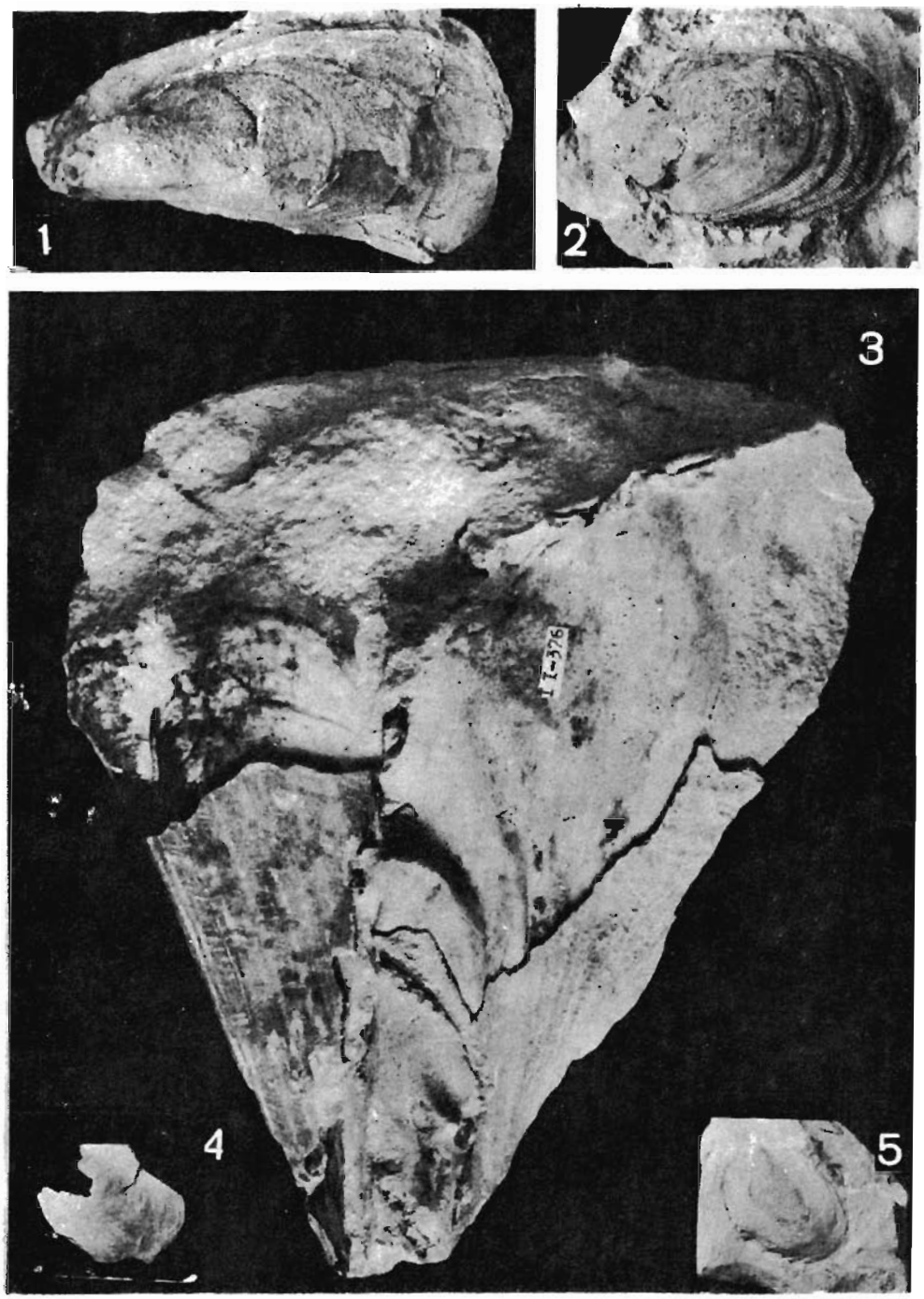
2-3 — *Modiolus (Modiolus) elongatus* (PUSCH); Nasiłów opoka (*2a*, *3* lateral views of LV, *2b* dorsal view)

4 — *Inoperna flagellifera* (FORBES); Kazimierz (external mold of LV; MACHALSKI's Coll.)

5 — *Modiolus (Modiolus) siliquus* (MATHERON); Nasiłów opoka (incomplete RV)

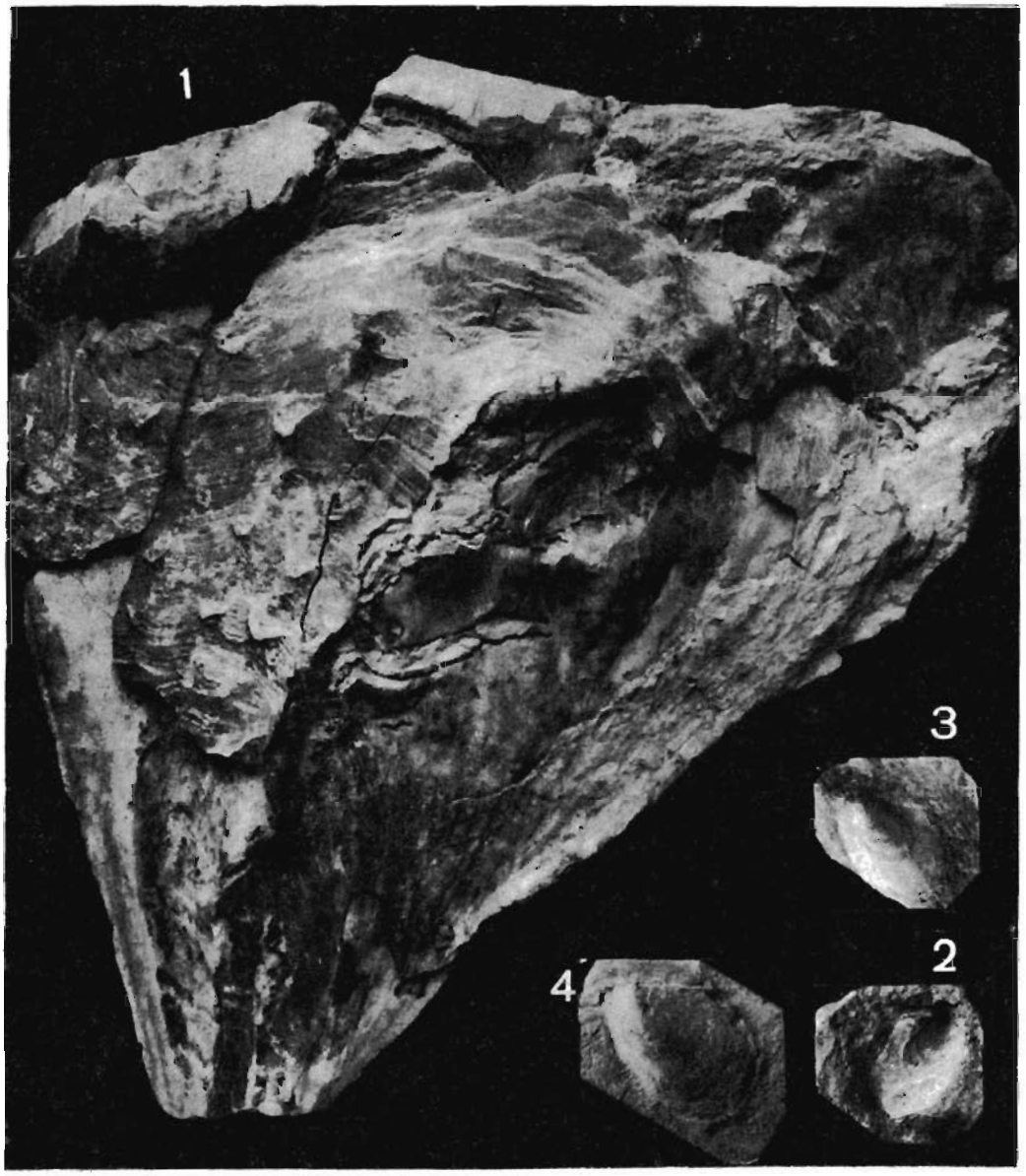
6 — *Septifer (Septifer) scalaris* (J. MÜLLER); Nasiłów opoka (LV)

All figures in natural size



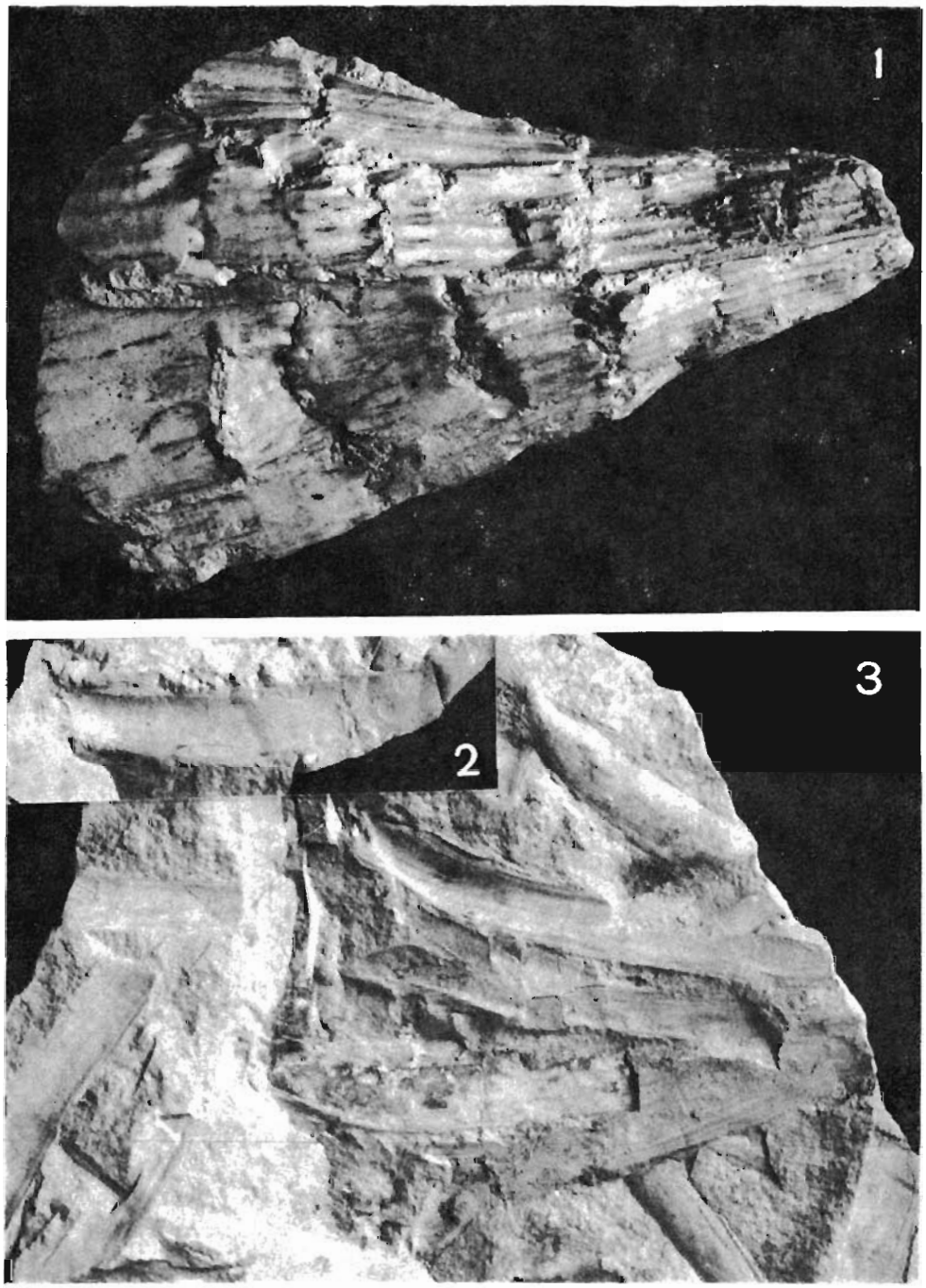
1 — *Septifer (Septifer) lineatus* (SOWERBY); Nasiłów opoka (LV view)
2 — *Septifer (Septifer) scalaris* (J. MÜLLER); Nasiłów opoka (LV)
3 — *Pinna (Plesiopinna) kasimirensis* sp. n.; Kazimierz, paratype (IGP II-356)
4-5 — *Phelopteria pectinoidea* (REUSS); *4* incomplete LV from Kazimierz, *5* LV from Męćmierz

All figures in natural size

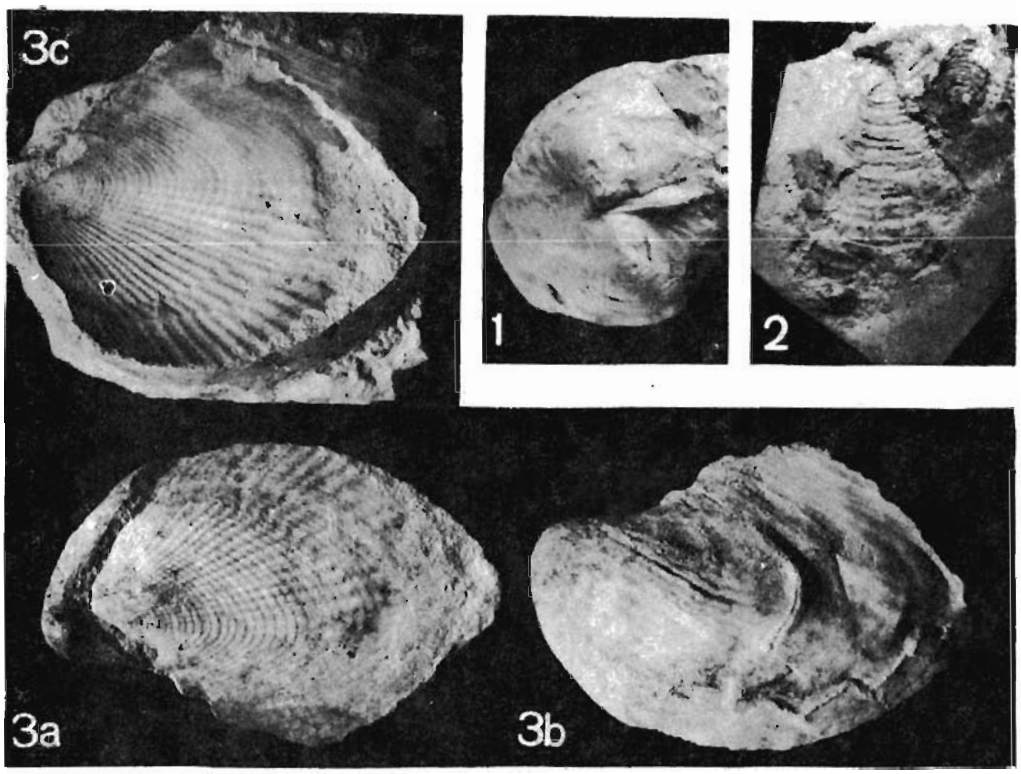


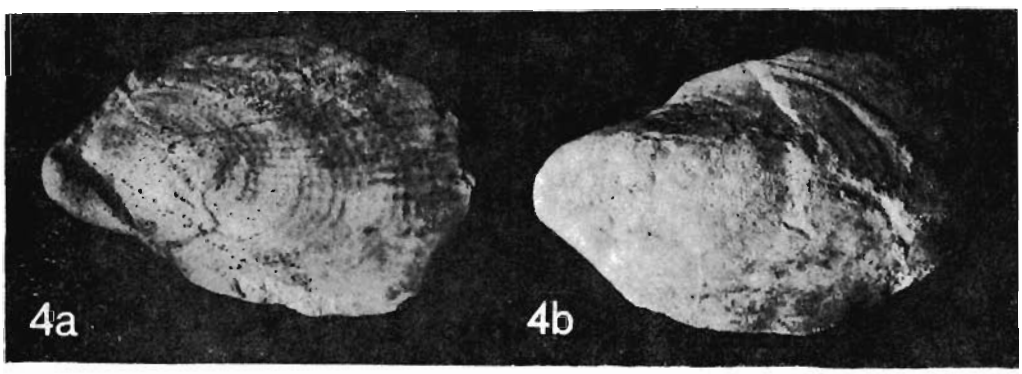
1 — *Pinna (Plesiopinna) kasimirensis* sp. n.; Kazimierz, holotype
2-3 — *Phelopteria cincta* (ALTH); Ciszyca Kolonia (*2* LV, *3* steinkern of LV; MZ-M. 2370)
4 — *Pseudoptera coerulescens* (NILSSON); Nasiłów opoka (LV)

All figures in natural size



1 — *Pinna (Pinna) cretacea* (v. SCHLOTHEIM); Nasiłów opoka (steinkern)
2-3 — *Gervillia (Gervillia) solenoidea* DEFRANCE; Kazimierz (*2* LV, *3* group of valves)

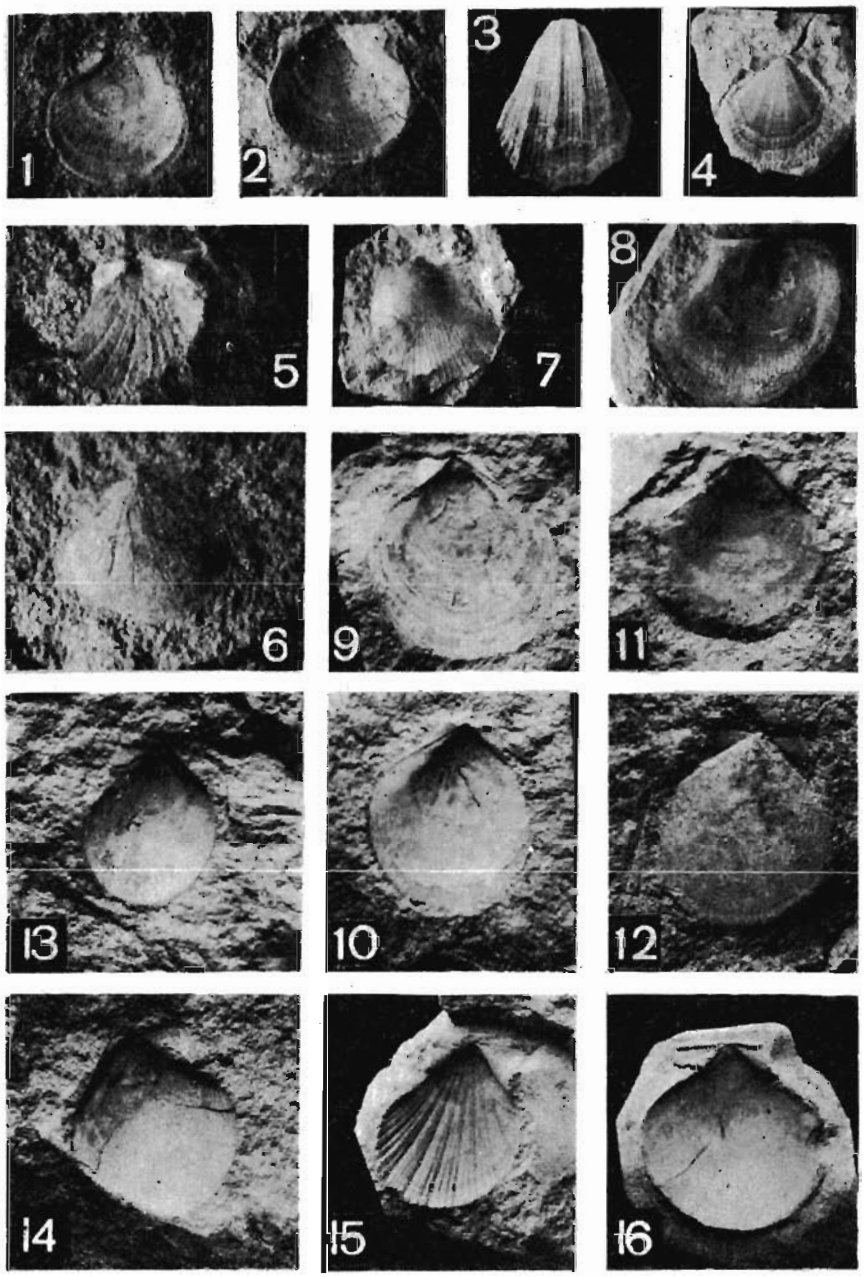




1-2 — *Spyridoceramus tegulatus* (v. HAGENOW); Chełm (*1* dorsal view of 2V steinkern, *2* fragment of steinkern)

3-4 — *Tenuipteria argentea* (CONRAD); Nasiłów opoka (*3a*, *3c*, *4a* RV; *3b*, *4b* LV views)

All figures in natural size



1—2 — *Lyropecten (Aequipecten) wisniowskii* (PASTERNAK); *1* from Kłudzie (internal view of RV), *2* from Piotrawin (internal view of LV), × 4
3—4 — *Neithea sexcostata* (WOODWARD); Nasiłów opoka (*3* RV, *4* LV), × 1
5—6 — *Propeamussium (Parvamussium) inversum* (NILSSON); Ciszyca Górna (incomplete valves), × 4
7—8 — *Oxytoma (Hypoxytoma) danica* (RAVN); *7* from Nasiłów opoka (external view of LV), *8* from Kazimierz (internal view of LV), × 1.5
9—10 — *Syncyclonema nilsoni* (GOLDFUSS); Kazimierz (*9* internal view of RV, *10* internal view of LV), × 1
11—12 — *Syncyclonema haeggi* DHONDT; *11* from Podgórz (internal view of RV), *12* from Kazimierz (external view of RV), × 3
13—41 — *Syncyclonema gamsensis* DHONDT; *13* from Męćmierz (internal view of RV), *14* from Kazimierz (internal view of LV), × 2.5
15 — *Merklinia variabilis* (v. HAGENOW); Nasiłów opoka (internal view of LV), × 1
16 — *Camptonectes (Camptonectes) virgatus* (NILSSON); Nasiłów opoka (internal view of RV), × 1

Nucula (Nucula) tenera J. MÜLLER, 1847
(Pl. 25, Fig. 5)

1847. *Nucula tenera* J. MÜLLER, p. 17, Pl. 2, Fig. 1.
1889. *Nucula tenera* MÜLL.; HOLZAPFEL, p. 200, Pl. 21, Figs 9—12.
p. p. 1912. *Nucula tenera* J. MÜLLER; PERVINQUIÈRE, p. 94, Pl. 7, Figs 8, 14.
1943. *Nucula tenera* J. MÜLLER; VAN DER WEIJDERN, p. 29, Pl. 1, Figs 1—6.
1968. *Nucula tenera* MÜLLER; PASTERNAK, p. 89, Pl. 7, Fig. 7.
1982. *Nucula tenera* MÜLLER; SOBETSKI, p. 72, Pl. 6, Fig. 1.

MATERIAL: 1 from Mećmierz, 2 from Kazimierz, 1 from Nasiłów (opoka).

REMARKES: The studied specimens are badly preserved, but they possess the diagnostic ornamentation which coincides with that of *N. tenera* J. MÜLLER. The species can easily be distinguished by ornamentation which mainly consists of numerous flat-toped radial riblets crossed by regular growth stops.

AGE and DISTRIBUTION: Upper Senonian of the Netherlands and West Germany, Campanian of the Lvov region and peri-Caspian basin, Maastrichtian of Tunisia, Upper Maastrichtian of the Middle Vistula Valley.

Nucula (Nucula) ovata NILSSON, 1827
(Pl. 25, Fig. 7)

1827. *Nucula ovata* n., NILSSON, p. 16, Pl. 5, Fig. 5 (*non* MANTELL 1822).
1897. *Nucula ovata* NILSS.; HENNIG, p. 63, Pl. 3, Fig. 21.
1935. *ucula ovata* NILSSON; HÄGG, p. 18.
1954. *Nucula ovata* NILSSON; HÄGG p. 28.
1968. *Nucula* cf. *ovata* NILSSON; PASTERNAK, p. 90, Pl. 12, Figs 8—9.
1977. *Nucula ovata* NILSSON; SOBETSKI, p. 12, Pl. 1, Fig. 1.

MATERIAL: 2 from Dobre, 2 from Podgórz, 2 from Kazimierz.

REMARKS: The studied specimens are badly preserved, stained by limonitic material masking the hinge and margins; however, they are characterized by their oval-shaped shell, with a somewhat short hinge of almost equal posterior and anterior segments, and with smooth surface and smooth inner margin. The species *N. ovata* MANTELL has a similar smooth surface and inner margin, but it is slightly elongate with the shorter posterior part (*see* WOODS 1899).

AGE and DISTRIBUTION: Upper Senonian of Sweden, the Lvov region and Crimea; Upper Maastrichtian of the Middle Vistula Valley.

Nucula (Nucula) sp.
(Pl. 25, Fig. 6)

MATERIAL: 2 from Kazimierz.

REMARKS: Two specimens of well preserved ornamentation are characterized by their subtrigonal shape; umbo rounded with distinct umbo-anterior carina; anterior part almost elongate with a truncate margin; dominant concentric sculpture of numerous closely spaced striae with distinct growth stops at regular intervals.

Superfamily **Nuculanacea** H. ADAMS & A. ADAMS, 1858
Family **Nuculanidae** H. ADAMS & A. ADAMS, 1858
Genus *Nuculana* LINK, 1807
Type species: *Arca rostrata* CHEMNITZ, 1774; *OD*
Subgenus *Nuculana* LINK, 1807

Nuculana (Nuculana) producta (NILSSON, 1827)
(Pl. 25, Figs 9—10)

1827. *Nucula producta* n., NILSSON, p. 16, Pl. 10, Fig. 5.
1837. *Nucula producta* NILSSON; PUSCH, p. 62, Pl. 6, Fig. 10.
(1850) *Nucula producta* NILSSON; d'ORBIGNY, p. 236.
1850. *Nucula producta* NILS.; KNER, p. 27.
1850. *Nucula producta* DITH.; ALTH, p. 232, Pl. 12, Figs 14—15.
1862. *Nucula producta* NILS.; KNER, p. 21, Pl. 16, Fig. 24.
1863. *Nucula producta* NILS.; PŁACHETKO, p. 17.
1869. *Leda producta* NILSSON sp.; FAVRE, p. 118, Pl. 12, Fig. 9.
1886. *Nucula producta* NILS.; SIEMIRADZKI, p. 62, Pl. 5, Fig. 17.
1889. *Leda producta* NILSSON; GRIEPENKERL, p. 57.
1897. *Nucula producta* NILSS.; HENNIG, p. 64.
1901. *Leda producta* NILSSON sp.; WOLLEMANN, p. 22.
1902. *Leda producta* NILSSON sp.; WOLLEMANN, p. 74.
1935. *Leda producta* (NILSSON); HÄGG, p. 19, Pl. 2, Figs 19—20.
(1938) *Leda producta* NILS.; POŻARYSKI, p. 22.
1954. *Leda producta* (NILSSON); HÄGG, p. 29.
1968. *Leda producta* (NILSSON); PASTERNAK, p. 92, Pl. 8, Figs 7—8.
1977. *Nuculana producta* (NILSSON); SOBETSKI, p. 15, Pl. 1, Fig. 4.
1982. *Nuculana producta* (NILSSON); SOBETSKI, p. 75, Pl. 4, Fig. 7.

MATERIAL: 48 from Upper Campanian opoka (5 from Dorotka, 4 from Ciszyca Kolonia, 4 from Ciszyca Górna, 35 from Piotrawin), 2 from Dziurków, 5 from Kłudzie, 2 from Dobre, 7 from Podgórz, 16 from Męćmierz, 30 from Kazimierz, 12 from Nasiłów (opoka).

REMARKS: The species is quite common in the Upper Campanian and Maastrichtian deposits of the study area. The collected specimens are preserved as internal molds, with a long hinge line which carries distinct hooked teeth. The species closely resembles *Nuculana panda* (NILLSON), but the latter has an elevated umbo, H/L ratio somewhat higher, and it is ornamented with distinct concentric striae.

AGE and DISTRIBUTION: Senonian of Sweden, West Germany, the Lvov region, Crimea, peri-Caspian basin; in Poland it is noted from the Middle Vistulla Valley (POŻARYSKI 1938), and environs of Zamość (PUSCH 1837) and of Chełm.

Nuculana (Nuculana) siliqua (GOLDFUSS, 1837)
(Pl. 25, Figs 11—12)

1837. *Nucula siliqua nobis*, GOLDFUSS, p. 156, Pl. 125, Fig. 13.
1846. *Nucula siliqua* GOLDFUSS; REUSS, p. 7, Pl. 34, Fig. 11.
(1850) *Leda siliqua* d'ORBIGNY, p. 236.
1851. *Nucula siliqua* GOLDFUSS; J. MÜLLER, p. 64.
1877. *Leda siliqua* GOLDF.; FRIČ, p. 117, Text-fig. 81.
1889. *Leda siliqua* GOLDF. sp.; HOLZAPFEL, p. 203.
1889. *Nucula siliqua* GOLDFUSS; GRIEPENKERL, p. 57.
1893. *Leda siliqua* GOLDF. sp.; FRIČ, p. 92.
1895. *Leda siliqua* GOLDF.; VOGEL, p. 37.
1909. *Leda siliqua* GOLDF. sp.; ROGALA, p. 699, Pl. 28, Fig. 15.
(1911) *Leda siliqua* GOLDF.; ROGALA, p. 492.
?1934. *Leda siliqua* GOLDF. sp.; ANDERT, p. 211, Pl. 11, Fig. 8.
1936. *Leda siliqua* GOLDF.; HÄGG, p. 20, Pl. 2, Fig. 22.
1954. *Leda siliqua* GOLDF.; HÄGG, p. 29, Pl. 3, Fig. 27.
1968. *Leda siliqua* (GOLDFUSS); PASTERNAK, p. 96, Pl. 9, Figs 2—3.

MATERIAL: 1 from Podgórz, 3 from Męćmierz, 6 from Kazimierz, 2 from Nasiłów (opoka).

REMARKS: The studied specimens are of large-sized shells, with an elongated posterior part and short anterior part, almost parallel dorsal and ventral margins, and with the posterior segment of the hinge carrying numerous fine teeth. They

agree with the type specimen of GOLDFUSS (1837). The species *Nuculana carinata* (ANDERT) shows some similarity in elongate shape, but its shell is somewhat lanceolated and has a faint umbo-posterior carina.

AGE and DISTRIBUTION: Cenomanian — Turonian of Bohemia, Upper Senonian of West Germany, Sweden, and the Lvov region; Maastrichtian of the Netherlands, and Upper Maastrichtian of the Middle Vistula Valley.

Nuculana (Nuculana) puschi (ALTH, 1850)
(Pl. 25, Fig. 8)

1850. *Nucula Puschii* m., ALTH, p. 232, Pl. 12, Figs 12—13.
1869. *Leda Puschi* ALTH; FAVRE, p. 119.
(1911) *Leda Puschi* ALTH; ROGALA, p. 492.
1968. *Leda puschii* (ALTH); PASTERNAK, p. 69, Pl. 9, Fig. 1.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Dziurków, 2 from Podgórz, 4 from Kazimierz, 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: The studied specimens are of medium-sized, elongated shell, with rounded anterior and posterior margins, height nearly of half total length, umbones small, hinge line long with a long posterior segment, and the inner margin smooth. The species can be easily differentiated from *Nuculana siliqua* (GOLDFUSS) and *N. scutula* (BÖHM) by the relatively inflated shell, rounded margins and relatively greater H/L ratio.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and the Middle Vistula Valley.

Nuculana (Nuculana) foersteri (J. MÜLLER, 1847)
(Pl. 25, Figs 16—17)

1847. *Nucula Försteri*, J. MÜLLER, p. 16, Pl. 2, Fig. 1.
(1850) *Leda Forsteri*, d'ORBIGNY, p. 236.
1889. *Leda Försteri* MÜLL.; HOLZAPFEL, p. 202, Pl. 21, Figs 13—17.
1895. *Leda Försteri* MÜLLER; VOGEL, p. 37.
(1911) *Leda Försteri* J. MÜLL.: ROGALA, p. 492.
1968. *Leda? försteri* (MÜLLER); PASTERNAK, p. 94, Pl. 13, Figs 9—10.

MATERIAL: 1 from Dobre, 8 from Kazimierz, 2 from Nasiłów (hardground).

REMARKS: The studied specimens are of a small-sized shell, trigonally ovate, with a slightly rostrate posterior end, rounded anterior and margins; ornamentation dominantly expressed by concentric closely spaced striae; the hinge line long, and the inner margin smooth. The studied species is closely allied to *Nuculana semilunaris* (BUCH) in general features, but the latter possesses more tapering posterior part.

AGE and DISTRIBUTION: Campanian of West Germany and the Netherlands, Upper Senonian of the Lvov region, Maastrichtian of the Netherlands, and Upper Maastrichtian of the Middle Vistulla Valley.

Nuculana (Nuculana) aff. *carinata* (ANDERT, 1934)
(Pl. 25, Fig. 18)

aff. 1934. *Leda carinata* n. sp. ANDERT, p. 212, Pl. 11, Figs 9—10.

REMARKS: Only one valve collected from Kazimierz is small-sized, lanceolated, with long posterior part slightly upcurved and ornamented with fine concentric striae oriented vertically on the posterior rostrate end. The specimen is clo-

sely similar to the figured specimens of *N. carinata* (ANDERT) in general form and ornamentation, but the umbo-posterior carina is less distinct in the studied specimen.

AGE and DISTRIBUTION: *(for N. carinata):* Upper Turonian — Lower Senonian of Bohemia and Upper Campanian — Maastrichtian of the Lvov region (PASTERNAK 1968).

Nuculana(?) *(Nuculana) brevirostris* (ALTH, 1850)
(Pl. 25, Figs 13—15)

1850. *Nucula (Dacryomya) brevirostris* m., ALTH, p. 233, Pl. 12, Fig. 16.
1869. *Neaerea brevirostris* ALTH sp.; FAVRE, p. 103.
(1911) *Neaerea brevirostris* ALTH; ROGALA, p. 492.
1968. *Leda brevirostris* (ALTH); PASTERNAK, p. 97, Pl. 9, Figs 4—6.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Dziurków, 2 from Podgórz, 2 from Męćmierz, 4 from Kazimierz.

REMARKS: The species is characterized by the rostrate shell with straight posterodorsal margin, pointed posterior end, distinct umbo-posterior carina and concentric ornamentation. The species *Nuculana tenuirostris* (REUSS) is similar in general features but it has a more elongate rostrum and a well rounded ventral margin.

The species was assigned to the subgenus *Dacryomya* AGASSIZ by ALTH (1850) based on the rostrate shape of the shell, the posterodorsal part of which is concave in *Dacryomya;* in the studied species it is straight. The species was erroneously cited under the genus *Neaera,* being the junior synonym of *Cuspidaria* NARDO, by FAVRE (1869) and ROGALA (1911). Generally, further investigations will probably allow to distinguish this species and *Nuculana tenuirostris* (REUSS) as a separate genus.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and of the Middle Vistula Valley.

Subclass **Pteriomorphia** BEURLEN, 1944
Order **Arcoida** STOLICZKA, 1871
Superfamily **Arcacea** LAMARCK, 1809
Family **Arcidae** LAMARCK, 1809
Subfamily **Arcinae** LAMARCK, 1809
Genus *Arca* LINNAEUS, 1758
Type species: *Arca noae* SCHMIDT, 1818
Subgenus *Eonavicula* ARKELL, 1929
Type species: *Arca quadrisulcata* J. de C. SOWERBY, 1824; *OD*
Arca (Eonavicula) propinqua REUSS, 1846
(Pl. 26, Figs 5—6)

1837. *Arca furcifera* MÜNSTER; GOLDFUSS, p. 142, Pl. 121, Fig. 14.
1846. *Arca (Cucullaea) propinqua* REUSS, p. 12, Pl. 34, Fig. 34.
1869. *Arca furcifera* v. MÜNSTER; GRIEPENKERL, p. 54.
1893. *Arca (Cucullaea) propinqua* REUSS; FRIČ, p. 94, Text-fig. 110.
1923. *Arca propinqua* REUSS; SYNIEWSKA, p. 290.
1934. *Arca (Cucullaea?) propinqua* REUSS; ANDERT, p. 226, Pl. 11, Fig. 23.
1968. *Arca propinqua* REUSS; PASTERNAK, p. 101, Pl. 10, Figs 6—7.

MATERIAL: 1 from Dorotka (Upper Campanian), 5 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens are of medium- to large-sized, rhombohedral shell, with a distinct umbo-posterior carina forming a small corselet; ornamented with 18-21 radial scaled ribs arranged in pairs which are separated by shallow interspaces. They agree in form and ornamentation with the type specimen of REUSS (1846).

AGE and DISTRIBUTION: Lower Senonian of Bohemia, Campanian of West Germany, Upper Campanian —Upper Maastrichtian of Lvov region and of the Middle Vistulla Valley.

Arca (Eonavicula) granulatoradiata ALTH, 1850
(Pl. 26, Fig. 1)

1850. *Arca granulato-radiata* m., ALTH, p. 235, Pl. 12, Fig. 20.
1889. *Arca granulato-radiata* ALTH; FAVRE, p. 128.
?1909. *Arca granulato-radiata* ALTH; ROGALA, p. 698.
1935. *Arca granulato-radiata* ALTH; HÄGG, p. 21, Pl. 3, Fig. 2.
1968. *Arca granulato-radiata* ALTH; PASTERNAK, p. 103, Pl. 11, Figs 1—4.
1978. *Arca (Arca) ernae* n. sp., HEINBERG, p. 106, Fig. 2.
1982. *Arca granulatoradiata* ALTH; SOBETSKI, p. 78, Pl. 6, Fig. 12.

MATERIAL: 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: Two specimens are left valves of small size, rhomboidal in outline, with a distinct umbo-posterior carina and a large corselet, and ornamented with granular radial ribs. The studied specimens agree with *Arca granutoradiata* ALTH. HEINBERG (1978) introduced *A. (Arca) ernae* as a new species from the Upper Maastrichtian hardground at Stevns Klint, Denmark, all main features of which are the same as those of ALTH's species. These features include the size and general shape, the presence of a distinct carina, and the granular radial ornamentation. Therefore, HEINBERG's species is considered herein as a junior synonym of the studied species.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region, the peri-Caspian basin and Sweden; Maastrichtian of Denmark; uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Barbatia* GRAY, 1842
Type species: *Arca barbata* LINNAEUS, 1758
Subgenus *Barbatia* GRAY, 1842
Barbatia (Barbatia) tenuistriata (v. MÜNSTER, 1837)
(Pl. 26, Figs 15—16)

1837. *Arca tenuistriata* MÜNSTER; GOLDFUSS, p. 142, Pl. 138, Fig. 1.
1846. *Arca tenuistriata* MÜNSTER; REUSS, p. 11.
1889. *Arca tenuistriata* MÜNSTER; FAVRE, p. 124, Pl. 12, Fig. 14.
1889. *Arca tenuistriata* v. MÜNSTER; GRIEPENKERL, p. 54.
(1911) *Arca tenuistriata* MÜNSTER; ROGALA, p. 492.
1911. *Arca tenuistriata* MÜNSTER; FRIČ, p. 34, Text-fig. 154.
1935. *Arca tenuistriata* MÜNSTER; HÄGG, p. 22, Pl. 3, Fig. 5.
(1938) *Arca tenuistriata* MÜNST.; POŻARYSKI, p. 22.
(1942) *Arca tenuistriata* MÜNST.; PUTZER, p. 371.
1954. *Arca tenuistriata* MÜNSTER; HÄGG, p. 30.
1955b. *Arca tenuistriata* MÜNSTER; CIEŚLIŃSKI, p. 26.
1968. *Arca tenuistriata* MÜNSTER; PASTERNAK, p. 104, Pl. 11, Figs 7—10.
1974. *Arca tenuistriata* MÜNSTER; SAVCZINSKAJA, p. 73, Pl. 11, Fig. 6.
1977. *Arca tenuistriata* MÜNSTER; SOBETSKI, p. 30, Pl. 3, Fig. 5.
1982. *Arca tenuistriata* MÜNSTER; SOBETSKI, p. 78, Pl. 6, Fig. 11; Pl. 30, Fig. 8.

MATERIAL: 10 from Kazimierz, 30 from Nasiłów (23 opoka, 7 hardground).

REMARKS: The species is common in the uppermost Maastrichtian deposits of the study area, particularly in the Nasiłów quarry. The studied specimens are of large-sized shell, elongately ovate in outline, with a well distinct ventral sinus and radial ornamentation.

CIEŚLIŃSKI (1965b) reported this species from the Cenomanian deposits of the Middle Vistula Valley.

AGE and DISTRIBUTION: Cenomanian of Bohemia and the Middle Vistula Valley; Upper Senonian of West Germany, Sweden, Donbass basin, and the peri-Caspian basin; Upper Maastrichtian of the Lvov region and of the Middle Vistula Valley.

Barbatia (Barbatia) geinitzi (REUSS, 1846)
(Pl. 26, Figs 7—8)

1846. *Arca geinitzii* REUSS, p. 11, Pl. 34, Fig. 31.
1852. *Arca Geinitzi?* REUSS; KNER, p. 22, Pl. 2, Fig. 27.
1869. *Arca Geinitzi* REUSS; FAYRE, p. 125, Pl. 12, Figs 15—16
1873. *Arca Geinitzi* REUSS; GEINITZ, p. 55, Pl. 16, Figs 7—8.
1889. *Arca Geinitzii* REUSS; FRIČ, p. 79, Text-fig. 63.
1934. *Arca (Barbatia) Geinitzi* REUSS; ANDERT, p. 229, Pl. 11, Fig. 17
1935. *Arca Geinitzi* REUSS; HÄGG, p. 21, Pl. 3, Fig. 1.
(1938) *Arca geinitzi* REUSS; POŻARYSKI, p. 22.
(1942) *Arca geinitzi* RSS.; PUTZER, p. 371.
1968. *Arca geinitzi* REUSS; PASTERNAK, p. 101, Pl. 10, Figs 8—12.
1974. *Arca geinitzi* REUSS; SAVCZINSKAJA, p. 73, Pl. 11, Figs 7—9.
1977. *Arca geinitzi* REUSS; SOBETSKI, p. 28, Pl. 2, Figs 2—3.
1982. *Arca geinitzi* REUSS; SOBETSKI, p. 76, Pl. 6, Fig. 9; Pl. 30, Fig. 7.

MATERIAL: 4 from Upper Campanian (3 from Ciszyca Kolonia, 1 from Piotrawin). 2 from Mędmierz, 3 from Kazimierz, 23 from Nasiłów (15 opoka, 8 hardground).

REMARKS: The studied specimens are of medium- to large-sized, subrhomboidal shell, with a faint umbo-posterior carina, a broad ventral sinus, a long and striaght hinge line with two segments which carry numerous teeth. Ornamentation consists mainly of granular radial ribs crossed by fine growth lines.

This species is closely allied to *Barbatia tenuistriata* (v. MÜNSTER) but it can be distinguished by its shape and ornamentation.

AGE and DISTRIBUTION: Middle Turonian — Lower Senonian of Bohemia, Upper Senonian of Denmark, West Germany, Sweden, the Lvov region, the Donbass basin, the peri-Caspian basin, Crimea, and the Middle Vistula Valley.

Barbatia (Barbatia) forchammeri (LUNDGREN, 1888)
(Pl. 26, Fig. 2)

1978. *Barbatia (Barbatia) forchammeri* (LUNDGREN): HEINBERG, p. 107, Fig. 1.

MATERIAL: 3 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens are identified with those of *B. (B.) forchammeri* (LUNDGREN) which were precisely described by HEINBERG (1978) from the Upper Maastrichtian of Denmark. The species is characterized by an elongated ovate shape, and the presence of tuberculated or scaled radial ribs.

AGE and DISTRIBUTION: Upper Maastrichtian of Denmark and of the Middle Vistulla Valley.

Subgenus *Acar* GRAY, 1857
Type species: *Arca gradata* BRODERIP & SOWERBY, 1829; *SD* WOODRING, 1925

Barbatia (Acar) hennigi HEINBERG, 1978
(Pl. 26, Fig. 4)

1978. *Barbatia (Acar) hennigi* n. sp., HEINBERG, p. 108, Fig. 4.

MATERIAL: 1 from Solec.

REMARKS: One external cast of the left valve possesses well preserved ornamentation. It is elongate and rhomboidal, with a distinct postero-ventral carina, and ornamented with discontinous radiating bars. It is undoubtedly identified with the figured specimen of *A (Acar) hennigi* HEINBERG from the uppermost Maastrichtian hardground of Stevns Klint, Denmark.

AGE and DISTRIBUTION: Lower Maastrichtian of the Middle Vistula Valley, and uppermost Maastrichtian of Denmark.

Family **Parallelodontidae** DALL, 1898
Subfamily **Grammatodontinae** BRANSON, 1942
Genus *Pseudogrammatodon* ARKELL, 1930
Type species: *Arca adversidentata* DESHAYES, 1858
Pseudogrammatodon lornae HEINBERG, 1978
(Pl. 26, Fig. 3)

1978. *Pseudogrammatodon lornae* n. sp.; HEINBERG, p. 114, Fig. 9.

MATERIAL: 1 from Nasiłów (hardground).

REMARKS: One well preserved specimen is of small-sized, ovate, and radially ornamented shell. The ribs on the dorsal flanks are oriented dorsally (Pl. 27, Fig. 3a); the hinge line is straight (Pl. 27, Fig. 3b); posterior segment carries long teeth parallel to the hinge line; anterior segment carries small oblique teeth. All these features agree with those of *P. lornae* HEINBERG from the uppermost Maastrichtian hardground of Stevns Klint, Denmark.

AGE and DISTRIBUTION: Uppermost Maastrichtian hardgrounds of Denmark and of the Middle Vistula Valley.

Family **Cucullaeidae** STEWART, 1930
Genus *Cucullaea* LAMARCK, 1801
Type species: *Cucullaea auriculifera* LAMARCK, 1801
Subgenus *Cucullaea* LAMARCK, 1801
Cucullaea (Cucullaea) leopoliensis (ALTH, 1850)
(Pl. 26, Figs 9—10)

1850. *Arca leopoliensis* m., ALTH, p. 235, Pl. 12, Fig. 19.
1863. *Arca leopoliensis* ALTH; PŁACHETKO, p. 18.
1869. *Arca leopoliensis* ALTH; FAVRE, p. 126, Pl. 12, Fig. 17.
1889. *Cucullaea leopoliensis* ALTH; GRIEPENKERL, p. 55.
1891. *Arca leopoliensis* ALTH; BÖHM, p. 60, Pl. 3, Fig. 25.
(1908) *Cucullaea (Arca) leopoliensis* ALTH; ROGALA, p. 52.
(1911) *Arca leopoliensis* ALTH; ROGALA, p. 492.
1935. *Arca leopoliensis* ALTH; HÄGG, p. 22, Pl. 3, Fig. 3.
1968. *Arca leopoliensis* ALTH; PASTERNAK, p. 102, Pl. 10, Figs 13—15.
1977. *Arca leopoliensis* ALTH; SOBETSKI, p. 29, Pl. 2, Fig. 4.

MATERIAL: 5 from Dobre, 3 from Podgórz, 3 from Mełmierz, 19 from Kazimierz, 12 from Nasiłów (9 opoka, 3 hardground).

REMARKS: The studied specimens are of medium- to large-sized shell, ornamented with radial ribs variable in size and number over the shell (more coarser on the anterior and posterior parts, finer and closely spaced on the umbo-ventral sulcus, and absent or less distinct on the dorsal flanks). The studied specimens agree with those figured by ALTH (1850), FAVRE (1869), and PASTERNAK (1968) from the Upper Senonian deposits of the Lvov region.

Based on the hinge features the genus *Cucullaea* LAMERCK is herein accepted for this species, as previously regarded by GRIEPENKERL (1889) and ROGALA (1908).

AGE and DISTRIBUTION: Upper Senonian of West Germany, Sweden, the Lvov region, Crimea; Maastrichtian of Upper Bavaria; Upper Maastrichtian of the Middle Vistula Valley.

Superfamily **Limopsacea** DALL, 1895
Family **Limopsidae** DALL, 1895
Genus *Limopsis* SASSI, 1827
Type species: *Arca aurita* BROCCHI, 1814; *OL*
Subgenus *Limopsis* SASSI, 1827
Limopsis (Limopsis) rhomboidalis ALTH, 1850
(Pl. 26, Fig. 13)

1850. *Limopsis rhomboidalis* m., ALTH, p. 233, Pl. 12, Fig. 17.
1863. *Limopsis rhomboidalis* ALTH; PŁACHETKO, p. 17.
1869. *Limopsis rhomboidalis* ALTH; FAVRE, p. 121, Pl. 12, Figs 11—12.
1895. *Limopsis rhomboidalis ALTH*; VOGEL, p. 37.
(1911) *Limopsis rhomboidalis* ALTH; ROGALA, p. 492.
1968. *Limopsis rhomboidalis* ALTH; PASTERNAK, p. 113, Pl. 15, Figs 8—9.

MATERIAL: 1 from Ciszyca Górna (Upper Campanian), 1 from Dziurków, 2 from Dobre, 20 from Kazimierz, 1 from Bochotnica, 11 from Nasiłów (8 opoka, 3 hardground).

REMARKS: The species can be easily distinguished from other associated limopsids by the rhomboidal shape and straight hinge line. The species *L. maggae* HEINBERG from the uppermost Maastrichtian hardground of Stevns Klint shows some similarity with the studied species, but it possesses a subcircular outline and a smaller umbo.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and of the Middle Vistula Valley; Maastrichtian of Kunrade (the Natherlands).

Limopsis (Limopsis) sacheri ALTH, 1850
(Pl. 26, Fig. 11)

1850. *Limopsis Sacheri* m., ALTH, p. 234, Pl. 12, Fig. 8.
1869. *Limopsis Sacheri* ALTH; FAVRE, p. 123.
1968. *Limopsis sacheri* ALTH; PASTERNAK, p. 114, Pl. 15, Figs 10—12.
1976. *Limopsis misjae* n. sp., HEINBERG, p. 67, Figs 15—16.

MATERIAL: 50 from Kazimierz, 2 from Bochotnica hardground, 62 from Nasiłów (30 opoka, 32 hardground).

REMARKS: The species is very common in the uppermost Maastrichtian deposits of the study area, particularly in the Nasiłów hardground. It is characterized by a compressed, obliquely oblong to subtrigonal shell, with its postero-ventral part acute, and with a slightly curved hinge. The species *L. misjae* HEINBERG from the uppermost Maastrichtian hardground of Stevns Klint is considered herein as a synonym of the species which carries the same diagnostic features.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and the uppermost Maastrichtian of Denmark and of the Middle Vistula Valley.

Limopsis (Limopsis) aff. *helenae* HEINBERG, 1976
(Pl. 26, Fig. 12)

aff. 1976. *Limopsis (Limopsis) helenae* n. sp., HEINBERG, p. 69, Fig. 17.

MATERIAL: 2 from Kazimierz, 11 Nasiłów (opoka).

REMARKS: The species is closely similar to *L. helenae* HEINBERG in its elongated lenticular shape, and a shorter hinge as well as in its dentition, but L. helenae differs in having radial striae, particularly near the margins. The species *L. kunraediensis* VOGEL, from the Maastrichtian deposits of Limburg is similar to the studied species in a general form, but it has a more inflated shell and its hinge bears greater number of teeth.

Limopsis (Limopsis) radiata ALTH, 1850
(Pl. 26, Fig. 14)

1850. *Limopsis radiata* m., ALTH, p. 234, Pl. 12, Fig. 19a.
1869. *Limopsis radiata* ALTH; FAVRE, p. 122, Pl. 12, Fig. 13.
(1911) *Limopsis radiata* ALTH; ROGALA, p. 492.
1968. *Limopsis radiata* ALTH; PASTERNAK, p. 114, Pl. 15, Figs 13—14.

MATERIAL: 3 from Dobre, 3 from Męćmierz, 30 from Kazimierz, 11 from Nasiłów (10 opoka, 1 hardground).

REMARKS: The species is of medium- to moderately large-sized shell, subtrigonal in outline, oblique posteriorly, and it displays acute and subcentral umbones, the hinge line is straight (ornamented 5-9 radial ribs restricted to the posterior part and crossed by fine growth lines) and the inner posterior margin is crenulated.

HEINBERG (1976) introduced *L. alvildae* and *L. magdae* as new species from the uppermost Maastrichtian hardground of Stevns Klint, closely resembling the studied species in having posterior ribs and inner crenulation, but *L. alvildae* differs in having numerous less distinct posterior ribs and closely spaced inner crenulations, and *L. magdae* differs in having less distinct posterior ribs and inner crenulations, extended along the margins.

AGE and DISTRIBUTION: Maastrichtian of the Lvov region and Upper Maastrichtian of the Middle Vistula Valley.

Order **Mytiloida** FÉRUSSAC, 1822
Superfamily **Mytilacea** RAFINÉSQUE, 1815
Family **Mytilidae** RAFINÉSQUE, 1815
Subfamily **Mytilinae** RAFINÉSQUE, 1815
Genus *Septifer* RACLUZ, 1848
Type species: *Mytilus bilocularis* LINNAEUS, 1758; *SD* STOLICZKA, 1871
Subgenus *Septifer* RACLUZ, 1848
Septifer (Septifer) scalaris (J. MÜLLER, 1847)
(Pl. 27, Fig. 6 and Pl. 28, Fig. 2)

1847. *Mytilus scalaris* MÜLLER, p. 35, Pl. 2, Fig. 11.
1889. *Mytilus lineatus* SOWERBY; HOLZAPFEL, p. 216, Pl. 25, Figs 10—13 (*non* SOWERBY).
1934. *Mytilus scalaris* J. MÜLLER sp.; ANDERT, p. 196, Pl. 10, Figs 23—24 (*cum syn.*).

MATERIAL: 8 from Kazimierz, 10 from Nasiłów (opoka), 1 from Chełm (Lublin Upland).

REMARKS: The studied specimens agree with those figured by MÜLLER (1847) and HOLZAPFEL (1889) from the Campanian greensands of Vaals and Aachen. HOLZAPFEL (1889) erroneously regarded this species as a synonym of *Septifer lineatus* (SOWERBY). The studied species is quite different from SOWERBY's species in its shape and ornamentation, as previously mentioned by WOODS (1900). The species *Septifer variabilis* PETHŐ and *Mytilus regiolutteranus* GRIEPENKERL from the Upper Senonian of Fruška Gora (Yugoslavia) and West Germany, respectively, are closely similar (and most probably related) to this species in their variable shape and ornamentation.

AGE and DISTRIBUTION: Upper Turonian — Lower Senonian of Bohemia, Campanian of Limburg, Upper Maastrichtian of Chełm (Lublin Upland) and of the Middle Vistula Valley.

Septifer (Septifer) lineatus (SOWERBY, 1836)
(Pl. 28, Fig. 1)

1900. *Septifer lineatus* (SOWERBY); WOODS, p. 106, Pl. 18, Figs 1—2 (*cum syn.*).
1923. *Septifer lineatus* (SOW. sp.); SYNIEWSKA, p. 287, Fig. 5.
1934. *Septifer lineatus* (SOW. sp.); ANDERT, p. 198, Pl. 10, Fig. 25.
1934. *Septifer lineatus* (SOW. sp.); BLANCKENHORN, p. 207, Pl. 10, Fig. 51.
1965b. *Septifer lineatus* (SOWERBY); CIEŚLIŃSKI, p. 23.
1974. *Septifer lineatus* (SOWERBY); SAVCZINSKAJA, p. 105, Pl. 37, Figs. 8—10.
1981. *Septifer lineatus* (SOWERBY): TZANKOV, p. 77, Pl. 19, Figs 2—3.

MATERIAL: 4 from Nasiłów (opoka).

REMARKS: The species is characterized by a large, regular mytiliform thin shell, ornamented with numerous very fine radial riblets cancellated by concentric growth lines. The studied specimens agree with those figured by WOODS (1900). CIEŚLIŃSKI (1965b) reported this species from the Cenomanian deposits of the Middle Vistula Valley.

AGE and DISTRIBUTION: Aptian — Upper Senonian of England, Neocomian — Turonian of France, Upper Turonian of Bohemia, Cenomanian of the Donbass basin and of the Middle Vistula Valley, Senonian of West Germany, Upper Senonian of the Lvov region, Maastrichtian of Bulgaria, uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Lithophaginae** H. ADAMS & A. ADAMS, 1857
Genus *Inoperna* CONRAD *in* KERR, 1875
Type species: *Modiolus (Inoperna) carolinensis* CONRAD, 1875; SD STEPHENSON, 1923
Inoperna flagellifera (FORBES, 1846)
(Pl. 27, Fig. 4)

1900. *Modiola flagellifera* FORBES; WOODS, p. 99, Pl. 27, Figs 1—2 (*cum syn.*).
1906. *Modiola flagellifera* FORBES; PETHŐ, p. 236, Pl. 16, Figs 17—18.
1913. *Modiola flagellifera* FORBES; SCUPIN, p. 198.
1934. *Modiola flagellifera* FORBES; ANDERT, p. 203, Pl. 10, Fig. 31.
1947. *Modiola flagellifera* FORBES; HÄGG, p. 61.
1981. *Modiolus flagelliferus* FORBES; TZANKOV, p. 78, Pl. 19, Fig. 9.

MATERIAL: 3 from Kazimierz, 7 from Nasiłów (opoka).

REMARKS: Only two specimens are complete and the rest are fragments of shells which can be easily identified by their characteristic ornamentation. The species is characterized by its elongated, posteriorly enlarged shell with sharp edges, and by its concentric flagelliform ribs.

The species *Inoperna gillieroni* (PICTET & CAMPICHE), is closely similar to the studied species, but it differs in having fewer ribs dorsally and the general absence of bifurcation (WOODS 1900).

AGE and DISTRIBUTION: Albian of England, Turonian of Bohemia, Senonian of Sweden and Austria, Upper Senonian of Bulgaria, uppermost Maastrichtian of the Middle Vistula Valley, and Upper Cretaceous of Southern India.

Subfamily **Modiolinae** KEEN, 1958

Genus *Modiolus* LAMARCK, 1799

Type species: *Mytilus modiolus* LINNAEUS, 1758; *SD* GRAY, 1847

Subgenus *Modiolus* LAMARCK, 1799

Modiolus (Modiolus) elongatus (PUSCH, 1837)

(Pl. 27, Figs 2—3)

1837. *Cypricardia? elongata* m., PUSCH, p. 68, Pl. 7, Fig. 6.
1842. *Cypricardia elongata* PUSCH; GEINITZ, p. 13, Pl. 5. Fig. 7.
1846. *Cypricardia elongata* PUSCH; GEINITZ, p. 168.
1866. *Modiola capitata* ZITTEL, p. 80, Pl. 12, Fig. 1.
1875. *Modiola capitata* ZITTEL; GEINITZ, p. 217, Pl. 48, Fig. 10; Pl. 16, Fig. 9.
1877. *Modiola capitata* ZITTEL; FRIČ, p. 123, Text-fig. 97.
?1866. *Modiola ligeriensis* d'ORB.; SIEMIRADZKI, p. 60, Pl. 4, Fig. 4.
1889. *Modiola* cf. *capitata* v. ZITTEL; HOLZAPFEL, p. 221, Pl. 25, Fig. 14.
1893. *Modiola capitata* ZITTEL; FRIČ, p. 95.
(1911) *Modiol capitata* ZITT.; ROGALA, p. 493.
1911. *Modiola capitata* ZITT.; FRIČ, p. 36, Text-fig. 165.
(1938) *Modiola capitata* ZITT.; POŻARYSKI, p. 21.
(1942) *Modiola capitata* ZITT.; PUTZER, p. 371.
(1951) *Modiola capitata* ZITT.; POŻARYSKA & POŻARYSKI, p. 21.

MATERIAL: 2 from Kazimierz, 1 from Bochotnica, 72 from Nasiłów (65 opoka, 7 hardground).

REMARKS: The species is considered as one of the most common bivalves in the uppermost Maastrichtian deposits of the study area. The species was introduced by PUSCH (1837) from opoka exposed at Kazimierz and in the environs of Zamość (Lublin Upland). Unfortunately, the specimen figured by PUSCH is somewhat badly illustrated. However, the specimens from the Turonian deposits of Bohemia figured by REUSS (1846) agree with the studied specimens. The species *Modiolus capitatus* ZITTEL (Upper Senonian of Gosau) is considered herein as a synonym of PUSCH's species, because the main features of both are identical.

The species is characterized by the large modioliform shell, with a distinct umbo-posterior carina and distinct concentric ornamentation. The species *Modiolus concentricus* (v. MÜNSTER) as figured by GOLDFUSS (1840) from the Campanian deposits of Haldem, West Germany, is closely similar (and most probably related) to the studied species.

AGE and DISTRIBUTION: Cenomanian — Turonian of Bohemia; Upper Senonian of West Germany, Austria and the Lvov region; Maastrichtian of Zamość (Lublin Upland) and uppermost Maastrichtian of the Middle Vistula Valley.

Modiolus (Modiolus) radiatus (v. MÜNSTER, 1838)

(Pl. 27, Fig. 1)

1838. *Mytilus radiatus* MÜNSTER; GOLDFUSS, p. 178, Pl. 138, Fig. 6.
1842. *Modiola arcuata* GEINITZ, p. 79, Pl. 20, Fig. 34.
1846. *Mytilus radiatus* MÜNSTER; RUSS, p. 16, Pl. 33, Fig. 8.
1866. *Modiola radiata* MÜNST.; ZITTEL, p. 83, Pl. 12, Fig. 3a, b.
1877. *Mytilus radiatus* GOLDF.; FRIČ, p. 120, Text-fig. 88.
1883. *Mytilus radiatus* GOLDF.; FRIČ, p. 104, Text-fig. 70.
1889. *Modiola radiata* MÜNST.; HOLZAPFEL, p. 221, Pl. 25, Fig. 16.

1931. *Modiola reversa* SOW.; KRACH, p. 368, Pl. 8, Fig. 8.
1934. *Modiola radiata* MÜNST. sp.; ANDERT, p. 202, Pl. 29, Fig. 29.
(1936) *Modiola radiata* MÜNST.; POŻARYSKI, p. 21.
(1942) *Modiola radiata* MÜNST.; PUTZER, p. 371.
(1951) *Modiola radiata* MÜNST.; POŻARYSKA & POŻARYSKI, p. 21.
(1951) *Modiola reversa* SOW.; POŻARYSKA & POŻARYSKI, p. 21.

MATERIAL: 1 from Bochotnica, 70 from Nasiłów (65 opoka, 5 hardground).

REMARKS: The species is recorded from the uppermost Maastrichtian of the study area (particularly at the Nasiłów section) and commonly associated with *Madiolus elongatus* (PUSCH) with equal frequency. In most of the studied specimens, the radial riblets are less distinct, and probably this make some confusion with *M. reversus* (SOWERBY), but the studied species can be easily distinguished by the presence of well pronounced irregular concentric riblets on the dorsal part.

AGE and DISTRIBUTION: Turonian — Senonian of Bohemia, Senonian of West Germany, Upper Senonian of Austria (Gosau), uppermost Maastrichtian of the Middle Vistula Valley.

Modiolus (Modiolus) siliquus (MATHERON, 1842)
(Pl. 27, Fig. 5)

1844. *Mytilus siliqua* d'ORBIGNY, p. 274, Pl. 339, Figs 3—4.
(1850) *Modiola siliqua* MATHERON; GEINITZ, p. 168, Pl. 10, Fig. 14.
1866. *Modiola siliqua* MATH.; ZITTEL, p. 81, Pl. 11, Fig. 3.
1875. *Mytilus (Modiola) siliqua* MATH.; GEINITZ, p. 215, Pl. 15, Fig. 4; Pl. 47, Fig. 3.
1891. *Modiola siliqua* MATH.; BÖHM, p. 81, Pl. 3, Fig. 29.

MATERIAL: 1 from Kazimierz and 1 from Nasiłów (opoka).

REMARKS: Two incomplete specimens possesses large-sized, elongated, and posteriorly enlarged shells with knife-like edges. They agree with the diagnosis of *Modiolus siliquus* (MATHERON).

AGE and DISTRIBUTION: Upper Cretaceous of West Germany, Turonian of France, Upper Senonian of Austria, uppermost Maastrichtian of the Middle Vistula Valley.

Superfamily **Pinnacea** LEACH, 1819
Family **Pinnidae** LEACH, 1819
Genus *Pinna* LINNAEUS, 1758
Type species: *Pinna rudis* LINNAEUS; *SD* CHILDERN, 1823
Subgenus *Pinna* LINNAEUS, 1758
Pinna (Pinna) cretacea (v. SCHLOTHEIM, 1813)
(Pl. 30, Fig. 1)

1813. *Pinnites cretaceus* v. SCHLOTHEIM, p. 113.
v. 1837. *Pinna decussata nobis*, GOLDFUSS, p. 166, Pl. 138, Fig. 2.
1863. *Hippurites quadrilateralis* PŁACHETKO, p. 26, Pl. 2, Fig. 7.
1866. *Pinna cretacea* SCHLOTHEIM; ZITTEL, p. 87, Pl. 13, Fig. 4.
1875. *Pinna cretacea* SCHLOTHEIM; GEINITZ, p. 54, Pl. 14, Figs 2—3.
1889. *Pinna cretacea* v. SCHLOTHEIM; GRIEPENKERL, p. 54.
1895. *Pinna cretacea* SCHLOTH.; VOGEL, p. 54.
1906. *Pinna decussata* GOLDFUSS; WOODS, p. 99, Pl. 78, Figs 1—2 (*cum syn.*).
(1936. *Pinna decussata* GOLDF.; POŻARYSKI, p. 21.
(1942) *Pinna decussata* GOLGF.; PUTZER, p. 371.
1943. *Pinna cretacea* (SCHLOTHEIM); VAN DER WEIJDEN, p. 81, Pl. 7, Figs 1—2.
1970. *Pinna decussata* GOLDFUSS; KUTSCHER, pp. 143—145, Pl. 2.
1974. *Pinna decussata* GOLDFUSS; KŘIŽ & SOUKUP, pp. 47—50, Pls 1—2.
1974. *Pinna decussata* GOLDFUSS; SAVCZINSKAJA, p. 75, Pl. 12, Figs 8—12.

p. p. 1981. *Pinna decussata* GOLDFUSS; TZANKOV, p. 80, Pl. 20, Fig. 1.
1981. *Pinna cretacea* (SCHLOTHEIM); TZANKOV, p. 80, Pl. 21, Fig. 1.
1982. *Pinna decussata* GOLDFUSS; NESTLER, p. 49, Fig. 69.
1982. *Pinna decussata* GOLDFUSS; DHONDT, p. 77, Pl. 4, Fig. 4.
1982. *Pinna decussata* GOLDFUSS; SOBETSKI, p. 81, Pl. 6, Fig. 16.

MATERIAL: 1 from Ciszyca Kolonia (Upper Campanian), 1 from Podgórz, 4 from Kazimierz, 2 from Bochotnica, 8 from Nasiłów (opoka).

REMARKS: The majority of the studied specimens are incomplete, with their apex damaged, and they agree without doubt with those described by WOODS (1906).

The author has studied the types of GOLDFUSS which are preserved in the Institut für Paläontologie, Bonn (No. 785—788), and some specimens of *P. decussata* from the BINKHORST's collection preserved in the Naturkunde Museum, East Berlin, as well as some examples of *P. cretacea* from the BOSQUET's Collection (KBIN, Brussels); they all are quite similar and the difference is only in the strenght of longitudinal ribs and cross-section. These differences are probably of ecological significance and they depend, perhaps, on the type of sediments (Dr. A. V. J. DHONDT, *pers. comm.*). The species *quadrilateralis* from the Upper Senonian deposits of the Lvov region, established by PŁACHETKO (1863) and attributed by him to the genus *Hippurites*, is just identical with *Pinna cretacea*.

The Upper Cretaceous Nort American species *P. laqueata* CONRAD from Owl Creek, Southeastern Missouri (*see* STEPHENSON 1955) and *P. calamitoides* SHUMARD from the West Coast (*see* PACKARD & JONES 1965) closely resemble *P. cretacea* in its general form and ornamentation, as well as in the internal appearance.

AGE and DISTRIBUTION: Very widely distributed in Upper Cenomanian — Upper Maastrichtian of Europe and Southern India.

Subgenus *Plesiopinna* AMANO, 1956
Type species: *Plesiopinna atriniformis* AMANO 1956; *OD*
Pinna (Plesiopinna) kasimirensis sp. n.
(Pl. 28, Fig. 3 and Pl. 29, Fig. 1)

HOLOTYPE: The specimen presented in Pl. 29, Fig. 1.
PARATYPE: The specimen presented in Pl. 29, Fig. 3.
TYPE LOCALITY: Kazimierz.
TYPE HORIZON: Uppermost Maastrichtian (Belemnella kazimiroviensis Zone).
DERIVATION OF THE NAME: *kasimirensis* — after its finding place in the Kazimierz Town Quarry.

DIAGNOSIS: The shell wedge-shaped, with a medium ridge in younger stage, flat ham-like in later stage, ornamented by radial ribs changing to files of sparsely distributed scaly nodes on the posterior part; shell thick with smooth internal surface.

MATERIAL: 2 from Kazimierz.

MEASUREMENTS:	EL	H	A.A.
Holotype (Pl. 30, Fig. 1)	185.0	147.8	65°
Paratype (Pl. 29, Fig. 1)	135.0	113.8	56°

DESCRIPTION: The shell is large, wedge-shaped, equivalved with a distinct median ridge and rhombic cross-section in the later stage. Umbones are sharply pointed. The dorsal margin is straight, and sharply edged; ventral margin is broadly curved. The valve is divided into two lobes. The dorsal lobe is ornamented

with radial ribs in the early stage, changing to radial files of sparsely distributed scaly nodes in the later stage. The ventral lobe is ornamented with growth undulations, more developed on the mid-shell, changing to granular closely spaced growth lines near the dorsal margin. The shell is covered with growth lines, which are more distinct on the posterior part near the margin. The prismatic layer is thick in dorsal lobes (ca. 4 mm), and thin in ventral lobes (ca. 2 mm). Internal surface of the shell is smooth with growth lines and growth stops.

REMARKS: The new species can be distinguished from *Pinna cretacea* (v. SCHLOTHEIM) by the following: (i) shell flat ham-shaped, with lenticular cross-section in later stage, (ii) dorsal lobes ornamented with radial files of scales, and internal surface smooth with growth lines, (iii) apical angle relatively large, (iv) prismatic layer always thicker than in *P. cretacea*.

The new species is comparable to *P. (Plesiopinna) atriniformis* AMANO (1956), the type species, as figured by HAYMI (1975) from the Albian — Cenomanian of the Gosyonoura Group in Shishijima Island, Japan.

The specimens described as *P. decussata* by TZANKOV (1981, Pl. 20, Fig. 2) from the Maastrichtian deposits of Bulgaria, are similar to the new species in its form and a wide apical angle, but ornamentation of the dorsal lobe is slightly different; these specimens obviously represent a species of *Plesiopinna*.

Order **Pterioida** NEWELL, 1965
Suborder **Pteriina** NEWELL, 1965
Superfamily **Pteriacea** GRAY, 1847
Family **Bakevelliidae** KING, 1850
Genus *Gervillia* DEFRANCE, 1820
Type species: *Gervillia solenoidea; SM* DEFRANCE, 1824
Subgenus *Gervillia* DEFRANCE, 1820
Gervillia (Gervillia) solenoidea DEFRANCE, 1820
(Pl. 30, Figs 2—3)

1840. *Gervillia solenoides* DEFR.; GOLDFUSS, p. 124, Pl. 115, Fig. 10.
1866. *Gervillia solenoides* DEFR.; ZITTEL, p. 91, Pl. 13, Fig. 2.
1895. *Gervillia solenoides* DRFR.; VOGEL, p. 29.
1898. *Gervillia solenoides* DEFR.; G. MÜLLER, p. 41, Pl. 5, Fig. 6.
1931. *Gervillia solenoides* DEFR.; KRACH, pp. 364—365, Pl. 8, Fig. 3.
1935. *Gervillia solenoides* DEFRANCE; HÄGG, p. 26.
(1938) (*Gervillia solenoides* DEFR.; POŻARYSKI, p. 21.
(1942) *Gervillia solenoides* DEFR.; PUTZER, p. 371.
1943. *Gervillia solenoides* DEFRANCE; VAN DER WEIJDEN, p. 82, Pl. 7, Figs 3—4.
1954. *Gervillia solenoides* DEFRANCE; HÄGG, p. 95.

MATERIAL: 2 from Piotrawin (uppermost Campanian), 3 from Solec, 1 from Męcmierz, 1 from Dobre, 80 from Kazimierz, 30 from Nasiłów (opoka).

REMARKS: The majority of the studied specimens are commonly accumulated, with random orientation, in patches along the bedding planes (*see* Pl. 30, Fig. 3). POŻARYSKI (1938) reported this species in the Upper Campanian — Maastrichtian of the Middle Vistula Valley.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian(?) and Turonian — Maastrichtian of Europe and Southern India.

Genus *Pseudoptera* MEEK, 1873
Type species: *Avicula anomala* J. de C. SOWERBY, 1836; *OD*
Pseudoptera coerulescens (NILSSON, 1827)
(Pl. 29, Fig. 4)

1827. *Avicula coerulescens* n., NILSSON, p. 18, Pl. 3, Fig. 19.
1905. *Pteria (Pseudoptera) coerulescens* (NILSSON); WOODS, p. 67, Pl. 9, Figs 13—19 (*cum syn.*).
1909. *Avicula coerulescens* NILSSON; ROGALA, p. 697.
(1911) *Avicula coerulescens* NILSS.; ROGALA, p. 493.
1913. *Avicula coerulescens* NILS.; SCUPIN, p. 217, Pl. 12, Fig. 5.
1932. *Avicula (Pseudoptera) coerulescens* NILSSON; WOLANSKY, p. 29, Pl. 3, Fig. 14.

MATERIAL: 2 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens are left valves of small size, and they are identified with *Pseudoptera coerulescens* (NILSSON), as described both by NILSSON (1827) and by WOODS (1905).

AGE and DISTRIBUTION: Cenomanian — Turonian of Bohemia; Senonian of England, West Germany and Sweden; Upper Senonian of the Lvov region; the Maastrichtian stratotype (the Netherlands); uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Phelopteria* STEPHENSON, 1952
Type species: *Pteria? dalli* STEPHENSON, 1936; *OD*
Phelopteria pectinoidea (REUSS, 1846)
(Pl. 28, Figs 4—5)

1846. *Avicula pectinoides* REUSS, p. 23, Pl. 32, Figs 8—9.
1867. *Avicula (Meleagrina) pectinoides* REUSS; FRECH, p. 156, Pl. 14, Figs 6—9.
1869. *Avicula pectinoides* REUSS; HOLZAPFEL, p. 226, Pl. 25, Fig. 20.
1893. *Avicula pectinoides* REUSS; FRIČ, p. 98, Text-Fig. 121.
1895. *Avicula pectinoides* REUSS; VOGEL, p. 28.
1898. *Avicula pectinoides* REUSS; G. MÜLLER, p. 38, Pl. 5, Fig. 13.
1902. *Avicula pectinoides* REUSS; RAVN, p. 80, Pl. 11, Fig. 3.
1909. *Avicula pectinoides* REUSS; ROGALA, p. 697.
(1911) *Avicula pectinoides* RSS.; ROGALA, p. 493.
1913. *Avicula pectinoides* REUSS; SCUPIN, p. 216, Pl. 12, Fig. 6.
1934. *Avicula pectinoides* REUSS; ANDERT, p. 85, Pl. 1, Fig. 1.

MATERIAL: 4 from Męćmierz, 4 from Kazimierz, 2 from Nasiłów (opoka).

REMARKS: All the studied specimens are left valves, small- to medium-sized, oblique, and slightly enlarged posteriorly. The posterior auricle is large, triangular, and the anterior auricle is small, weakly defined, with a truncated anterior part. The shell is smooth, thin and fragile.

The species can be easily distinguished from *Phelopteria geinitzi* (REUSS), *P. neglecta* (REUSS) and *P. caudigera* (ZITTEL) by its smaller anterior auricles and by the value of prosoclinality.

AGE and DISTRIBUTION: Turonian — Lower Senonian of Bohemia, Senonian of West Germany, Upper Senonian of the Lvov region, the Maastrichtian stratotype (the Netherlands), Upper Maastrichtian of the Middle Vistula Valley.

Phelopteria cincta (ALTH, 1850)
(Pl. 29, Figs 2—3)

1850. *Avicula cincta* m., ALTH, p. 239, Pl. 12, Fig. 24.
1869. *Avicula cincta* ALTH; FAVRE, pp. 130—131.

MATERIAL: 3 from Ciszyca Kolonia (Upper Campanian), 1 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: All the studied specimens are left valves, of medium size, prosocline, moderately inflated, inequilateral with a large posterior auricle. The shell is relatively thick. Its dorsal half is moderately inflated, ornamented with concentric furrows, two of them being more distinct. The ventral half is almost flat and smooth.

The species can be easily distinguished from other Upper Cretaceous *Phelopteria* by the presence of concentric furrows on its dorsal half.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and of the Middle Vistula Valley.

Family **Inoceramidae** GIEBEL, 1852

DISCUSSION: The extinction of the inoceramids has been a gradual process which began in the Campanian (*see* DHONDT 1983b). This gradual decrease in inoceramids is clearly noticable in the Upper Campanian — Maastrichtian deposits of the Middle Vistula Valley. Many inoceramid species crossing the Campanian — Maastrichtian boundary in the Middle Vistula Valley were listed by POŻARYSKI (1938) and BŁASZKIEWICZ & CIEŚLIŃSKI (1976), and some of them recently monographed by CIEŚLIŃSKI & BŁASZKIEWICZ (1984). All these species are of relatively smaller importance in the biostratigraphy of the Maastrichtian in the North European Province, if compared with the tegulated inoceramid species, the equivalve *Spyridoceramus tegulatus* (v. HAGENOW) and the inequivalve *Tenuipteria argentea* (CONRAD).

The identification of equi- and inequivalve tegulated inoceramids in the Maastrichtian of North Europe is a matter of confusion for several investigators, due to a lack of any illustration made by v. HAGENOW (1942) for *Inoceramus tegulatus*, the similarity of „tile-like" ornamentation in both equi- and inequivalve species, and pelomorphic (DHONDT 1983a) deformation as well as the scarcity of complete specimens. SPEDEN (1970a) reviewed in detail the history of this problem, and revised the materials of ØDUM (1922) from Denmark and those from North America; he correlated the equivalve species *Tenuipteria argentea* (CONRAD) with *Inoceramus dobrovi* JELETZKY; and inequivalve species *T. fibrosa* (MEEK & HAYDEN) with *I. tegulatus* (s. s.) and *I. caucasicus* DOBROV, and he accepted *Tenuipteria* STEPHENSON as a generic name for these five species.

DHONDT (1979) discovered the inequivalve species *Tenuipteria geulemensis* (VOGEL) in the Maastrichtian stratotype (the Netherlands); she also recorded (DHONDT 1982) both equivalve and inequivalve tegulated species in the Upper Maastrichtian (Belemnitella junior Zone) of Hemmoor Chalk, West Germany. However, the figured specimens from Hommoor are incomplete and most probably belong to equivalve not inequuivalve species if carefully compared with the material from Maastricht and Isle of Rügen. Recently, DHONDT (1983a, b) fully discussed taxono-

mic, biostratigraphic and paleogeographic distribution of the tegulated inoceramids in the Maastrichtian of North Temperate Realm, and she divided (DHONDT 1983a) the tegulated species into two groups:

— equivalve *I. tegulatus* v. HAGENOW (s.s.), *I. fibrosus* (MEEK & HAYDEN), *I. caucasicus* DOBROV, and *I. kusiroensis* NAGO & *MATSUMOTO* (the latter from the Maastrichtian of Japan);
— inequivalve *T. argentea, T. geulemensis,* and *I. dobrovi.*

DHONDT (1983a) accepted *Tenuipteria* STEPHENSON as a generic name for inequivalve species and *Spyridoceramus* HEINZ for equivalve ones. In this work the author follows DHONDT (1983a), regardless her Text-fig. 3 (lower part) which presents the species not belonging to the equivalve genus *Spyridoceramus.*
1960),

All the Polish investigators (*see* Text-fig. 7), *viz.* POŻARYSKI (1938, 1960), POŻARYSKA & POŻARYSKI (1951), CIEŚLIŃSKI (1960), BŁASZKIEWICZ & CIEŚLIŃSKI (1976), and CIEŚLIŃSKI & BŁASZKIEWICZ (1984) considered both equivalve and inequivalve species as *I. tegulatus* v. HAGENOW, following ØDUM (1922), DOBROV (1951), DOBROV & PAVLOVA (1959), and JELETZKY (1962).

After a careful study for the occurrence of these tegulated species in the Maastrichtian deposits of the Middle Vistula profile and comparison with other materials recognized outside Poland, it is clear that the equivalve species *Spyridoceramus tegulatus* is only recorded (*see* Text-fig. 15) in the Lower Maastrichtian and low-Upper Maastrichtian (Belemnitella junior Zone), while the inequivalve *Tenuipteria argentea* is restricted to the uppermost Maastrichtian (*see* Text-figs 5—6 and 15). The

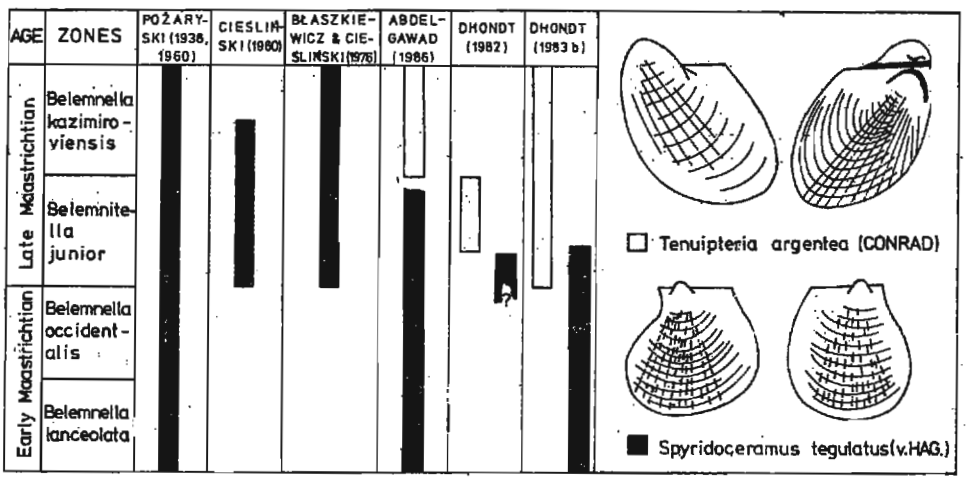


Fig. 15. Stratigraphic range of the tegulated inoceramids in the Maastrichtian deposits of the Middle Vistula Valley, as compared with their stratigraphic range in Hemmoor Chalk (DHONDT 1982, doubtful specimens of the both species) and in North Temperate Realm (DHONDT 1983b)

two species are not overlapping, and there is a small gap of few meters in the uppermost part of the Belemnitella junior Zone (*see* Text-fig. 15). Hence, all the specimens collected from the uppermost Maastrichtian (Kazimierz, Bochotnica and Nasiłów sections) and misidentified as *Inoceramus tegulatus* v. HAGENOW by the previous investigators are considered herein as *Tenuipteria argentea* (CONRAD). Other specimens collected from the Lower Maastrichtian by POŻARYSKI (1938) are listed (see further synonymy lists) under *Spyridoceramus tegulatus*.

It seems that the both equi — and inequivalve species were recorded in the studied section (Middle Vistula), Denmark, North Caucasus, and probably (*see* DHONDT 1983a) in the Maastrichtian stratotype, but without overlapping each other. This observation is in contrary to the doubtful specimens studied by DHONDT (1982) from the Hommoor section (*see also* SCHULZ & *al.* 1984).

As a conclusion, the inequivalve species *Tenuipteria argentea* (based on the studied material) is suggested to be an alternative zone index for the uppermost Maastrichtian zone of *Belemnella kazimiroviensis*, which is missing in several uppermost Maastrichtian sections, particularly in Central Asia and North America.

Genus *Spyridoceramus* HEINZ, 1932

Type species: *Ineceramus tegulatus* v. HAGENOW, 1842; *non* ØDUM, 1922

Spyridoceramus tegulatus (v. HAGENOW, 1842)

(Pl. 31, Figs 1—2)

1842. *Inoceramus tegulatus* n., v. HAGENOW, p. 559 (32).
p. p. 1922. *Inoceramus tegulatus* v. HAGENOW; ØDUM, pp. 1—13, Figs 4—6.
1928. *Inoceramus* sp. (cf. *tuberculatus* WOODS); SYNIEWSKA, p. 285, Fig. 3.
1932. *Inoceramus (Spyridoceramus) tegulatus* v. HAGENOW; WOLANSKY, p. 28, Pl. 4, Fig. 5; Pl. 5, Figs 5—6.
p. p. (1938) *Inoceramus tegulatus* HAG.; POŻARYSKI, p. 21.
1951. *Inoceramus caucasicus* n. sp. DOBROV, p. 167, Pl. 2, Fig. 2.
1959. *Inoceramus caucasicus* DOBROV; DOBROV & PAVLOVA, p. 150, Pl. 19, Fig. 4a, b.
1961. *Inoceramus tegulatus* HAGENOW; SEITZ, pp. 123—124.
1962. *Inoceramus fibrosus* (MEEK & HAYDEN); JELETZKY, p. 1011, Pl. 141, Figs 4—7.
1965. *Inoceramus fibrosus* a synonym of *I. tegulatus* HAGENOW; JELETZKY & CLEMENS, p. 957.
1966. *Inoceramus tegulatus* HAGENOW; KOTSYUBINSKII, p. 148, Pl. 28, Fig. 3; Pl. 29, Fig. 8.
1970a. *Tenuipteria tegulata* (HAGENOW); SPEDEN, p. 6, Pl. 2, Figs 1—3.
1970a. *Tenuipteria fibrosa* (MEEK & HAYDEN); SPEDEN, p. 24, Text-fig. 3a and Pl. 1, Figs 1—6.
1970b. *Tenuipteria fibrosa* (MEEK & HAYDEN); SPEDEN, p. 62, Pl. 8, Figs 11—18; Pl. 9, Figs 1—16.
1974. *Inoceramus* ex. gr. *tegulatus* HAGENOW; PERGAMENT, p. 191, Pl. 65, Figs 7—8.
1982. *Inoceramus tegulatus* v. HAGENOW; NESTLER, p. 46, Fig. 72.
non 1982. ? *Tenuipteria tegulata* (VON HAGENOW); DHONDT, p. 79, Pl. 1, Figs 1—2.
1983a. *Spyridoceramus tegulatus* (VON HAGENOW); DHONDT, p. 48, (*non* Text-fig. 3).
1983b. *Spyridoceramus tegulatus* (VON HAGENOW); DHONDT, p. 697.

MATERIAL: 1 from Dziurków, 6 from Kłudzie, 2 from Podgórz (own collection); 1 from Solec (POŻARYSKI's Collection; I. G., No. 12 II. 27); 7 from Miechów—Pińczów, Miechów Upland (MAZUREK's Collection; I. G., No. 1401 II. 199, 201, 202, 203, 313, 411, 424); Specimens from borehole Garwolin, Polish Lowland (I. G. No. 633, II. 80, 82, 86); Some 50 specimens from the Chełm chalk (Lublin Upland).

MEASUREMENTS: All the studied specimens from the Middle Vistula Valley, and others are fragmented, except of 3 specimens from Chełm which are almost complete.

	L	H	valve
(Pl. 32, Fig. 1)	30.0	21.0	2V
2	30.0	25.6	RV
3	30.0	28.8	RV

REMARKS: The species is characterized by an equivalve shell, inequilateral and submytiloid (SPEDEN 1970a) or *Avicula*-like (SEITZ 1961); umbones prosogyrous projecting slightly above the straight dorsal margin; and both valves are covered with a "tile-like" ornamentation (DHONDT 1983a). Although the majority of the studied specimens are incomplete, they possess a characteristic ornamentation, and agree with the specimens figured by WOLANSKY (1932), NESTLER (1962), SPEDEN (1970a), and KOTSYUBINSKII (1968) from Isle of Rügen, Denmark and the Lvov region, respectively. Nothing can be added to the discussion given by DHONDT (1983a) on the synonymy of this species.

AGE and DISTRIBUTION: Very widely distributed in the Lower Maastrichtian — low-Upper Maastrichtian of North Temperate Realm (DHONDT 1983a,b). In the North European Province (Denmark, Hemmoor, Isle of Rügen, Poland, the Lvov region, Crimea, Caucasus), Pacific region, Japan(?) and the Western Interior (North America).

In Poland: — The Middle Vistula Valley: Dziurków, Solec, Kłudzie (Lower Maastrichtian); Podgórz (Belemnitella junior Zone),
— Lublin Upland: Chełm chalk (Belemnitella junior Zone),
— Miechów Upland: Miechów and Pińczów (Lower Maastrichtian),
— Encountered in boreholes penetrating the Lower Maastrichtian deposits, such as Puławy, and Garwolin (Polish Lowland).

Genus *Tenuipteria* STEPHENSON, 1955; *emend.* SPEDEN (1970a, b)

Type species: *Inoceramus argenteus* CONRAD, 1858; OD

Tenuipteria argentea (CONRAD, 1858)

(Pl. 31, Figs 3—4)

1858. *Inoceramus argenteus* CONRAD, p. 324, Pl. 34, Fig. 15.
1895. *Avicula Geulemensis* VOGEL, p. 28, Pl. 2, Figs 3—5.
1902. *Avicula spec.*; RAVN, p. 81, Pl. 1, Figs 4—5.
p. p. 1922. *Inoceramus tegulatus* v. HAGENOW; ODUM, pp. 1—13, Figs 1—3, 7.
p. p. (1938) *Inoceramus tegulatus* HAG.; POŻARYSKI, p. 21.
(1942) *Inoceramus tegulatus* HAG.; PUTZER, p. 370.
(1951) *Inoceramus tegulatus* HAG.; POŻARYSKA & POŻARYSKI, p. 21.
1959. *Inoceramus tegulatus* v. HAGENOW; DOBROV & PAVLOVA, p. 150, Pl. 23, Figs 1—4.
(1960) *Inoceramus tegulatus*; HAG.; CIEŚLIŃSKI, p. 434.
1961. *"Inoceramus tegulatus"*; ODUM; SEITZ, p. 124.
1965. *Inoceramus dobrovi* n. sp.; JELETZKY & CLEMENS, pp. 955—956.
1969. *Tenuipteria argenteus* (CONRAD); COX, p. N310, Figs C42—5a, b.
1969. *Spyridoceramus tegulatus* v. HAGENOW; COX, p. N320, Figs C48—3a, b.
1970a. *Tenuipteria dobrovi* (JELETZKY); SPEDEN, p. 34, Pl. 2, Figs 4—6.
1970a. *Tenuipteria argentea* (CONRAD); SPEDEN, p. 33, Pl. 2, Fig. 7; Pl. 3, Figs 1—6.
p. p. 1979. *Tenuipteria geulemensis* (F. VOGEL); DHONDT, p. 142, Pl. 1, Figs 1—3, 5—6 (*non* Fig. 4).
p. p. 1982. *Tenuipteria geulemensis* (F. VOGEL); DHONDT, p. 77, Pl. 1, Figs 9, 10, 11 (*non* Figs 3, 4, 5, 7, 8).
1983a. *Tenuipteria argentea* (CONRAD); DHONDT, p. 47, Text-fig. 3.
1983b. *Tenuipteria argentea* (CONRAD); DHONDT, p. 697.
1984. *Inoceramus tegulatus* HAGENOW; CIEŚLIŃSKI & BŁASZKIEWICZ, p. 367, Pl. 161, Fig. 4.

MATERIAL: 6 from Kazimierz, 2 from Bochotnica, 58 from Nasiłów (55 opoka, 3 hardground);
Samples from boreholes Garwolin (I. G. — No. 633 II. 14, 16, 36), and Łowicz (I. G. — No. 432 II. 35) in the Polish Lowland.

MEASUREMENTS: All the measured specimens are from Nasiłów.

L	varies	from	15.9	to	48.5;	av.	33.0.	n = 26
HL	„	„	17.0	„	57,8;	„	40.15	n = 17
HR	„	„	16.35	„	41.4;	„	28.22	n = 10
HL/L	„	„	0.77	„	1.56;	„	1.16.	n = 16
HR/L	„	„	0.82	„	1.19;	„	1.00,	n = 9

where HL — height of LV, HR — height of RV.

REMARKS: The studied specimens are of medium to large sized shell, strongly inequivalve, and inequilateral. The left valve is inflated, *Pholadomya*-like (VOGEL 1895), with the elevated, projecting prosogyrous umbo. The right valve is almost flat, *Avicula*-like, with a small rounded umbo, slightly projecting above the dorsal margin. In both valves the posterior part is compressed, flattened, wing-like, and the small anterior auricles are less distinct. The shell is ornamented with a "tile-like" sculpture, more distinct on the right valve.

The majority of the studied specimens which are well preserved agree with those from the Maastrichtian stratotype (DHONDT 1979), Denmark (RAVN 1902, ØDUM 1922), North Caucasus (DOBROV & PAVLOVA 1959) and the Gulf Coast (STEPHENSON 1955, SPEDEN 1970a).

AGE and DISTRIBUTION: Very widely distributed in the uppermost Maastrichtian of Limburg, Denmark, West Germany(?), Poland, North Caucasus, and the Gulf Coast in North America (*see* DHONDT 1983a,b).

In Poland the species is restricted to the uppermost Maastrichtian (Belemnella kazimiroviensis Zone) of the Middle Vistula Valley and it also recorded in boreholes Garwolin and Łowicz (Polish Lowland).

Superfamily **Pectinacea** RAFINÉSQUE, 1815
Family **Oxytomidae** ICHIKAWA, 1958
Genus *Oxytoma* MEEK, 1864
Type species: *Avicula muensteri* BRONN, 1830; *OD*
Subgenus *Hypoxytoma* ICHIKAWA, 1958
Type species: *Avicula danica* RAVN, 1902; *OD*
Oxytoma (Hypoxytoma) danica (RAVN, 1902)
(Pl. 32, Figs 7—8)

1902. *Avicula danica* n. sp. RAVN, p. 79, Pl. 1, Figs 1—2.
1941. *Avicula danica* RAVN; STOLL, p. 88, Pl. 1, Fig. 24.
(1951) *Avicula danica* RAVN; POŻARYSKA & POŻARYSKI, p. 21.
1954. *Pteria (Oxytoma) danica* RAVN; VOIGET, pp. 621—629, Pl. 17, Figs 1—7; Pl. 18, Fig 1—11.
1958. *Oxytoma (Hypoxytoma) danica* (RAVN); ICHIKAWA, p. 164, Pl. 24, Figs 9—10.
(1960) *Pteria (Oxytoma) danica* RAVN; CIEŚLIŃSKI, p. 434.
1964. *Oxytoma danica danica* (RAVN); PARAMONOVA, 135.
(1965a) *Pteria danica* RAVN; CIEŚLIŃSKI, p. 120.
1982. *Oxytoma (Hypoxytoma) danica* (RAVN); DHONDT, p. 80, Pl. 4, Fig. 3.

MATERIAL: 25 from Męćmierz, 3 from Dobre, 2 from Podgórz, 75 from Kazimierz, 1 from Janowiec, 3 from Nasiłów (opoka).

REMARKS: The majority of the collected specimens are left valves, which were accumulated in patches along the bedding plane, particularly in the Męćmierz marly chalk and in the Kazimierz marly opoka. Right valves are rare.

The species can be easily distinguished from *O. (H.) pectinata* (SOWERBY) from the Lower Cretaceous, *O. (H.) tenuicostata* (ROEMER) from the Campanian of West Germany, and *O. (H.) nebrascana* (EVANS & SHUMARD) from the Maastrichtian of the Fox Hills Formation, U.S.A., by the number and strength of radial ribs of the left valve as well as the smoothness of the umbonal part

of the shell. PARAMONOVA (1964) introduced new subspecies *O. (H.) danica volgensis* from the Lower Maastrichtian of the Russian Platform, and she differentiated it from the nominative subspecies, *O. (H.) danica danica* by the smaller size and smaller number of radial ribs (20—62).

AGE and DISTRIBUTION: Upper part of the Lower Maastrichtian and Upper Maastrichtian of North Germany, Upper Maastrichtian of Denmark, Russian Platform and the Middle Vistula Valley.

Family **Amusiidae** RIDEWOOD, 1903
Subfamily **Entoliinae** VON TEPPNER, 1922
Genus *Entolium* MEEK, 1865
Type species: *Pecten demissus* PHILLIPS, 1829; *OD*
Entolium membranaceum (NILSSON, 1827)
(Pl. 33, Fig. 10)

1827. *Pecten membranaceus* NILSSON, p. 23, Pl. 9, Fig. 16.
1896. *Pecten membranaceus* NILSS.; SIEMIRADZKI, p. 59, Pl. 4, Fig. 5.
(1938) *Pecten membranaceus* NILSS.; POŻARYSKI, p. 23.
(1942) *Pecten membranaceus* NILSS.; PUTZER, p. 371.
(1965a) *Pecten (Syncyclonema) membranaceus* NILSS.; CIEŚLIŃSKI, p. 120.
1968. *Entolium membranaceum* (NILSSON); PASTERNAK, p. 151, Text-fig. 18 and Pl. 30, Figs 11—12.
1971. *Entolium membranaceum* (NILSSON); DHONDT, p. 27, Pl. 1, Fig. 2 (*cum syn.*).
1977. *Entolium membranaceum* (NILSSON); SOBETSKI, p. 37, Pl. 2, Figs 16—17.
1982. *Entolium membranaceum* (NILSSON); SOBETSKI, p. 99, Pl. 6, Fig. 22; Pl. 31, Figs 3—4.
1982. *Entolium membranaceum* (NILSSON); DHONDT, p. 89.

MATERIAL: 1 from Męcmierz, 19 from Kazimierz, 1 from Bochotnica, 6 from Nasiłów (opoka).

REMARKS: The species is characterized by a large suborbicular, thin and smooth shell. Auricles are equal and projecting above the straight hinge margin. The height and length are almost equal. The studied specimens agree in size and main features with those from the Upper Cretaceous of Europe, revised by DHONDT (1971), who also fully discussed the synonymy, stratigraphic range and geographic distribution of this species.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Maastrichtian of Europe. In the Middle Vistula Valley it ranges from the Upper Santonian to the Upper Maastrichtian (POŻARYSKI 1938).

Subfamily **Amussinae THIELE, 1935**
Genus *Propeamussium* de GREGORIO, 1884
Type species: *Pecten ceciliae* de GREGORIO, 1884; *OD*
Subgenus *Parvamussium* SACCO, 1897
Type species: *Pecten duodecimlamellatus* BRONN, 1831; *OD*
Propeamussium (Parvamussium) inversum (NILSSON, 1827)
(Pl. 32, Figs 5—6)

1827. *Pecten inversus* NILSSON, p. 24, Pl. 9, Fig. 18a—c.
1971. *Propeamussium (Parvamussium) inversum* (NILSSON); DHONDT, p. 37 (*cum syn.*).
1977. *Propeamussium (Propeamussium) inversum* (NILSSON); SOBETSKI, p. 78, Pl. 4, Fig. 18.
1982. *Propeamussium inversum* (NILSSON); SOBETSKI, p. 101, Pl. 6, Fig. 24.

MATERIAL: 4 from Upper Campanian opoka (1 from Ciszyca Kolonia, 2 from Ciszyca Górna, 1 from Piotrawin), 2 from Solec, 3 from Dziurków, 1 from Janowiec, 8 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens agree in general features with those revised by DHONDT (1971) from the Upper Cretaceous of Europe. However, numerous and closely spaced concentric lines are noticed in the studied specimens, particularly in the well preserved ones. This concentric ornamentation was not reported by DHONDT (1971). The species *Pecten (Amussium) ignoratus* RAVN, 1918 from the Cretaceous of Greenland is similar to the studied species, but it has smaller auricles and greater H/L ratio. The studied species is closely similar to *Propeamussium samariensis* (CONRAD) from the Upper Cretaceous of Jordan.

The Lower Tertiary (Paleocene) species *Propeamussium (Parvamussium) bisculptum* (VON KOENEN) as figured by GILBERT & VAN DE POEL (1973) resembles the studied species, but it differs in having numerous external radial riblets covering the left valve.

AGE and DISTRIBUTION: Widely distributed in the Turonian — Upper Maastrichtian of Europe.

Family **Pectinidae** RAFINESQUE, 1815
Subfamily **Chlamydinae** VON TAPPNER, 1922
Genus *Syncyclonema* MEEK, 1864
Type species: *Pecten rigida* HALL & MEEK, 1856; *OD*
(non SOWERBY, 1818)
Syncyclonema haeggi DHONDT, 1971
(Pl. 32, Figs 11—12)

1827. *Pecten laevis* NILSSON, p. 24, Pl. 9, Fig. 17.
1971. *Syncyclonema haggi* nom. nov., DHONDT, p. 48, Pl. 2 (*cum syn.*).
1982. *Syncyclonema laeve* (NILSSON); SOBETSKI, p. 101, Pl. 6, Fig. 25.

MATERIAL: 2 from Dziurków, 1 from Podgórz, 12 from Kazimierz, 4 from Nasiłów (2 opoka, 2 hardground).

REMARKS: The studied specimens coincide with those revised by DHONDT (1971), who indicated that the species can be distinguished by the small size, long apical margins and large auricles.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Upper Maastrichtian of the North European Province.

Syncyclonema gamsensis DHONDT, 1971
(Pl 32, Figs 13—14)

1868. *Pecten exilis* REUSS; ZITTEL, p. 109, Pl. 17, Fig. 5a—c.
1895. *Pecten (Pseudamussium) spathulatus* VOGEL, p. 20, Pl. 1, Figs 14—16.
1971. *Syncyclonema gamsensis* nom. nov.; DHONDT, p. 63, Pl. 1, Fig. 3.

MATERIAL: 1 from Podgórz, 1 from Męćmierz, 2 from Kazimierz, 1 from Nasiłów (opoka).

REMARKS: The studied specimens agree with those figured by VOGEL (1895) and DHONDT (1971) from the Maastrichtian stratotype (the Netherlands), but the H/L ratio is slightly higher in the studied specimens.

DHONDT (1971) fully discussed the generic status as well as the synonymy of this species, and she distinguished it form other *Syncyclonema* species by the more convex shell and smaller posterior auricles.

AGE and DISTRIBUTION: Upper Coniacian — Santonian of Austria, Senonian of Sweden, the Maastrichtian stratotype, Upper Maastrichtian of the Middle Vistula Valley.

Syncyyclonema nilsoni (GOLDFUSS, 1835)
(Pl. 32, Figs 9—10)

v. 1835. *Pecten Nilsoni* nobis, GOLDFUSS, p. 76, Pl. 98, Fig. 8a—b.
1912. *Pecten (Syncyclonema) nilssoni* GOLDF.; ŁOPUSKI, p. 196, Pl. 2, Fig. 15.
1932. *Pecten (Syncyclonema) nilssoni* GOLDFUSS; WOLANSKY, p. 17, Pl. 2, Figs 9—11.
(1938) *Pecten Nilssoni* GOLDF.; POŻARYSKI, p. 23.
(1951) *Pecten nilssoni* GOLDF.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 7, Fig. 13.
(1965a) *Pecten (Syncyclonema) nilssoni* GOLDF.; CIEŚLIŃSKI, p. 120.
1965b. *Pecten (Syncyclonema) nilssoni* GOLDFUSS; CIEŚLIŃSKI, p. 16.
1968. *Chlamys (Comptonectes?) nilssoni* (GOLDFUSS); PASTERNAK, p. 167, Text-fig. 31 and Pl. 35, Figs 1—2.
1971. *Syncyclonema nilsoni* (GOLDFUSS); DHONDT, p. 54, Pl. 4 (*cum. syn.*)
1981. *Syncyclonema nilssoni* (GOLDFUSS); TZANKOV, p. 100, Pl. 44, Fig. 4
1982. *Syncyclonema nilssoni* (GOLDFUSS); SOBETSKI, p. 102, Pl. 6, Fig. 26.
1982. *Syncyclonema nilssoni* (GOLDFUSS); NESTLER, p. 46, Fig. 74.

MATERIAL: 2 from Dobre, 25 from Kazimierz, 1 from Bochotnica, 14 from Nasiłów (opoka).

REMARKS: The studied specimens are identified with those described by WOLANSKY (1932) from the Lower Maastrichtian "Schreibkreide" of the Isle of Rügen. They are slightly different from the topotypes from Maastricht in the almost straight apical margins, the higher H/L ratio, and the smaller size. These differences have been noticed by DHONDT (1971) between the topotypes and the Rügen specimens, and she concluded that this difference might be due to environmental factors. On the other hand, PASTERNAK (1968) also noticed this difference and erroneously identified WOLANSKY's figures and *"Pecten" membranaceus* Roemer, 1870 (= *Syncyclonema haeggi* DHONDT) as *Pseudamussium* sp.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Upper Maastrichtian of Europe.

Genus *Camptonectes* AGASSIZ *in* MEEK, 1864
Type species: *Pecten lens* SOWERBY, 1818; *OD*
Subgenus *Camptonectes* AGASSIZ *in* MEEK, 1864
Camptonectes (Camptonectes) virgatus (NILSSON, 1827)
(Pl. 32, Fig. 16)

1827. *Pecten virgatus* n., NILSSON, p. 22, Pl. 9, Fig. 15.
(1938) *Pecten virgatus* NILSS.; POŻARSKI, p. 22.
1968. *Chlamys (Camptonectes) virgata* (NILSSON); PASTERNAK, p. 167, Pl. 35, Figs 6—8.
1972a. *Comptonectes (Camptonectes) virgatus* (S. NILSSON); DHONDT, p. 18, Pl. 2, Fig. 1 (*cum syn.*).
1977. *Camptonectes virgatus* (NILSSON); SOBETSKI, p. 65, Pl. 4, Fig. 16.
1981. *Camptonectes (Camptonectes) virgatus* (NILSSON); TZANKOV, p. 101, Pl. 45, Fig. 1.
1983. *Camptonectes virgatus* (NILSSON); DHONDT, p. 80.

MATERIAL: 4 from Kazimierz, 4 from Nasiłów (opoka).

REMARKS: The studied specimens are identical with those from the Upper Cretaceous of Europe revised by DHONDT (1972a), who precisely discussed the generic status, stratigraphic range and geographic distribution of this species. POŻARYSKI (1938) recorded this species in the Lower Maastrichtian of the study area.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Upper Maastrichtian of Europe, Southern India, North Africa (Tunisia) and South Africa.

Genus *Lyropecten* CONRAD, 1863
Type species: *Pallium estrellatum* CONRAD, 1856; *SD* DALL, 1898
Subgenus *Aequipecten* FOSCHER, 1887
Type species: *Ostrea opercularis* LINNAEUS, 1758; *OD*
Lyropecten (Aequipecten) acuteplicatus (ALTH, 1850)
(Pl. 33, Figs 1—3)

1837. *Pecten asper* var. *polonica* PUSCH, p. 41, Pl. 5, Fig. 7a—b (*nomen oblitum*).
1850. *Pecten acute-plicatus* m., ALTH, p. 248, Pl. 12, Fig. 34.
1912. *Pecten (Aequipecten) acuteplicatus* ALTH; ŁOPUSKI, p. 181, Pl. 2, Figs 2—4.
(1938) *Pecten acuteplicatus* ALTH; POŻARYSKI, p. 22.
(1942) *Aequipecten acuteplicatus* ALTH; PUTZER, p. 371.
(1951) *Pecten acuteplicatus* ALTH; POŻARYSKA & POŻARYSKI, p. 21, Pl. 7, Fig. 11.
(1965a) *Pecten (Aequipecten) acuteplicatus* ALTH; CIEŚLIŃSKI, p. 120.
1968. *Chlamys (Aequipecten)? acuteplicata* (ALTH); PASTERNAK, p. 165, Pl. 34, Figs 16—19.
1972b. *Lyropecten (Aequipecten) acuteplicatus* (ALTH); DHONDT, p. 25, Pl. 1, Figs 3a—b; Pl. 2, Figs 1a—b (*cum syn.*).
1974. *Chlamys acuteplicatus* (ALTH); SAVCZINSKAJA, p. 91, Pl. 29, Figs 11—13.
1977. *Chlamys (Microchlamys) acuteplicata* (ALTH); SOBETSKI, p. 64, Pl. 4, Figs 14—15.
1982. *Lyropecten (Aequipecten) acuteplicatus* (ALTH); DHORNT, p. 80.

MATERIAL: More than 600 separate valves from Kazimierz and Janowiec, and the majority from Nasiłów and Bochotnica.

REMARKS: The studied specimens are identical with those from the Lvov region figured by ALTH (1850) and others, and with those revised by DHONDT (1972b) from the Upper Maastrichtian of Northern European Province. In the studied material, especially in the best preserved valves, the *Camptonectes*-like fine striation is recorded on the inter-rib areas, particularly along the apical margins, which does not continue to the auricles as in *L. (A.) pulchellus* (NILSSON).

DHONDT (1972b) fully discussed the synonymy and geographic distribution of this species, and she indicated that *Pecten obrutus* CONRAD and *P. farafrensis* ZITTEL from the Maastrichtian of Jordan and Egypt, respectively, are undoubtedly synonyms of the studied species (*see also* ŁOPUSKI 1912).

AGE and DISTRIBUTION: Very widely distributed in the Maastrichtian of the North European Province, Crimea, and the Middle East (Syria, Jordan, Palestine, and Egypt).

Lyropecten (Aequipecten) pulchellus (NILSSON, 1827)
(Pl. 33, Figs 8—9)

1827. *Pecten pulchellus* NILSSON, p. 22, Pl. 9, Fig. 12.
1902. *Pecten (Aequipecten) pulchellus* NILSSON; WOODS, p. 194, Pl. 37, Figs 12—15.
1912. *Pecten (Aequipecten) pulchellus* NILSSON; ŁOPUSKI, p. 191, Pl. 2, Fig. 14.
1968. *Chlamys (Aequipecten) pulchella* (NILSSON); PASTERNAK, p. 166, Pl. 34, Figs 12—15.
v. 1972b. *Lyropecten (Aequipecten) pulchellus* (NILSSON); DHONDT, p. 16, Pl. 1, Fig. 2 (*cum syn.*).
1974. *Chlamys pulchellus* (NILSSON); SAVCZINSKAJA, p. 91, Pl. 26, Figs 14—16.
1977. *Chlamys (Microchlamys) pulchella* (NILSSON); SOBETSKI, p. 57, Pl. 4, Fig. 9.
1982. *Lyropecten (Aequipecten) pulchellus* (NILSSON); DHONDT, p. 82, Pl. 3, Figs 8—9.
1982. *Chlamys (Microchlamys) pulchella* (NILSSON); SOBETSKI, p. 110, Pl. 11, Figs 13—14.

MATERIAL: 2 from Dobre, 6 from Męćmierz, 8 from Kazimierz, 5 from Nasiłów (3 opoka, 2 greensand).

REMARKS: The measurements and ornamentation of the studied specimens agree with those revised by DHONDT (1972b) from the Upper Cretaceous of Europe. DHONDT (1982) mentioned that this species occurs more frequently in the Maastrichtian calcarenite facies than in white chalk where it is often replaced

by *L. (A.) acuteplicatus* (ALTH). The scarcity of this species and the abundance of *L. (A.) acuteplicatus* (ALTH) in the uppermost Maastrichtian deposits of the study area, confirm DHONDT's opinion.

AGE and DISTRIBUTION: Very widely distributed in the Coniacian — Maastrichtian of the North European Province and Crimea.

Lyropecten (Aequipecten) campaniensis (d'ORBIGNY, 1847)
(Pl. 33, Figs 6—7)

1847. *Pecten campaniensis* d'ORBIGNY, p. 620, Pl. 440, Figs 12—16.
1902. *Pecten (Aequipecten) campaniensis* d'ORBIGNY; WOODS, p. 192, Pl. 37, Figs 4—8.
(1938) *Pecten campaniensis* d'ORB.; POŻARYSKI, p. 23.
1968. *Chlamys (Aequipecten) campaniensis* (ORBIGNY); PASTERNAK, p. 161, Pl. 34, Fig. 2.
1972b. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); DHONDT, p. 9, Pl. 1, Figs 1a—c (*cum syn.*).
1974. *Chlamys campaniensis* (ORBIGNY); SAVCZINSKAJA, p. 90, Pl. 26, Figs 8—10.
1982. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); DHONDT, p. 81, Pl. 3, Figs 4—7.
1983. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); NESTLER, p. 46, Fig. 78.

MATERIAL: 7 from Piotrawin (uppermost Campanian), 1 from Dziurków, 2 from Kłudzie, 4 from Męćmierz, 1 from Kazimierz, 4 from Nasiłów (opoka).

REMARKS: The species is characterized by relatively large number of divided radial ribs crossed by slightly elevated concentric striae which form the trellis macrosculpture. DHONDT (1972b) discussed the synonymy as well as the variability of this species, particularly in the number of radial ribs.

The species is relatively less common in the Maastrichtian deposits of the study area, however, it is represented in most of the studied sections. POŻARYSKI (1938) recorded its range as the Lower Campanian — Lower Maastrichtian of the study area.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Upper Maastrichtian of the North European Province.

Lyropecten (Aequipecten) wisniowskii (PASTERNAK, 1962)
(Pl. 32, Figs 1—2)

1968. *Chlamys (Aequipecten) wisniowskii* PASTERNAK; PASTERNAK, p. 163, Pl. 34, Figs 9—11.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 3 from Kłudzie.

REMARKS: The studied specimens are identified with those figured by PASTERNAK (1968) from the Upper Campanian — Lower Maastrichtian opoka of the Lvov region. PASTERNAK (1968) differentiated this species from *L. (A.) campaniensis* (d'ORBIGNY) by its smaller size and by the reticulate ornamentation (*see* PASTERNAK 1968, Text-fig. 30).

AGE and DISTRIBUTION: Upper Campanian — Lower Maastrichtian of the Lvov region and the Middle Vistula Valley.

Genus *Chlamys* RÖDING, 1798
Type species: *Pecten islandicus* MÜLLER, 1776; *SD* HERRMANNSEN, 1847
Subgenus *Lyriochlamys* SOBETSKI, 1977
Type species: *Pecten fissicosta* ETHERIDGE, 1881

Chlamys (Lyriochlamys) septemplicata (NILSSON, 1827) (Pl. 33, Figs 4—5)

1827. *Pecten septemplicatus* NILSSON, p. 20, Pl. 10, Fig. 8.
1886. *Pecten dujardini* REUSS; SIEMIRADZKI, pp. 59—60, Pl. 5, Fig. 1.
1912. *Pecten (Aequipecten) Dujardini* ROMMER var. *vesiculosa*; ŁOPUSKI, p. 191, Pl. 2, Fig. 9.
? (1936) *Pecten dujardini* ROEM.; POŻARYSKI, p. 22.
? (1942) *Aequipecten dujardini* ROEM.; PUTZER, p. 371.
? (1951) *Pecten dujardini* ROEM.; POŻARYSKA & POŻARYSKI, p. 21.
1968. *Chlamys (Chlamys) septemplicata* (NILSSON); PASTERNAK, p. 157, Pl. 33, Fig. 6.
1972b. *Lyropecten? septemplicatus* (NILSSON); DHONDT, p. 59, Pl. 3, Fig. 3.
1977. *Chlamys (Lyriochlamys) septemplicata* (NILSSON); SOBETSKI, p. 53, Pl. 4, Fig. 3.
1981. *Chlamys (Chlamys) septemplicatus* (NILSSON); TZANKOV, p. 102, Pl. 45, Figs 2—4.

MATERIAL: 2 from Bochotnica, 30 from Kazimierz, 28 from Nasiłów (opoka).

REMARKS: Most of the studied specimens are fragments of separate valves. They are of large-sized shells, ornamented with 8—10 radial costae with rounded tops and separated by moderately deep intercostal furrows. Both the costae and intercostal furrows are covered with secondary scaly radial ribs.

The studied specimens agree with those from the Maastrichtian of the Lvov region and Bulgaria as figured by PASTERNAK (1968) and TZANKOV (1981), respectively. They are slightly different from those described by DHONDT (1972b) from the Maastrichtian stratotype in having a greater number of costae, narrow intercostal areas and the presence of concentric ornamentation on the auricles.

ŁOPUSKI (1912) determined such specimens from the Middle Vistula Valley as *Pecten dujardini* ROEMER var. *vesiculosa*. The herein indicated species can be distinguished from *Pecten ternatus* GOLDFUSS (= *Pecten dujardini* ROEMER) by the well rounded and undivided costae.

AGE and DISTRIBUTION: Very widely distributed in the Senonian of Europe.

Genus *Mimachlamys* IREDALE, 1929
Type species: *Pecten asperrimus* LAMARCK, 1819; *OD*
Mimachlamys cretosa cretosa (DEFRANCE *in* A. BRONGNIART, 1822) (Pl. 34, Figs 1—2)

1847. *Pecten cretosus* DEFRANCE; d'ORBIGNY, p. 617, Pl. 440, Figs 1—7.
1902. *Pecten (Chlamys) cretosus* DEFRANCE; WOODS, p. 174, Pl. 32, Figs 4—6; Pl. 33, Figs 1—12.
1912. *Pecten (Chlamys) cretosus* DEF.; ŁOPUSKI, p. 192, Pl. 2, Figs 5—6.
(1936) *Pecten cretosus* DEF.; POŻARYSKI, p. 22.
(1942) *Aequipecten cretosus* DEF.; PUTZER, p. 371.
1973a. *Mimachlamys cretosa* (DEFRANCE); DHONDT, p. 77, Pl. 8, Fig. 1; Pl. 7, Fig. 1 (*cum syn.*).
1974. *Chlamys cretosa* (DEFRANCE); SAVCZINSKAJA, p. 90, Pl. 26, Figs 5—6.
1977. *Chlamys (Chlamys) cretosa* (DEFRANCE); SOBETSKI, p. 44, Pl. 3, Fig. 6.
1981. *Chlamys (Chlamys) cretosa* (DEFRANCE); TZANKOV, p. 103, Pl. 45, Fig. 6.
1982. *Chlamys (Chlamys) cretosa* (DEFRANCE); SOBETSKI, p. 104, Pl. 11, Figs 1—3; Pl. 31, Fig. 6.

MATERIALS: 5 from Piotrawin (uppermost Campanian), 3 from Dziurków, 2 from Kłudzie, 1 from Dobre, 1 from Podgórz, 1 from Męćmierz, 8 from Kazimierz, 1 from Bochotnica, 5 from Nasiłów (opoka).

REMARKS: Most of the studied specimens are fragments. However, they agree with those given by DHONDT (1973a) from different European localities. DHONDT (1973a) accepted the genus *Mimachlamys* IREDALE for this species instead of *Chlamys* RÖDING due to the absence of a thimble-microsculpture which characterizes the latter genus.

POŻARYSKI (1938) reported the species *M. cretosa* in the Middle Vistula Valley from the Upper Santonian to the uppermost Maastrichtian.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Upper Maastrichtian of Europe.

Mimachlamys cretosa denticulata (v. HAGENOW, 1842)
(Pl. 34, Figs 3—6)

1842. *Pecten denticulatus* nob., v. HAGENOW, p. 519 (22).
1932. *Pecten (Chlamys) denticulatus* v. HAGENOW; WOLANSKY, p. 16, Pl. 2, Figs 23—25.
1973a. *Mimachlamys cretosa* subspecies *denticulata* (VON HAGENOW); DHONDT, p. 93, Pl. 8, Figs 1a—c.
1982. *Mimachlamys cretosa* subspecies *denticulata* (VON HAGENOW); DHONDT, p. 83, Pl. 3, Figs 1—3.

MATERIAL: 10 from Kazimierz, 2 from Bochotnica, 7 from Nasiłów (8 opoka, 1 greensand).

REMARKS: The studied specimens are identified with those described by WOLANSKY (1932) and DHONDT (1973a, 1982). DHONDT (1973a) concluded that *Pecten denticulatus* v. HAGENOW is undoubtedly conspecific with *M. cretosa* (DEFRANCE), and the only difference is that the specimens of *M. cretosa cretosa* have a higher number of ribs usually almost smooth.

AGE and DISTRIBUTION: Maastrichtian of the Isle of Rügen and Hemmoor, and uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Merklinia* SOBETSKI, 1960
Type species: *Pecten asper* LAMARCK, 1819; *OD*
Merklinia variabilis (v. HAGENOW, 1842)
(Pl. 32, Fig. 15)

1842. *Pecten variabilis* nob., v. HAGENOW, p. 552 (25).
1912. *Pecten (Chlamys) trisulcus* v. HAGENOW; ŁOPUSKI, p. 194, Pl. 2, Figs 10—11.
1912. *Pecten trisulcus* var. *plicata* mihi; ŁOPUSKI, p. 195, Pl. 2, Figs 12—13.
(1938) *Pecten trisulcus v.* HAG.; POŻARYSKI, p. 22.
(1942) *Aequipecten trisulcus* v. HAG.; PUTZER, p 371
(1951) *Pecten trisulcus* HAG,; POŻARYSKA & POŻARYSKI, p. 21.
(1965a) *Pecten (Chlamys) trisulcatus* HAG.; CIEŚLIŃSKI, p. 120.
1975. *Merklinia variabilis* (VON HAGENOW); DHONDT, pp. 18—27, Pl. 1, Fig. 2; Pl. 2, Figs 1a—b (*cum syn.*).
1982. *Merklinia variabilis* (VON HAGENOW); DHONDT, p. 84, Pl. 2, Fig. 12.

MATERIAL: 4 from Męćmierz. 13 from Kazimierz, 75 from Nasiłów (70 opoka, 5 hardground).

REMARKS: The studied specimens are identical with those revised by DHONDT (1975) from the Upper Cretaceous of the North European Province. DHONDT (1975) fully discussed the synonymy of this species and concluded that *Pecten leonhardi, P. variabilis,* and *P. trisulcus* of v. HAGENOW (1842) are conspecific, and *P. variabilis* has priority over the formely used name of *P. trisulcus.*

The species *Merklinia triformis* (SOBETSKI, 1977) from the Upper Senonian of Crimea is closely similar to the studied species, and probably related.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Upper Maastrichtian of the North European Province.

Genus *Neithea* DROUET, 1824
Type species: *Pecten aequicostatus* LAMARCK, 1819;
SD CHENU, 1862

Subgenus *Neithea* DROUET, 1824
Neithea (Neithea) sexcostata (WOODWARD, 1833)
(Pl. 32, Figs 3—4)

1903. *Pecten (Neithea) sexcostatus* WOODWARD; WOODS, p. 214, Pl. 40, Figs 10—15; Pl. 41, Figs 1—10.
(1938) *Vola sexcostata* WOODW.; POŻARYSKI, p. 22.
1962. *Neithea sexcostata* (WOODWARD); ABBASS, p. 53, Pl. 4, Figs 12—13, 15.
1973b. *Neithea (Neithea) sexcostata* (WOODWARD); DHONDT, p. 44, Pl. 5, Figs 2a—b (*cum syn.*).
1974. *Neithea sexcostata* (WOODWARD); SAVCZINSKAJA, p. 61, Pl. 20, Figs 4—6.
1977. *Neithea (Neitheops) sexcostata* (WOODWARD); SOBETSKI, p. 71, Pl. 5, Figs 4—5.
1981. *Neithea (Neithea) sexcostata* (WOODWARD); TZANKOV, p. 100, Pl. 49, Figs 1, 1a.
1982. *Neithea sexcostata* (WOODWARD); NESTLER, p. 49, Figs 68a—c.
1982. *Neithea sexcostata* (WOODWARD); DHONDT, p. 85, Pl. 2, Figs 7—11.

MATERIAL: 1 from Dziurków, 1 from Męćmierz, 2 from Kazimierz, 42 from Nasiłów (40 opoka, 2 hardground).

REMARKS: The studied specimens coincide with those revised by DHONDT (1973b). The species *Neithea striatocostata* (GOLDFUSS) is the only species which makes confusion with this species, because in the both species the ribs are radially striated. DHONDT (1973b) mentioned that *N. sexcostata* differs from GOLDFUSS' species in having more salient and sharp principal ribs, higher number of intercalaries, the areas inwardly bent, and the H/L ratio higher than one, especially in small specimens.

The species has been recorded by POŻARYSKI (1938) in the Lower Campanian deposits of the study area.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — uppermost Maastrichtian of the North European Province, and Crimea, Cenomanian of Texas, Turonian of Algeria, and Senonian of Egypt.

Family **Spondylidae** GRAY, 1826
Genus *Spondylus* LINNAEUS, 1758
Type species: *Spondylus gaederopus* LINNAEUS, 1758; *SD* SCHMIDT, 1818

DISCUSSION: SOBETSKI (1977) accepted the genus *Dianchora* J. SOWERBY, 1815, for the Late Cretaceous spondylids, such as *Spondylus dutempleanus* d'ORBIGNY, *S. truncatus* (LAMARCK), *S. latus* (SOWERBY), and *S. serratus* WOODS; he grouped them in the new family Dianchoridae which is differentiated from the Spondylidae GRAY by the absence of dentition, large auricles, a large cardinal area, and by the shells strongly inequivalved. However, SOBETSKI's opinion is not accepted in the present study, because according to CARTER (1972) the spondylids have calcitic external shell layers and aragonitic internal layers (*see also* TAYLOR & *al.* 1969). All specimens collected in the chalk (also opoka) are preserved only without aragonitic layers, and hence without dentition.

Spondylus dutempleanus d'ORBIGNY, 1847
(Pl. 35, Figs 1—3)

1847. *Spondylus Deutempleanus* d'ORBIGNY, p. 672, Pl. 460, Figs 6—11.
1901. *Spondylus Deutempleanus* d'ORBIGNY; WOODS, p. 125, Pl. 22, Figs 11—14; Pl. 23, Figs 1—5.
1912. *Spondylus Dutempleanus* d'ORBIGNY; ŁOPUSKI, p. 203, Pl. 2, Fig. 16; Pl. 3, Figs 1—3.
(1938) *Spondylus dutempleanus* d'ORB.; POŻARYSKI, p. 21.
(1942) *Spondylus dutempleanus* d'ORB.; PUTZER, p. 371.
(1951) *Spondylus dutemplei* d'ORB.; POŻARYSKA & POŻARYSKI, p. 21.

1962. *Spondylus dutempleanus* D'ORBIGNY; ABBASS, p. 37, Pl. 4, Figs 18—23.
1968. *Spondylus dutempleanus* ORBIGNY; PASTERNAK, p. 189, Pl. 38, Figs 12—14.
1974. *Spondylus dutempleanus* ORBIGNY; SAVCZINSKAJA, p. 94, Pl. 28, Figs 4—5.
1977. *Dianchora dutempleana* (ORBIGNY); SOBETSKI, p. 84, Pl. 5, Fig. 13.
1981. *Spondylus (Spondylus) dutempleanus* d'ORBIGNY; TZAKOV, p. 112, Pl. 50, Fig. 8.
1982. *Spondylus dutempleanus* d'ORBIGNY; DHONDT, p. 85, Pl. 2, Figs 1—4; Pl. 4, Fig. 5.
1982. *Dianchora dutempleana* (ORBIGNY); SOBETSKI, p. 121, Pl. 12, Fig. 4; Pl. 31, Fig. 7.

MATERIAL: 6 from Piotrawin (uppermost Campanian), 2 from Kłudzie, 1 from Dziurków, 4 from Męćmierz, 64 from Kazimierz, 1 from Bochotnica, 28 from Nasiłów (22 opoka, 6 hardground); and 5 from Chełm (Lublin Upland).

REMARKS: The species is considered as a predominant spondylid species in the Maastrichtian deposits of the Middle Vistula Valley. The majority of the collected specimens are fragments of shells or internal molds.

This species has been reported by POŻARYSKI (1938) from the Upper Campanian — Maastrichtian opoka of the study area.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Upper Maastrichtian of Europe and Central Asia, and in the Campanian (ABBASS 1962) of Egypt.

Spondylus truncatus (LAMARCK, 1819)
(Pl. 35, Figs 4—5)

1827. *Podopsia truncata* LAM.; NILSSON, p. 27, Pl. 3, Fig. 20.
v. 1832. *Spondylus truncatus* nobis, GOLDFUSS, p. 97, Pl. 106, Fig. 4.
1847. *Spondylus truncatus* LAMARCK; d'ORBIGNY, p. 668, Pl. 499, Figs 1—6.
1898. *Spondylus truncatus* LAMARCK; G. MÜLLER, p. 19 ,Text-fig. 5.
(1911) *Spondylus truncatus* d'ORB.; ROGALA, p. 493.
1912. *Spondylus truncatus* LAM. sp.; ŁOPUSKI, p. 205, Pl. 3, Fig. 12.
1977. *Dianchora truncata* (LAMARCK); SOBETSKI, p. 85, Pl. 6, Figs 1—2.
1981. *Spondylus truncatus* GOLDFUSS; TZANKOV, p. 112, Pl. 50, Figs 6—7.
1982. *Dianchora truncata* (LAMARCK); SOBETSKI, p. 121, Pl. 12, Fig. 5; Pl. 31, Fig. 8.

MATERIAL: 2 from Dziurków, 3 from Dobre, 2 from Męćmierz, 25 from Kazimierz, 29 from Nasiłów (opoka).

REMARKS: The studied specimens coincide with those described by GOLDFUSS (1832) and d'ORBIGNY (1847).

In the Maastrichtian deposits of the study area the species was reported only by ŁOPUSKI (1912).

AGE and DISTRIBUTION: Upper Senonian of France, Sweden, West Germany, the Lvov region, Crimea and the peri-Caspian basin; Maastrichtian of Bulgaria and of the Middle Vistula Valley.

Spondylus serratus WOODS, 1902
(Pl. 35, Fig. 6)

1902. *Spondylus serratus* sp. n., WOODS, p. 124, Pl. 21, Figs 6—7.
1912. *Spondylus serratus* WOODS; ŁOPUSKI, p. 206, Pl. 3, Figs 4—7.
1982. *Dianchora serrata* (WOODS); SOBETSKI, p. 120, Pl. 12, Fig. 3.

MATERIAL: 1 from Kazimierz, 14 from Nasiłów (13 opoka, 1 hardground).

REMARKS: The studied specimens coincide with those described by WOODS (1902) from the Upper Chalk of England. However, the studied specimens bear slightly longer spines. In the Maastrichtian deposits of the study area the species was reported only by ŁOPUSKI (1912).

AGE and DISTRIBUTION: Upper Senonian of England, Upper Santonian of the peri-Caspian basin, Upper Maastrichtian of the Middle Vistula Valley.

Family **Terquemiidae** COX, 1964
Genus *Placunopsis* MORRIS & LYCETT, 1853
Type species: *Placunopsis fibrosa* LANBE, 1867
Placunopsis granulosa (ROEMER, 1841)
(Pl. 36, Figs 4—7)

1841. *Anomia granulosa* N., ROEMER, p. 49, Pl. 8, Fig. 4.
1889. *Placunopsis undulatus* J. MÜLLER; HOLZAPFEL, p. 246, Pl. 26, Figs 21—25.
1902. *Placunopsis undulatus* MÜLLER; RAVN, p. 111, Pl. 2, Fig. 26.
1932. *Placunopsis granulosa* A. ROEMER; WOLANSKY, p. 25, Pl. 3, Figs 10—12.
(1968) *Placunopsis undulata* MÜLL.; POŻARYSKI, p. 21.

MATERIAL: 1 from Kłudzie, 1 from Dobre, 21 from Kazimierz, 1 from Janowiec, 13 from Nasiłów (opoka).

REMARKS: This species is common in marly opoka of the Belemnella kazimiroviensis Zone, where it occurs attached by almost the entire surface of the right valve. The shape is strongly variable, and the ornamentation is composed mainly of numerous and closely spaced fine granulated radial riblets. The studied specimens agree with those described by WOLANSKY (1932) from Isle of Rügen. WOLANSKY (1932) first considered *P. undulata* (J. MÜLLER, 1851) as a junior synonym of the studied species.

AGE and DISTRIBUTION: Campanian of the Netherlands, Lower Maastrichtian of East Germany, Maastrichtian of Denmark and the Middle Vistula Valley.

Family **Plicatulidae** WATSON, 1930
Genus *Atreta* ÉTALLON, 1862
Type species: *Ostrea blandina* d'ORBIGNY, 1850; *SD* COX, 1964
Atreta nilssoni (v. HAGENOW, 1842)
(Pl. 36, Figs 1—3)

1842. *Ostrea Nilssonii* nob., v. HAGENOW, p. 548 (19).
1891. *Dimyodon Nilssoni* v. HAG. sp.; J. BÖHM, p. 89, Pl. 4, Fig. 7.
1895. *Cyclostreon nilssoni* HAG.; VOGEL, p. 14, Pl. 1, Figs 4—7.
1901. *Plicatula sigillina* WOODWARD; WOODS, p. 143, Pl. 26, Figs 19—22.
1902. *Dimyodon Nilssoni* v. HAGENOW sp.; RAVN, p. 109.
1902. *Dimyodon Nilssoni* HAGENOW sp.; WOLLEMANN, p. 53.
1909. *Dimyodon Nilssoni* HAG. sp.; ROGALA, p. 692.
(1911) *Dimyodon Nilssoni* HAG.; ROGALA, p. 493.
1932. *Dimyodon nilssoni* v. HAGENOW; WOLANSKY, p. 24, Pl. 3, Fig. 22.
p. p. 1965. *Dimyodon nilssoni* v. HAGENOW; PUGACZEWSKA, p. 89, Pl. 12, Figs 2—3 (*non* Fig. 4).
1965a. *Dimyodon nilssoni* (v. HAGENOW); NESTLER, pp. 67—69, Pl. 1, Fig. 7; Pl. 3, Figs 1—10.
1972. *Atreta nilssoni* (HAGENOW); CARTER, p. 332, Pl. 1, Fig. 11.
1982. *Dimyodon nilssoni* (v. HAGENOW); NESTLER, p. 46, Fig. 67.
1982. *Dimyodon nilssoni* (v. HAGENOW); DHONDT, p. 87, Pl. 2, Fig. 10.
1985. *Atreta nilssoni* (v. HAGENOW); SKELTON, p. 91, Pl. 6. 4. 33.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Dziurków, 7 from Kazimierz, 5 from Nasiłów (2 opoka, 3 greensand).

REMARKS: The studied specimens coincide in shape and size with those from the Maastrichtian stratotype, the Isle of Rügen, Hemmoor, English Chalk, as figured by VOGEL (1895), WOLANSKY (1932), DHONDT (1982), and WOODS (1905), respectively. All the collected specimens are right valves attached to the belemnite guards, oysters, echinoids, baculites, pectinids and other shells.

The confusion in identification of this species with small juvenile oysters was discussed by WOODS (1905) and NESTLER (1965a).

The genus *Atreta* ÉTALLON resembles *Dimyodon* MUNIER-CHALMAS in having crenulated rim and the hinge structure, but the latter has two adductor scars whilst *Atreta* has one obscure scar (COX 1964). TASHIRO (1978) described *Atreta intulaevis* as the new species from the lower Santonian of Lower Himenoura Subgroup, Japan, and he recognized one adductor scar on the right valve which recommended the position of *Atreta* under the Plicatulidae.

AGE and DISTRIBUTION: Albian — Senonian of England, Upper Senonian of West Germany, Lower Maastrichtian of East Germany, Upper Campanian — uppermost Maastrichtian of the Lvov region and of the Middle Vistula Valley.

Superfamily **Limacea** RAFINÉSQUE, 1815
Family **Limidae** RAFINÉSQUE, 1815
Genus *Limatula* WOODS, 1839
Type species: *Pecten subauriculatus* MONTAGU, 1808; *SD* GRAY, 1847
Limatula kunradensis MARQUET, 1982
(Pl. 36, Fig. 10)

1982. *Limatula kunradensis* n. sp., MARQUET, pp. 13—16, Pl. 1, Figs 1a—d.
1982. *Limatula kunradensis* MARQUET; DHONDT, p. 90.

MATERIAL: 9 from Piotrawin (uppermost Campanian), 1 from Dziurków, 2 from Kłudzie, 11 from Kazimierz, 49 from Nasiłów (42 opoka, 7 hardground).

REMARKS: The majority of the studied specimens are internal molds with incomplete shell fragments. However, their identification is based mainly on the ornamentation which is identical with that described by MARQUET (1982).

AGE and DISTRIBUTION: Upper Campanian — Maastrichtian of Belgium, the Netherlands, West Germany, and the Middle Vistula Valley.

Limatula ovata (NILSSON, 1827)
(Pl. 36, Fig. 11)

1827. *Plagiostoma ovatum* NILSSON, p. 25, Pl. 9, Fig. 2.
1897. *Lima ovata* NILSSON; HENNIG, p. 47, Pl. 2, Fig. 12.

MATERIAL: 5 from Kazimierz, 9 from Nasiłów (8 opoka, 1 hardground).

REMARKS: The species is characterized by longitudinally striated radial ribs. The ribs and striae are tuberculated at points of intersection with growth lines. The majority of the studied specimens are incomplete shells; however, they possess a diagnostic ornamentation identified with that of *Limatula ovata* (NILSSON).

AGE and DISTRIBUTION: Upper Campanian of Sweden, and uppermost Mastrichtian of the Middle Vistula Valley.

Genus *Limea* BRONN, 1831
Type species: *Ostrea strigilata* BROCCHI, 1814; *M*
Subgenus *Limea* BRONN, 1831
Limea geinitzi (v. HAGENOW, 1842)
(Pl. 36, Figs 8—9)

1842. *Lima Geinitzii* nob., v. HAGENOW, p. 556, Pl. 9, Fig. 13.
1902. *Lima Geinitzi* v. HAGENOW; RAVN, p. 98, Pl. 2, Fig. 19.
1912. *Lima Geinitzi* HAGENOW; ŁOPUSKI, p. 202, Pl. 2, Fig. 1.
1932. *Lima (Limea) geinitzi* v. HAGENOW; WOLANSKY, p. 21, Pl. 3, Figs 4—5.
(1960) *Lima geinitzi* HAG.; CIEŚLIŃSKI, p. 434.
1968. *Limatula (Limatulella) geinitzi* (HAGENOW); PASTERNAK, p. 184, Pl. 38, Fig. 3.
1977. *Limaria (Limatulella) geinitzi* (HAGENOW); SOBETSKI, p. 115, Pl. 7, Figs 9—10.
1982. ? *Pseudolimea geinitzi* (VON HAGENOW); DHONDT, p. 89, Pl. 4, Fig. 2.
1982. *Limaria geinitzi* (HAGENOW); SOBETSKI, p. 126, Pl. 12, Fig. 12.

MATERIAL: 2 from Dobre, 5 from Męćmierz, 20 from Kazimierz, 6 from Nasiłów (opoka).

REMARKS: The species was reported from the Upper Campanian of the study area by ŁOPUSKI (1912).

The generic assignement of this species is a matter of disscusion by the previous investigators, who assigned it either to *Lima, Limea, Limatula,* or to *Pseudolimea.* However, *Limea* BRONN is accepted herein for *"Lima" geinitzi* v. HAGENOW, on the basis of having numerous rounded, closely spaced radial riblets and the short hinge that bears short denticles on both sides.

AGE and DISTRIBUTION: Maastrichtian of Denmark, West Germany, East Germany, the Lvov region, Crimea and the peri-Caspian basin; the Upper Campanian — Maastrichtian of the Middle Vistula Valley.

Genus *Pseudolimea* ARKELL *in* DOUGLAS & ARKELL, 1932
Type species: *Plagiostoma duplicata* J. de C. SOWERBY, 1827; *OD Pseudolimea(?) granulata* (NILSSON, 1827)
(Pl. 37, Figs 1—3)

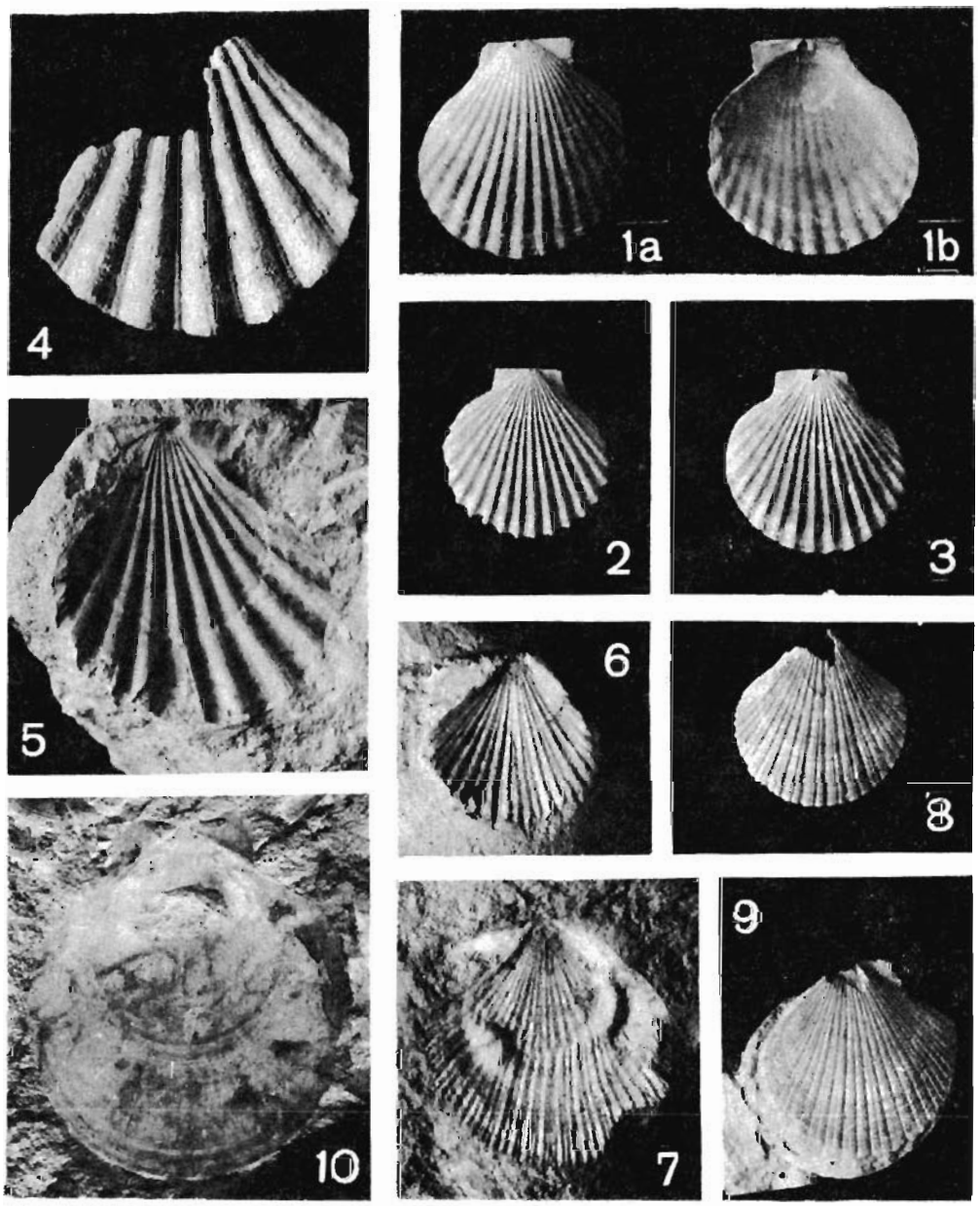
1827. *Plagiostoma granulatum* NILSSON, p. 26, Pl. 9, Figs 4a—b.
1904. *Lima (Limea?) granulata* (NILSSON); WOODS, pp. 54—55, Pl. 7, Figs 27—29 (*cum syn.*).
1909. *Lima (Limea) granulata* NILSSON; ROGALA, p. 693.
(1911) *Lima granulata* NILSS.; ROGALA,, p. 493.
1912. *Lima (Limea) granulata* NILSSON; ŁOPUSKI, p. 201, Pl. 1, Fig. 8.
1932. *Lima (Limea?) granulata* (NILSSON); WOLANSKY, p. 21.
(1938) *Lima granulata* NILS.; POŻARYSKI, p. 21.
(1942) *Lima granulata* NILS.; PUTZER, p. 371.
1954. *Lima (Limea) granulata* (NILSSON); HÄGG, p. 38, Pl. 5, Fig. 53.
1965b. *Lima (Limea) granulata* NILSSON; CIEŚLIŃSKI, p. 27, Pl. 2, Fig. 8.
1968. *Lima (Limea?) granulata* (NILSSON); PASTERNAK, p. 182, Pl. 37, Figs 10—12.
1974. *Limea granulata* (NILSSON); SAVCZINSKAJA, p. 96, Pl. 28, Figs 12—14.
1977. *Limea granulata* (NILSSON); SOBETSKI, p. 109, Pl. 7, Fig. 5.
1981. *Limea granulata* (NILSSON); TZANKOV, p. 117, Pl. 52, Fig. 6.
1982. *Pseudolimea granulata* (NILSSON); DHONDT, p. 87, Pl. 5, Figs 7—8.
1982. *Limea granulata* (NILSSON); SOBETSKI, p. 124, Pl. 12, Fig. 9.

MATERIAL: 3 from Piotrawin (uppermost Campanian), 3 from Dziurków, 2 from Kłudzie, 3 from Dobre, 9 from Kazimierz, 32 from Nasiłów (24 opoka, 5 hardground, 3 greensand).

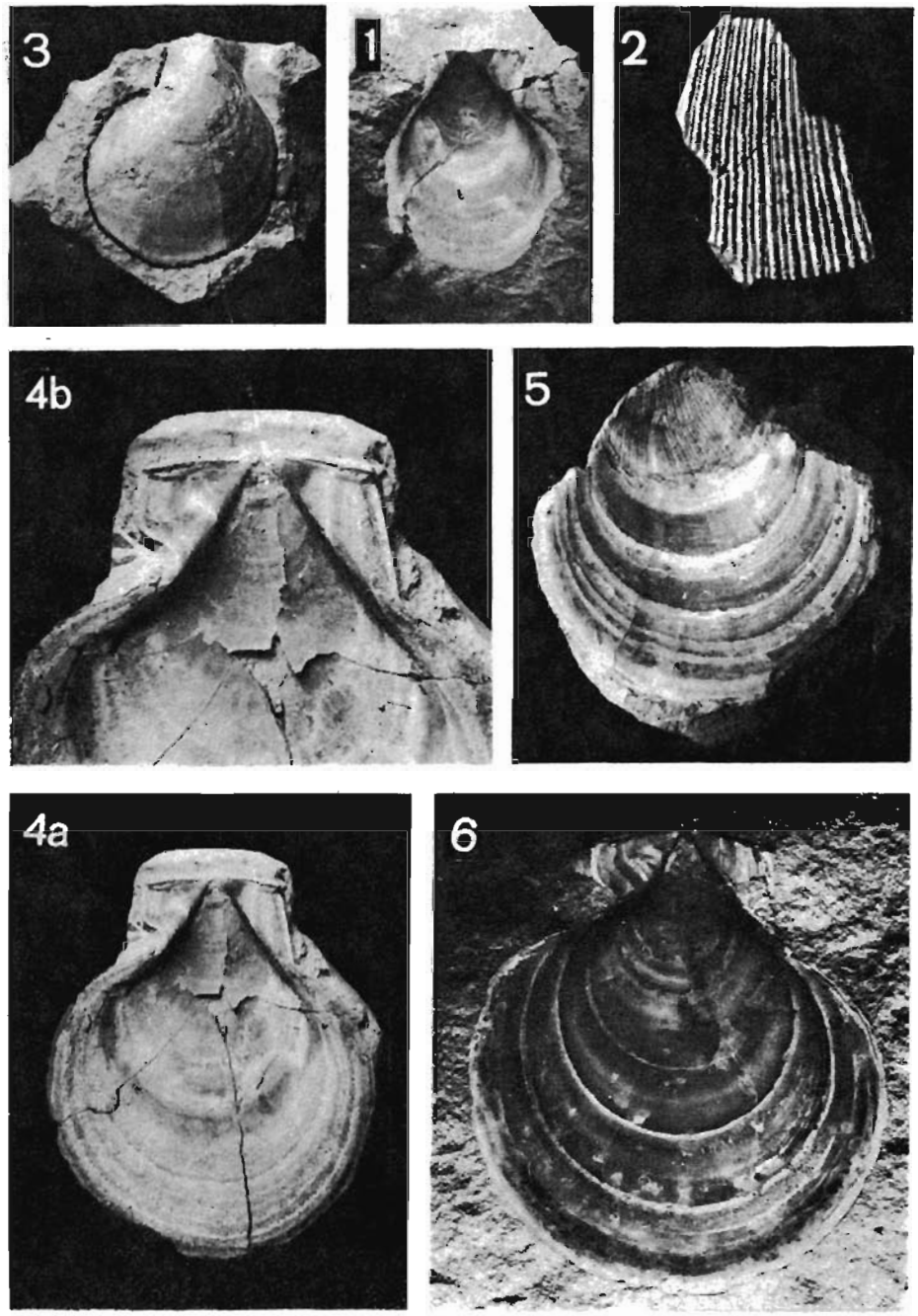
REMARKS: The studied specimens are identical with those described by WOODS (1904). The species has been described by ŁOPUSKI (1912) from the Maastrichtian deposits of the study area. ANDERT (1934) and CIEŚLIŃSKI (1965b) considered *Lima pseudocardium* REUSS as a synonym of this species, although these two species, similar in shape, are diferent in ornamentation, as figured by REUSS (1864), GEINITZ (1875), and SCUPIN (1913).

The species is tentatively assigned to the genus *Pseudolimea* ARKELL, on the basis of having similar from and small number of sharp radial ribs. Because the dentition is absent in the studied species, the generic name is still questionable.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Maastrichtian deposits of Europe.



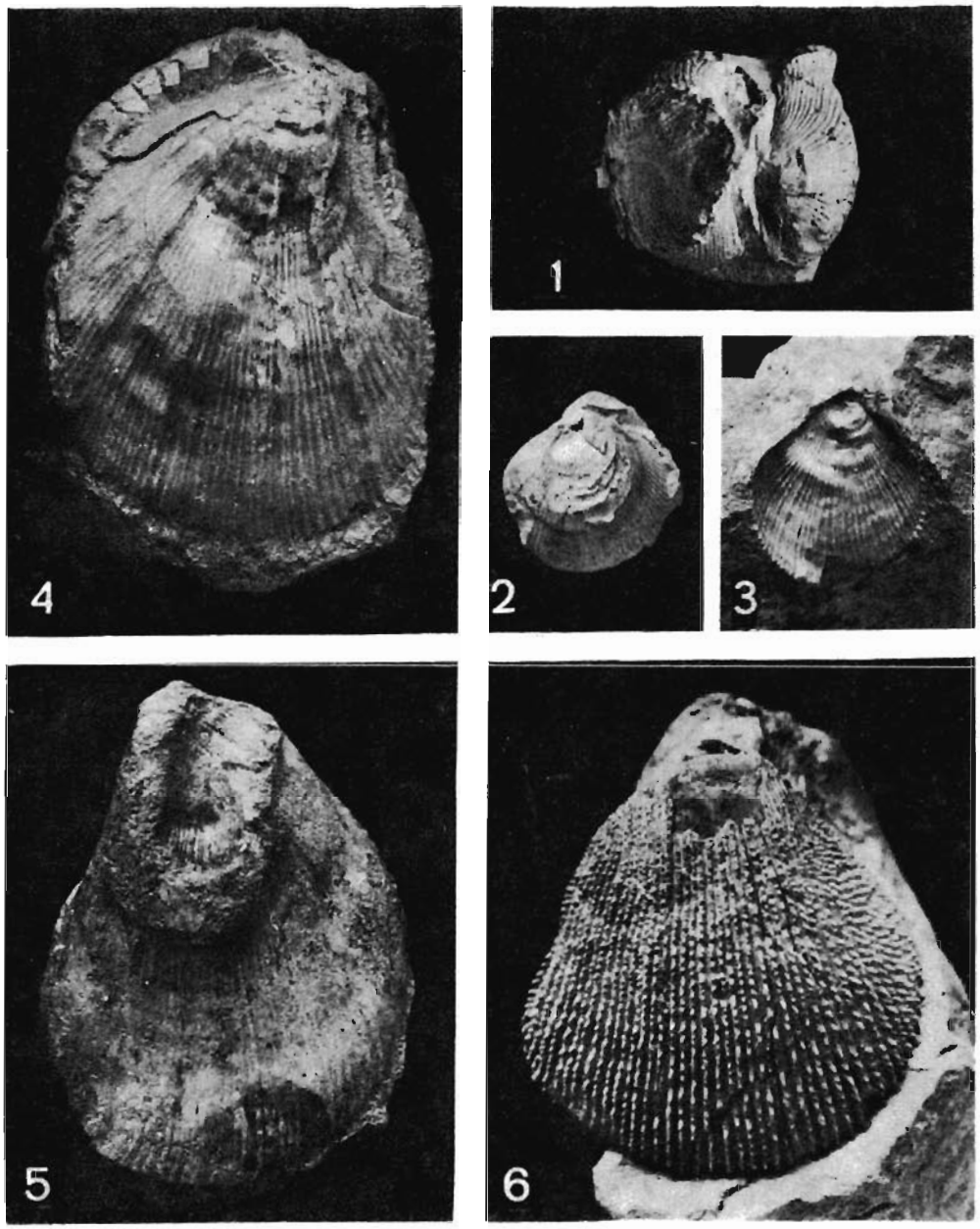
1-3 — *Lyropecten (Aequipecten) acuteplicatus* (ALTH); Nasiłów opoka (*1a, 1b* external and internal views of RV; *2* and *3* external view of LV), ×1
4-5 — *Chlamys (Lyriochlamys) septemplicata* (NILSSON); Nasiłów opoka (*4* shell fragment, *5* internal view of RV), ×1
6-7 — *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); *6* from Kazimierz (LV), *7* from Piotrawin (LV), ×3
8-9 — *Lyropecten (Aequipecten) pulchellus* (NILSSON); *8* from Nasiłów opoka, *9* from Dobre (incomplete valves), ×2
10 — *Entolium membranaceum* (NILSSON); Kazimierz (steinkern of RV), ×1



1-2 — *Mimachlamys cretosa cretosa* (DEFRANCE); *1* internal view of LV from Kazimierz; *2* shell fragment from Nasiłów opoka

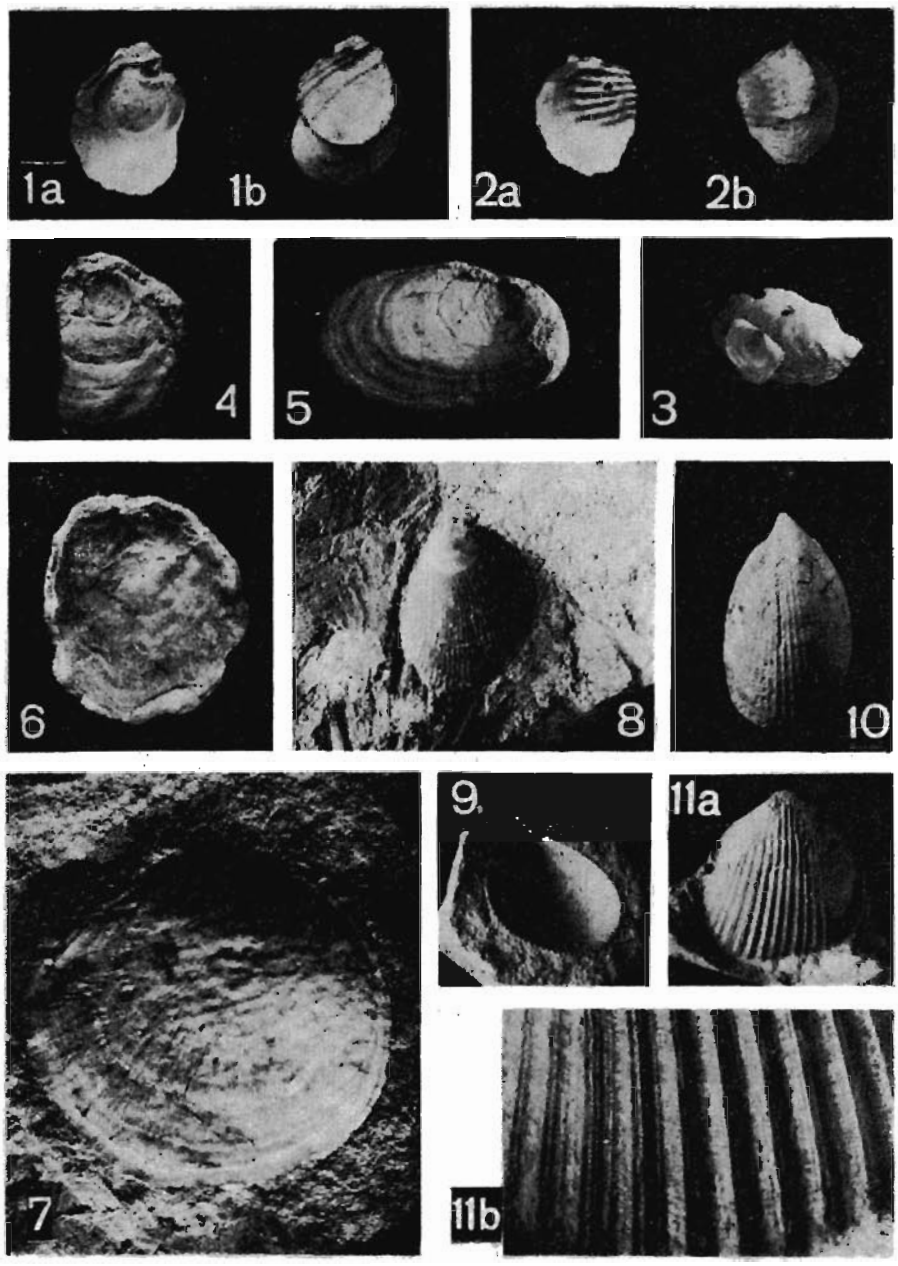
3-6 — *Mimachlamys cretosa denticulata* (v. HAGENOW); *3—4* from Nasiłów opoka (*3* incomplete LV, *4* internal view of RV), *5* from Kazimierz (incomplete, internal view), *6* from Bochotnica (internal view of RV); note color bands in specimen presented in Fig. 5

All figures in natural size except Figs. 2, 4b taken ×2



1-3 — *Spondylus dutempleanus* d'ONBIGNY; *1—2* from Chełm chalk (dorsal view of both valves, *2* RV), *3* from Kazimierz (incomplete; internal view of RV)
4-5 — *Spondylus truncatus* (LAMARCK); Nasiłów opoka (LV and RV internal views)
6 — *Spondylus serratus* WOODS; Nasiłów opoka (incomplete valve)

All figures in natural size except Fig. 6 taken ×2



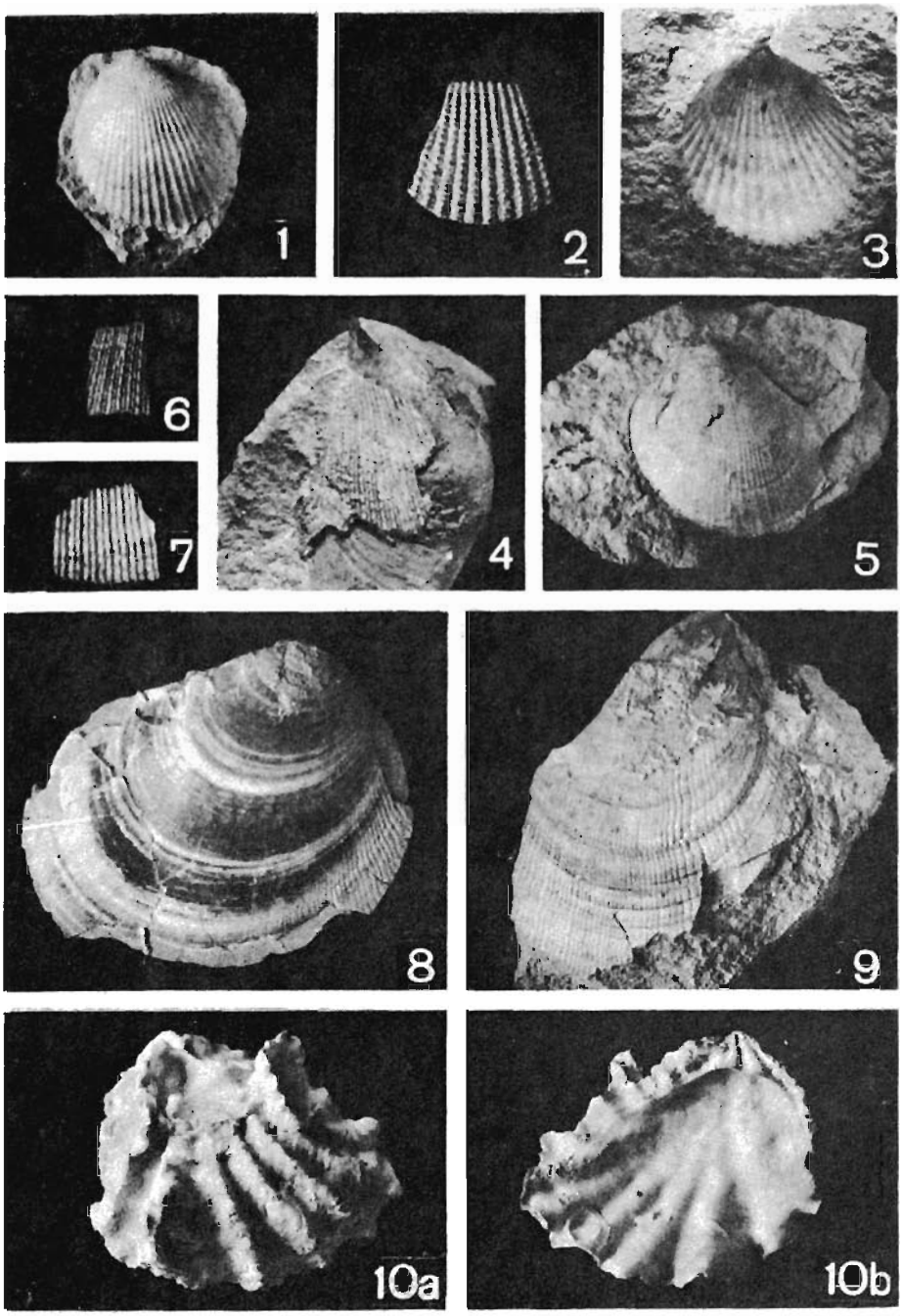
1—3 — *Atreta nilssoni* (v. HAGENOW); *1—2* from Nasiłów opoka (*1a*, *2a* internal and *1b*, *2b* external views of RV), *3* juvenile RV attached to oyster shell from Nasiłów greensand, × 1

4—7 — *Placunopsis granulosa* (ROEMER); *4—5* from Kazimierz, *6—7* from Nasiłów opoka, RV), × 1

8—9 — *Limea geinitzi* (v. HAGENOW); Nasiłów opoka (*8* external, *9* internal views of LV), *8* is × 3, *9* is × 2

10 — *Limatula kunradensis* MARQUET; steinkern from Nasiłów opoka, × 1

11a—11b — *Limatula ovata* (NILSSON); Nasiłów opoka (*11a* fragment of shell, × 1; *11b* sculpture, × 4)



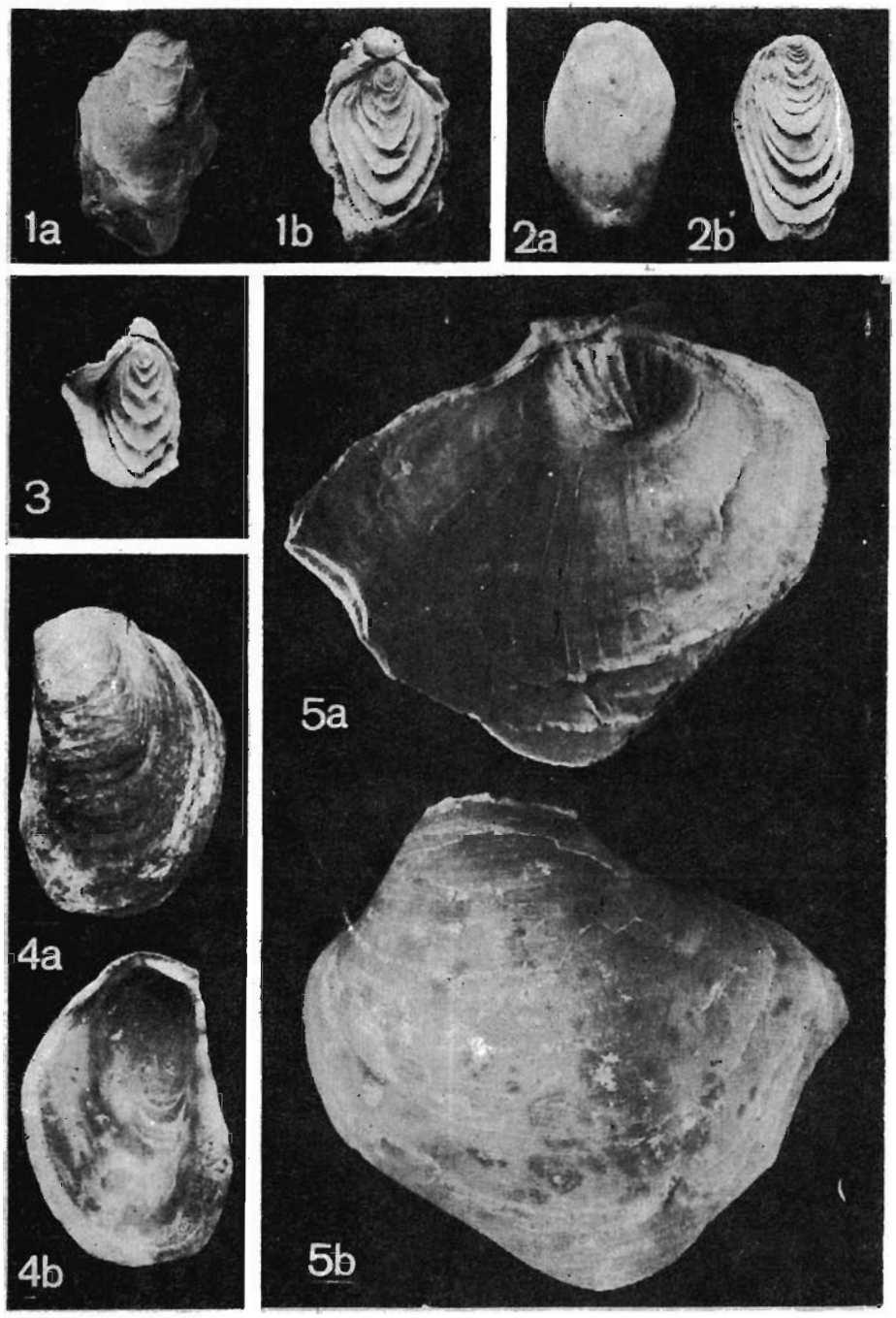
1—3 — *Pseudolimea*(?) *granulata* (NILSSON), *1* steinkern from Kazimierz, × 1; *2* fragment of shell showing sculpture from Nasiłów opoka, × 2; *3* from Kazimierz (internal view), × 2

4—7 — *Ctenoides dunkeri* (v. HAGENOW); *4* from Nasiłów opoka (incomplete), × 2; *5* steinkern from Nasiłów opoka (RV), × 1; *6—7* shell fragments (sculpture) from opoka, × 4

8 — *Plagiostoma hoperi* MANTELL; Nasiłów opoka (LV), × 1; note color bands

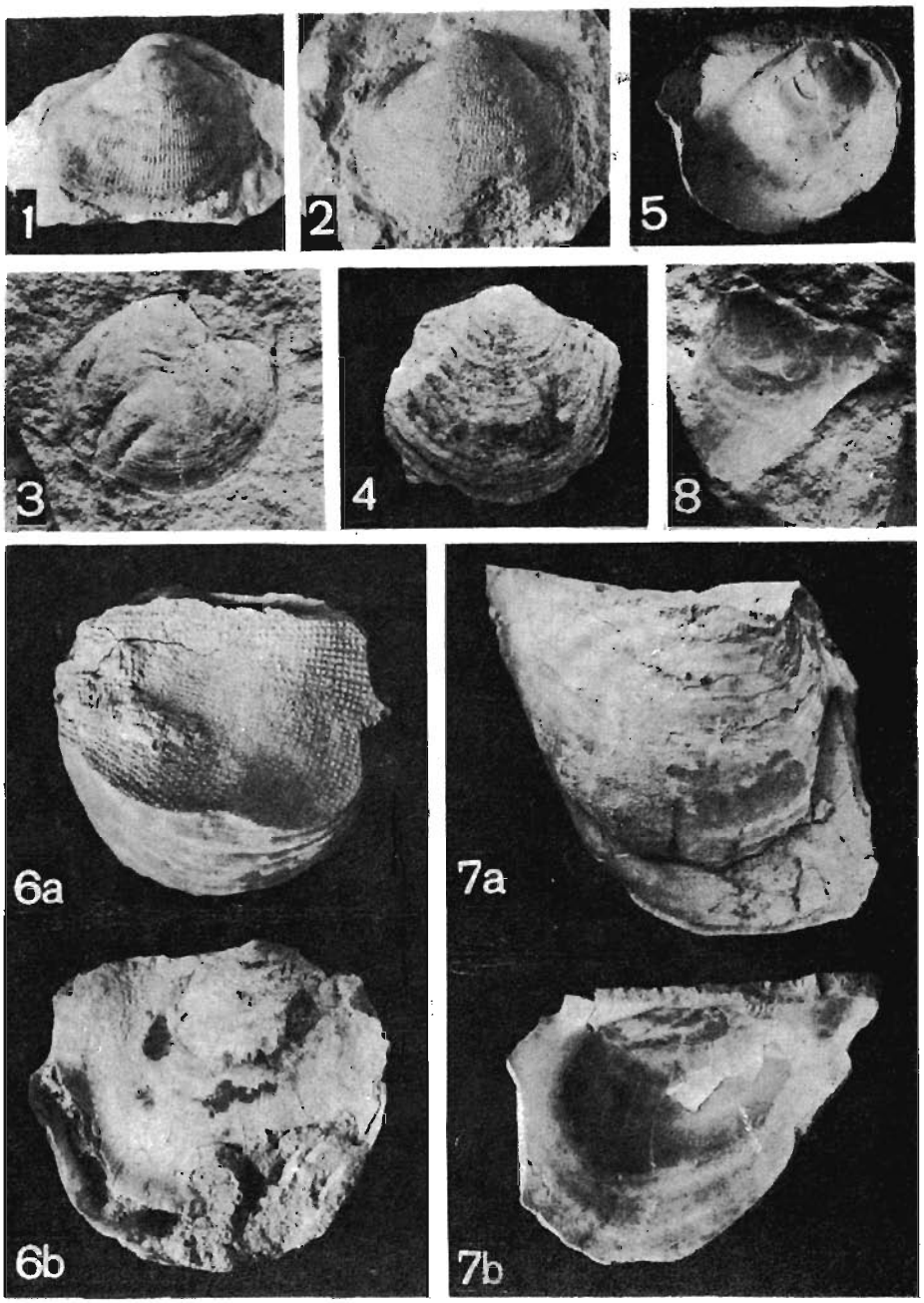
9 — *Plagiostoma cretacea* (WOODS); Nasiłów opoka (incomplete), × 1

10a—10b — *Hyotissa semiplana* (SOWERBY); Bochotnica (*10a* external *10b* internal views of LV) × 1



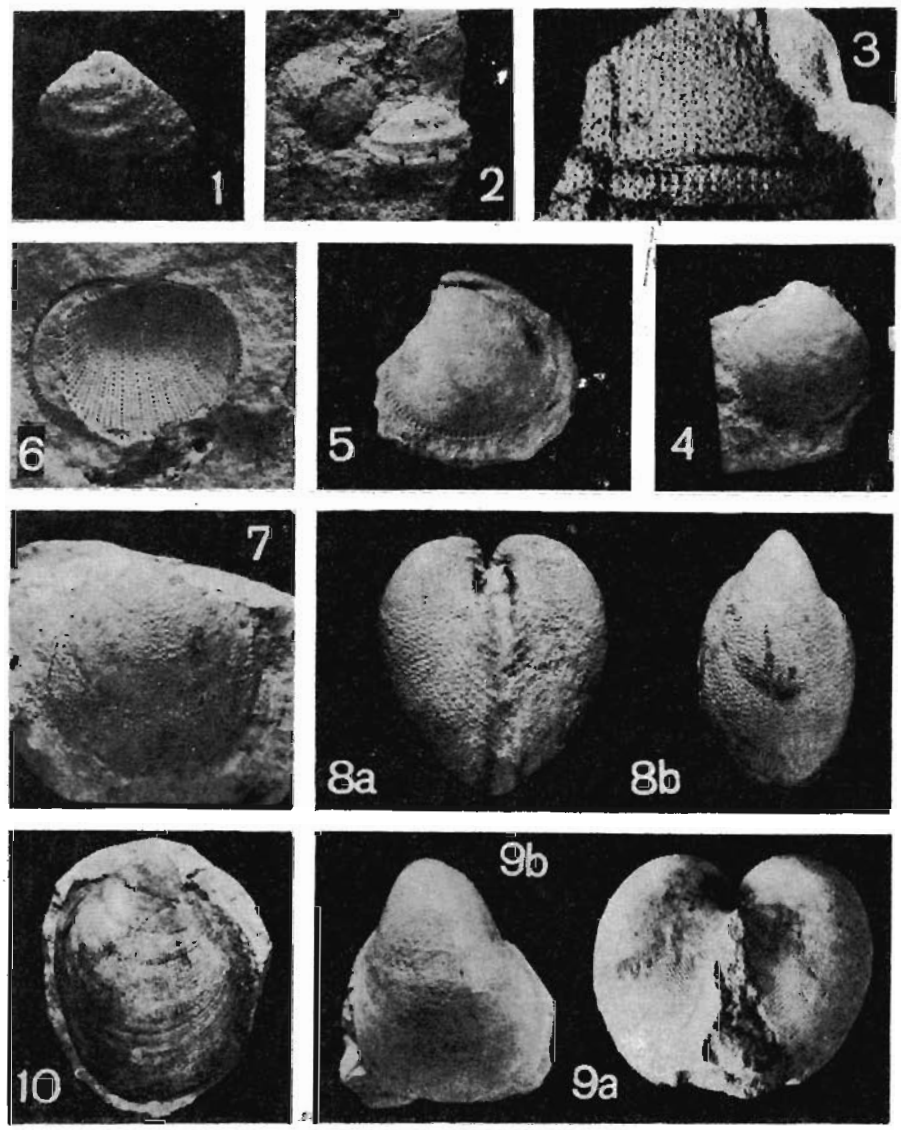
1-3 — *Gryphaeostrea canaliculata* (SOWERBY); Nasiłów greensand (*1a* LV view; *1b, 3* RV views; *2a, 2b* internal and external views of RV)
4a-4b — *Acutostrea incurva* (NILSSON); Kazimierz (external and internal views of RV)
5a-5b — *Pycnodonte (Phygraea) vesiculare* (LAMARCK); Nasiłów opoka (RV and LV views)

All figures in natural size



1-2 — *Multiella coarctata* (ZITTEL); *1* from Nasiłów opoka (external mold of RV), *2* from Kazimierz (external mold of RV)
3 — *Lucina (Lucina) laminosa* (REUSS); Nasiłów opoka (internal mold of LV)
4 — *Lucina (Lucina) subnumismalis* d'ORBIGNY; Nasiłów opoka (external mold of LV)
5-7 — *Pycnodonte (Phygraea) vesiculare* (LAMARCK); *5* from Piotrawin (internal view of RV), *6* from Nasiłów greensand (*6a* LV view with large xenomorphic area, *6b* RV view), *7* from Kazimierz (*7a* external, and *7b* internal views of LV)
8 — *Acutostrea incurva* (NILSSON); Kazimierz (internal view of RV)

All figures in natural size



1-2 — *Astarte (Astarte) similis* v. MÜNSTER; *1* from Bochotnica hardground, *2* from Ciszyca Kolonia, ×2

3-4 — *Granocardium (Granocardium) alutacium* (v. MÜNSTER); *4* steinkern from Nasiłów hardground, ×1; *3* from Kazimierz (fragment of external mold showing sculpture), ×2

5 — *Venericardia santonensis* G. MÜLLER; steinkern from Nasiłów opoka, ×1

6-7 — *Granocardium (Criocardium) productum* (SOWERBY); Kazimierz (*6* sculpture, *7* external mold)

8a-8b — *Granocardium (Granocardium)* aff. *pustulosum* (v. MÜNSTER); Nasiłów opoka (anterior and LV views)

9a-9b — *Nemocardium (Nemocardium) fenestratum* (KNER); Kazimierz (anterior and LV views), ×1

10 — *Pleuriocardia (Pleuriocardia) noeggerathi* (J. MÜLLER); Nasiłów opoka (external mold of LV, slightly limonitic), ×1

Genus *Plagiostoma* J. SOWERBY, 1814
Type species: *Plagiostoma giganteum* SOWERBY 1814; *SD* STOLICZKA, 1871
Plagiostoma hoperi MANTELL, 1822
(Pl. 37, Fig. 8)

1822. *Plagiostoma Hoperi* MANTELL, pp. 204—205, Pl. 26, Figs 2, 3, 15.
1886. *Lima Hoperi* F. ROEMER; SIEMIRADZKI, pp. 58—59, Pl. 5, Fig. 7.
1904. *Lima (Plagiostoma) Hoperi* MANTELL; WOODS, pp. 17—22, Pl. 4, Figs 7—12 (*cum syn.*).
1912. *Lima (Plagiostoma) Hoperi* MANT.; ŁOPUSKI, p. 197, Pl. 1, Fig. 10.
1932. *Lima (Plagiostoma) Hoperi* MANTELL; WOLANSKY, p. 20, Pl. 3, Fig. 2.
(1938) *Lima hoperi* MANT.; POŻARYSKI, p. 21.
(1942) *Lima hoperi* MANTELL; PUTZER, p. 371.
1951. *Lima hoperi* MANTELL; POŻARYSKA & POŻARYSKI, p. 21, Pl. 7, Fig. 8.
1968. *Lima (Plagiostoma) hoperi hoperi* (MANTELL); PASTERNAK, pp. 179—180, Pl. 37, Figs 3—5.
1974. *Lima hoperi* MANTELL; SAVCZINSKAJA, p. 95, Pl. 28, Fig. 11.
1977. *Plagiosaoma hoperi* MANTELL; SOBETSKI, p. 101, Pl. 6, Fig. 13.
1981. *Plagiostoma hoperi* MANTELL; TZANKOV, p. 118, Pl. 52, Fig. 9.
1982. *Lima (Plagiostoma) hoperi* (MANTELL); NESTLER, p. 50, Gig. 30.
1982. *Plagiostoma hoperi* MANTELL; DHONDT, p. 89, Pl. 4, Fig. 1.
1982. *Plagiostoma hoperi* MANTELL; SOBETSKI, p. 124, Pl. 12, Fig. 8; Pl. 32, Figs 1—2.

MATERIAL: 1 fram Solec, 1 from Dobre, 2 from Podgórz, 4 from Męćmierz, 50 from Kazimierz, 1 from Janowiec, 1 from Bochotnica, 50 from Nasiłów (45 opoka, 5 hardground).

REMARKS: The species is considered as one of the predominant bivalves in the Maastrichtian deposits of the study area, particularly in the uppermost part of the Belemnella kazimiroviensis Zone. ŁOPUSKI (1912) discussed in detail the variabilities of the studied species occurring in the Upper Campanian — Upper Maastrichtian of the Middle Vistula Valley.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Maastrichtian deposits of Europe.

In Poland, it occurs since the Upper Turonian through the Maastrichtian of the Middle Vistula Valley (POŻARYSKI 1938), and in the Upper Maastrichtian chalk of Chełm (Lublin Upland).

Plagiostoma cretacea (WOODS, 1904)
(Pl. 37, Fig. 9)

1904. *Lima (Plagiostoma) cretacea* nom. nov., WOODS, pp. 22—23, Pl. 4, Figs 13—15; Pl. 5, Figs 1—4.
1968. *Lima (Lima?) cretacea* WOODS; PASTERNAK, p. 179, Pl. 36, Fig. 17.
1974. *Lima cretacea* WOODS; SAVCZINSKAJA, p. 96, Pl. 28, Figs 8—9.
1977. *Plagiostoma cretaceum* WOODS; SOBETSKI, p. 102, Pl. 6, Fig. 19.
1981. *Lima cretacea* WOODS; TZANOV, p. 113, Pl. 51, Figs 3—4.

MATERIAL: 3 from Kazimierz, 37 from Nasiłów (36 opoka, 1 hardground).

REMARKS: WOODS (1904) distinguished this species from *P. hoperi* MANTELL by its smaller apical angle (less than 100°), relatively higher and shorter, by less convex valves, the anterior area relatively smaller, the entire surface of the shell always ornamented, and by the grooves usually deeper.

AGE and DISTRIBUTION: Upper Senonian of England, the Lvov region, Donbass basin and Crimea; Maastrichtian of Bulgaria; uppermost Maastrichtian of the Middle Vistula Valley.

Genus *Ctenoides* MÖRCH, 1853
Type species: *Ostrea scabra* BORN, 1778; *SD* STOLICZKA, 1871
Ctenoides dunkeri (v. HAGENOW, 1842)
(Pl. 37, Figs 4—7)

1842. *Lima Dunkeri* nob., v. HAGENOW, p. 556 (22).
v. 1895. *Lima (Radula) Dunkeri* HAG., VOGEL, p. 17, Pl. 1, Fig. 9.
1902. *Lima Dunkeri* v. HAGENOW; RAVN, p. 100, Pl. 2, Fig. 14.
1912. *Lima (Plagiostoma) Dunkeri* v. HAGENOW; ŁOPUSKI, p. 190, Pl. 1, Fig. 11.
1932. *Lima (Radula) dunkeri* v. HAGENOW; WOLANSKY, p. 20, Pl 3, Fig. 8.
(1938) *Lima dunkeri* HAG.; POŻARYSKI, p. 21.
(1942) *Lima dunkeri* HAG.; PUTZER, p. 371.
(1951) *Lima dunkeri* HAG.; POŻARYSKA & POŻARYSKI, p. 21.
1968. *Lima (Lima) dunkeri* HAGENOW; PASTERNAK, p. 178, Pl. 37, Figs 1—2.
1977. *Plagiostoma dunkeri* (HAGENOW); SOBETSKI, p. 104, Pl. 6, Fig. 20.

MATERIAL: 1 from Solec, 1 from Podgórz, 27 from Kazimierz, 6 from Nasiłów (opoka).

REMARKS: The species can be easily distinguished from *C. muricata* (GOLDFUSS) and *C. squamifera* (GOLDFUSS) by the larger apical angle, the smaller H/L ratio and the numerous closely speced spiny radial ribs.

The species was reported by ŁOPUSKI (1912) from Kaliszany (uppermost Campanian) and Kazimierz.

AGE and DISTRIBUTION: Maastrichtian of Denmark, Isle of Rügen, the Lvov region, Crimea, and the Maastrichtian stratotype (the Netherlands); uppermost Campanian — Upper Maastrichtian of the Middle Vistula Valley.

Suborder **Ostreina** FÉRUSSAC, 1822
Superfamily **Ostreacea** RAFINÉSQUE, 1815
Family **Gryphaeidae** VYALOV, 1936
Subfamily **Pycnodonteinae** STENZEL, 1959
Genus *Pycnodonte* FISCHER de WALDHEIM, 1835
Type species: *Pycnodonte radiata* FISCHER de WALDHEIM, 1835; *OD*
Subgenus *Phygraea* VYALOV, 1936
Type species: *Gryphaea (Gryphaea)* sec. *Phygraea frauscheri* VYALOV, 1936; *OD*
Pycnodonte (Phygraea) vesiculare (LAMARCK, 1806)
(Pl. 38, Fig. 5 and Pl. 39, Figs 5—7)

1827. *Ostrea vesicularis* LAM.; NILSSON, p. 29, Pl. 7, Figs 3—5; Pl. 8, Figs 5—6.
1837. *Gryphaea dilatata* SOW.; PUSCH, p. 34 (*non* SOWERBY).
1913. *Ostrea vesicularis* LAMARCK; WOODS, pp. 360—374, Text-figs 143—182 and Pl. 55, Figs 4—9 (*cum syn.*).
1931. *Ostrea vesicularis* LAM.; KRACH, p. 367, Pl. 8, Fig. 2.
(1938) *Ostrea vesicularis* LAM.; POŻARYSKI, p. 21.
(1942) *Gryphaea dilatata* SOW.; PUTZER, p. 372.
1951. *Ostrea vesicularis* LAM.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 8, Fig. 16.
1969. *Gryphaea vesicularis* (LAMARCK); IVANOVA, p. 328, Pl. 11, Figs 1—2.
1965a. *Pycnodonta vesicularis* (LAM.); NESTLER, pp. 64—66, Pl. 1, Figs 1—6; Pl. 2, Figs 1—5.
1974. *Gryphaea vesicularis* (LAMARCK); SAVCZINSKAJA, p. 103, Pl. 35, Fig. 8.
p. p. 1977. *Pycnodonte (Phygraea) vesicularis* (LAMARCK); PUGACZEWSKA, p. 191, Pl. 13, Figs 1—13 (*non* Fig. 7).
1977. *Pycnodonte (Pycnodonte) biauriculata* (LAMARCK); PUGACZEWSKA, p. 189, Pl. 11, Fig. 3 (*non* LAMARCK).
1977. *Pycnodonte vesiculare* (LAMARCK); SOBETSKI, p. 145, Pl. 11, Figs 7—9.

1962. *Pycnodonte vesiculare* (LAMARCK); SOBETSKI, p. 130, Pl. 12, Fig. 19; Pl. 32, Fig. 6.
1962. *Pycnodonte (Phygraea) vesiculare* (LAMARCK); DHONDT, p. 91, Pl. 4, Fig. 7.

MATERIAL: 70 from Upper Campanian opoka (25 from Ciszyca Kolonia, 10 from Ciszyca Górna, 35 from Piotrawin), 2 from Męćmierz, 40 from Kazimierz, 10 from Bochotnica, 120 from Nasiłów (60 opoka, 10 hardground, 50 greensand); (46 specimens taken from the KONGIEL's Collection).

REMARKS: The species is considered as one of the most predominant bivalves in the Maastrichtian deposits of the study area. PUGACZEWSKA (1977) discussed the different growth stages of this species and reported some internal features of its shell. WOODS (1913) discussed the complex synonymy and the variability of this species. This variability depends merely upon the shape and nature of the attachement surface. Some shells have elongate xenomorphic area parallel to the hinge line and acquire their anteriors auricle-like. Such shell were erroneously attributed to *Pycnodonte biauriculatum* (LAMARCK) by PUGACZEWSKA (1977) and TZANKOV (1981) from the Maastrichtian deposits of the study area and Bulgaria, respectively. Moreover, DHONDT (1984) concluded that *P. (Pycnodonte) biauriculatum* (LAMARCK) is widely distributed mainly along the northern Tethys, stratigraphically restricted to the low-Late Cenomanian, displaying no attachemnt surface an which presumably lived unattached all its life, being floated on fine substrate (recliner). DHONDT added that this species suddenly disapperated and was replaced by *Rhynchostreon suborbiculatum* (LAMARCK).

WOLANSKY (1932) and NESTLER (1965a) considered *Ostera ungulata equina* v. HAGENOW as a juvenile form of *P. vesiculare*. PUSCH (1837) erroneously attributed the material from the marly opoka exposed at Kazimierz to *Gryphaea dilatata* SOWERBY and he considered *"Ostrea vesicularis"* LAMARCK as a synonym of SOWERBY's species. The species *Gryphaea similis* PUSCH differs from *P. vesiculare* in its gryphate left valve, a more curved elevated umbo, small xenomorphic area, and also in the number and position of chomata. The species *Gryphaea similis* is completely absent in the Upper Maastrichtian deposits of the Middle Vistula Valley, and it is only recorded (*see* POŻARYSKA & POŻARYSKI 1951) in the overlying younger Paleocene strata (Siwak). Therefore, the stratotype of *Gryphaea similis* PUSCH is the Lower Paleocene (Siwak) not "Kreidemargel" (opoka) as stated by PUSCH (1837).

AGE and DISTRIBUTION: Cosmopolitic in the Albian — Maastrichtian of Europe (Temperate and Tethyan); Senonian of North America, the Middle East (Egypt, Algeria, Tunisia, Syria and Palestine), Central Asia and Southern India.

Genus *Hyotissa* STENZEL, 1971
Type species: *Mytilus hyotis* LINNAEUS, 1758; *OD*
Hyotissa semiplana (SOWERBY, 1825)
(Pl. 37, Fig. 10)

1825. *Ostrea semiplana* J. de C. SOWERBY, Vol. 5, p. 144, Pl. 489, Fig. 3.
1847. *Ostrea semiplana* d'ORBIGNY, p. 747, Pl. 488, Figs 4—5.
1897. *Ostrea semiplana* SOW.; HENNIG, p. 9, Pl. 1, Figs 7, 10—14, 16, 18, 19.
p. p. 1912. *Ostrea semiplana* SOWERBY; WOODS. p. 379. Text-figs 184—193 and Pl. 17, Figs 5—7.
1931. *Ostrea semiplana* SOW.; KRACH, p. 366, Pl. 7, Figs 9, 9a
(1938) *Ostrea semiplana* SOW.; POŻARYSKI, p. 21.
1951. *Ostre semiplana* SOW.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 8, Fig. 13.
1959. *Lopha semiplana* (SOWERBY); IVANOVA, p. 334, Pl. 13, Figs 1—3.
1977. *Lopha (Actinostrea) simplana* (SOWERBY); SOBETSKI, p. 140, Pl. 10, Figs 3—6.
1977. *Hyotissa semiplana* (SOWERBY); PUGACZEWSKA, p. 193, Pl. 14, Figs 1—3.
1977. *Hyotissa armata* (GOLDFSS); PUGACZEWSKA, p. 194, Pl. 12, Figs 4—5.
1981. *Lopha semiplana* (SOWERBY); TZANKOV, p. 124, Pl. 60, Figs 1—2.

1931. *Ostrea semiplana* SOWERBY; KRACH, p. 34, Pl. 3, Fig. 6.
1982. *Hyotissa semiplana* (SOWERBY); NESTLER, p. 44, Fig. 66.
1982. *Lopha semiplana* (SOWERBY); SOBETSKI, p. 137, Pl. 14, Fig. 1; Pl. 32, Fig. 7.

MATERIAL: 1 from Dziurków, 2 from Kłudzie, 1 from Kazimierz, 1 from Bochotnica, 12 from Nasiłów (5 opoka, 1 hardground, 6 greensand).

REMARKS: PUGACZEWSKA (1977) described *Hyotissa armata* (GOLDFUSS) from the Nasiłów quarry, she differentiated between *H. armata* and *H. semiplana* by the irregularity in the radial folds as well as the absence of phase growth in latter species. In the author's opinion, all the specimens studied by PUGACZEWSKA (1977) fall with in the wide range of variability of *H. semiplana*, this variability being dependent upon the shape, size and the position of the surface to which the left valve is attached (*see* WOODS 1913). However, the large list of synonyms given by WOODS (1913) needs a careful study based on the structure of shell, since STENZEL (1971) introduced the new genus *Hyotissa* based on the presence of the vesicular shell structure, and considered *Ostrea semiplana* as related to this genus.

The species *Lopha sibirica* GLASUNOVA from the Maastrichtian of the Donbass basin as figured by SAVCZINSKAJA (1974) is closely similar to the studied species and probably related.

AGE and DISTRIBUTION: Very widely distributed in the Senonian of Europe (Temperate and Tethyan), North Africa (Algeria, Tunisia and Egypt), Syria and Palestine.

Subfamily Exogyrinae VYALOV, 1936
Tribe Gryphaeostreini STENZEL, 1971
Genus *Gryphaeostrea* CONRAD, 1865
Type species: *Gryphaea eversa* MELLEVILLE, 1843; *M Gryphaeostrea canaliculata* (SOWERBY, 1813)
(Pl. 38, Figs 1—3)

1813. *Chama canaliculata* SOWERBY, Vol. 1, p. 68, Pl. 26, Fig. 1.
1827. *Ostrea lateralis* n., NILSSON; PUSCH, p. 35.
1913. *Ostrea canaliculata* (SOWERBY); WOODS, p. 375, Pl. 56, Figs 2—16 (*cum syn.*).
1931. *Ostrea canaliculata* SOW.; KRACH, p. 365, Pl. 7, Figs 8, 8a.
1932. *Ostrea canaliculata* SOWERBY; WOLANSKY, p. 14.
1934. *Ostrea canaliculata* SOW. sp.; ANDERT, p. 163, Pl. 10, Figs 7—8.
(1938) *Ostrea canaliculata* SOW.; POŻARYSKI, p. 21.
1951. *Ostrea canaliculata* SOW.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 8, Fig. 15.
1954. *Ostrea canaliculata* (SOWERBY); HÄGG, p. 43.
1959. *Amphidonta (Gryphaeostrea)* lateralis (NILSSON); IVANOVA, p. 344, Pl. 10, Fig. 5.
1974. *Amphidonta canaliculata* (SOWERBY); SAVCZINSKAJA, p. 104, Pl. 37, Figs 2—5.
1977. *Gryphaeostrea canaliculata* (SOWERBY); SOBETSKI, p. 162, Pl. 15, Figs 5—7.
1977. *Gryphaeostrea lateralis* (NILSSON); SOBETSKI, p. 164, Pl. 15, Figs 8—10.
v. 1977. *Gryphaeostrea vomer* STEPHENSON; PUGACZEWSKA, p. 197, Pl. 16, Figs 2—5.
1981. *Gryphaeostrea canaliculata* (SOWERBY); TZANKOV, p. 132, Pl. 66, Figs 1—4.
1982. *Gryphaeostrea canaliculata* (SOWERBY); SOBETSKI, p. 136, Pl. 13, Fig. 10; Pl. 32, Fig. 4.
1982. *Gryphaeostrea lateralis* (NILSSON); SOBETSKI, p. 138, Pl. 14, Fig. 2; Pl. 32, Fig. 5.

MATERIAL: 5 from Kazimierz, 74 from Nasiłów (14 opoka, 60 greensand); 29 from the PUGACZEWSKA's Collection, 20 from the KONGIEL's Collection.

REMARKS: The species was described by KRACH (1931) and PUGACZEWSKA (1977) from the studied sections. The latter authoress erroneously attributed her material from Nasiłów to the North America species *Gryphaeostrea vomer* STEPHENSON, 1941, and she neglected the famous European species *Gryphaeostrea canaliculata* (SOWERBY, 1813), and *G. lateralis* (NILLSON, 1827). Indeed, there is

no distinct morphological difference between these three species, and the European species *G. canaliculata* has the priority. POŻARYSKI (1938) recorded this species in the Campanian — Maastrichtian deposits of the Middle Vistula Valley.

AGE and DISTRIBUTION: Very widely distributed in the Albian — Maastrichtian of Europe (Temperate and Tethyan), North Africa (Morocco, Algeria, Tunisia, Libya and Egypt), Central Asia and Southern India.

Family **Ostreidae** RAFINESQUE, 1815
Subfamily **Ostreinae** RAFINESQUE, 1815
Genus *Acutostrea* VYALOV, 1936
Type species: *Ostrea acutirostris* NILSSON, 1827; *OD*
Acutostrea incurva (NILSSON, 1827)
(Pl. 38, Fig. 4 and Pl. 39, Fig. 8)

1827. *Ostrea incurva* NILSSON, p. 30, Pl. 7, Figs 6a, b.
1897. *Ostrea incurva* NILSSON; HENNIG, p. 11, Pl. 1, Figs 15, 17, 23, 25—28.
1902. *Ostrea incurva* NILSSON; RAVN, p. 113, Pl. 3, Fig. 4.
1909. *Ostrea incurva* NILSSON; ROGALA, p. 691.
(1911) *Ostrea incurva* NILSSON; ROGALA, p. 494.
1913. *Ostrea incurva* NILSSON; WOODS, p. 388, Pl. 58, Figs 10—13, Pl. 59.
(1936) *Ostrea incurva* NILSS.; POŻARYSKI, p. 21.
1959. *Liostrea incurva* (NILSSON); IVANOVA, p. 326, Pl. 10, Fig. 4.
1974. *Liostrea incurva* (NILSSON); SAVCZINSKAJA, p. 97, Pl. 29, Figs 3—4.

MATERIAL: 4 from Piotrawin (uppermost Campanian), 3 from Dziurków, 3 from Kłudzie, 1 from Dobre, 3 from Kazimierz.

REMARKS: The studied specimens are medium- to large-sized, have elongate — spatulated shells with acute and curved umbones. The shell is more thicker in the umbonal part and gradually thinner toward the ventral commissural shelf.

POŻARYSKI (1938) recorded this species in the Upper Campanian — Lower Maastrichtian of the study area.

AGE and DISTRIBUTION: Widely distributed in the Cenomanian — Maastrichtian of the North European Province.

Genus *Agerostrea* VYALOV, 1936
Type species: *Ostracites ungulatus* von SCHLOTHEIM, 1813; *OD*
Agerostrea lunata (NILSSON, 1827) *sensu* WOODS, 1913

1913. *Ostrea lunata* NILSSON; WOODS, pp. 393—395, Pl. 60, Figs 16—19; Pl. 61, Figs 1—6.
1974. *Lopha lunata* (NILSSON); SAVCZINSKAJA, p. 100, Pl. 30, Figs 13—15.
v. 1977. *Hyotissa lunata* (NILSSON); PUGACZEWSKA, p. 193, Pl. 15, Figs 1—7.
1982. *Agerostrea lunata* (NILSSON); SOBETSKI, p. 147, Pl. 15, Fig. 7.

MATERIAL: 3 from Piotrawin (uppermost Campanian), 1 from Solec, 3 from Nasiłów (greensand; the PUGACZEWSKA's Collection).

REMARKS: The studied specimens from the opoka and greensand of the study area (*see* PUGACZEWSKA 1977) agree with those figured by WOODS (1913), SAVCZINSKAJA (1974), and SOBETSKI (1982) from the white chalk and marl facies of England, Donbass basin, and Crimea, respectively. However, they differ from those described by NILLSON (1827) and GOLDFUSS (1833) from the arenaceous facies of Åhus sandstone (Scania, Sweden) and St. Pietersburg (Maastricht, the Netherlands) in having a distinct posterior auricle as well as small and numerous commissural plications. Moreover, the specimens figured by NILLSON (1827, Pl. 4, Fig. 3) and GOLDFUSS (1833, Pl. 14, Fig. 2) are characterized by thick and lunate shell, with 2-4 broadly curved commissural plications. Further study is recommen-

ded to explain the ecological significance of these forms, if they are really belonging to the same species.

AGE and DISTRIBUTION: Very widely distributed in the Upper Campanian — Maastrichtian of Europe.

Subclass **Heterodonta** NEUMAYR, 1884
Order **Veneroida** H. ADAMS & A. ADAMS, 1856
Superfamily **Lucinacea** FLEMING, 1828
Family **Lucinidae** FLEMING, 1828
Subfamily **Lucininae** FLEMING, 1828
Genus *Lucina* BRUGUIÈRE, 1797
Type species: *Venus jamaicensis* SPENGLER, 1784; *SD* GRAY, 1847
Subgenus *Lucina* BRUGUIÈRE, 1797
Lucina (Lucina) subnumismalis d'ORBIGNY, 1850
(Pl. 39, Fig. 4)

1847. *Venus numismalis* J. MÜLLER, p. 25, Pl. 2, Fig. 5.
(1850) *Lucina subnumismalis* d'ORBIGNY, p. 241.
1889. *Lucina subnumismalis* D'ORB.; HOLZAPFEL, p. 187, Pl. 19, Figs 1—3.
1891. *Lucina subnummismalis* D'ORB.; BÖHM, p. 73, Pl. 3, Fig. 6.
1898. *Lucina subnummismalis* D'ORB.; G. MÜLLER, p. 59, Text-fig. 17.
1903. *Lucina subnummismalis* d'ORBIGNY; RAVN, p. 129, Pl. 4, Fig. 21.
1909. *Lucina subnumismalis* d'ORB.; ROGALA, p. 245.
(1911) *Lucina subnumismalis* d'ORB.; ROGALA, p. 492.
1931. *Lucina subnummismalis* d'ORB.; KRACH, p. 358, Pl. 7, Fig. 3.
1935. *Lucina subnummismalis* (d'ORBIGNY); HÄGG, p. 46, Pl. 6, Figs 12—15.
1964. *Lucina subnummismalis* (d'ORBIGNY); HÄGG, p. 48.
1977. *Lucina subnumismalis* ORBIGNY; SOBETSKI, p. 171, Pl. 15, Fig. 17.

MATERIAL: 5 from Kazimierz, 3 from Nasiłów (opoka).

REMARKS: The studied specimens agree with those described by J. MÜLLER (1851), HOLZAPFEL (1889), BÖHM (1891). KRACH (1931) described one specimen of this species from the opoka exposed at Piotrawin (uppermost Campanian) of the study area.

AGE and DISTRIBUTION: Senonian of West Germany; Upper Senonian of the Netherlands, Sweden and the Lvov region; Maastrichtian of Crimea and Denmark; uppermost Campanian — Upper Maastrichtian of the Middle Vistula Valley.

Lucina (Lucina) laminosa (REUSS, 1846)
(Pl. 39, Fig. 3)

1846. *Venus laminosa* REUSS, p. 21, Pl. 41, Figs 6, 15.
(1850) *Venus sublaminosa* d'ORBIGNY, p. 237.
1893. *Venus laminosa* REUSS; FRIČ, pl 97, Text-figs 17—17a.
1934. *Lucina laminosa* REUSS; ANDERT, p. 253, Pl. 12, Figs 6—7.
(1965a) *Lucina laminosa* REUSS; CIEŚLIŃSKI, p. 120.
1977. *Lucina laminosa* (REUSS); SOBETSKI, p. 172, Pl. 15, Fig. 18.

MATERIAL: 2 from Dziurków, 3 from Kazimierz, 6 from Nasiłów (opoka).

REMARKS: The species can be easily distinguished from *Lucina subnumismalis* d'ORBIGNY by its higher posterodosal part and the finer concentric ornamentation. The species is closely similar to *L. tenera* (SOWERBY), described by WOODS (1904) from the Albian of England, in its general form and ornamentation.

AGE and DISTRIBUTION: Upper Turonian — Lower Senonian of Bohemia, Maastrichtian of Crimea and the Middle Vistula Valley; recorded also (CIEŚLIŃSKI 1965a) from the Maastrichtian deposits of the borehole Ostrów Mazowiecka near Warsaw.

Family **Fimbriidae** NICOL, 1950
Genus *Mutiella* STOLICZKA, 1871
Type species: *Corbis rotundata* d'ORBIGNY, 1843; *OD*
Mutiella coarctata (ZITTEL, 1865)
(Pl. 39, Figs 1—2)

1865. *Fimbria coarctata* ZITTEL, p. 44, Pl. 7, Fig. 5.
1896. *Mutiella coarctata* ZITT.; G. MÜLLER, p. 60, Pl. 8, Fig. 6; Pl. 11, Figs 1—3.
1909. *Mutiella coarctata* ZITT. sp.; ROGALA, p. 700, Pl. 28, Fig. 4.
(1911) *Mutiella coarctata* ZITT.; ROGALA, p. 492.
? 1934. *Mutiella coarctata* ZITT.; ANDERT, p. 252, Pl. 12, Figs 4—5.
(1938) *Mutiella coarctata* ZITT.; POŻARYSKI, p. 22.
(1942) *Mutiella coarctata* ZITT.; PUTZER, p. 371.
1961. *Mutiella coarctata* (ZITTEL); TZANKOV, p. 133, Pl. 66, Fig. 11; Pl. 67, Fig. 1.

MATERIAL: 1 from Męćmierz, 27 from Kazimierz, 65 from Nasiłów (55 opoka, 10 hardground).

REMARKS: The species is closely allied to *Mutiella rotundata* (d'ORBIGNY) from the Cenomanian — Lower Turonian of France, but the latter differs in having a higher shell and fine reticulate ornamentation.

In the study area, the species is predominant in the uppermost part of the Belemnella kazimiroviensis Zone, particularly in the Nasiłów section.

AGE and DISTRIBUTION: Middle Turonian — Lower Senonian of Bohemia, Lower Senonian of West Germany, Santonian — Maastrichtian of Bulgaria, Upper Senonian of Austria and the Lvov region, Upper Maastrichtian of the Middle Vistula Valley.

Superfamily **Crassatellacea** FÉRUSSAC, 1822
Family **Astartidae** d'ORBIGNY, 1844
Subfamily **Astartinae** d'ORBIGNY, 1844
Genus *Astarte* J. SOWERBY, 1816
Type species: *Venus scotica* MATON & RACKETT, 1807; *OD*
Subgenus *Astarte* J. SOWERBY, 1816
Astarte (Astarte) similis v. MÜNSTER, 1840
(Pl. 40, Figs 1—2)

1840. *Astarte similis* MÜNSTER; GOLDFUSS, p. 193, Pl. 134, Fig. 22.
1863. *Astarte similis* v. MÜNSTER; PŁACHETKO, p. 17, Pl. 1, Fig.14.
1865. *Astarte similis* v. MÜNSTER; ZITTEL, p. 53, Pl. 8, Fig. 6.
1869. *Astarte similis* MÜNSTER; FAVRE, p. 115, Pl. 12, Fig. 7.
1887. *Astarte similis* MÜNSTER; FRECH, p. 162, Pl. 12, Figs 15—15a.
1889. *Astarte similis* MNSTR.; HOLZAPFEL, p. 194, Pl. 19, Figs 11—13.
1934. *Astarte similis* MNSTR.; ANDERT, p. 242, Pl. 11, Fig. 44.
1935. *Astarte similis* MÜNSTER; HÄGG, p. 44, Pl. 6, Fig. 5.
(1938) *Astarte similis* MAN.; POŻARYSKI, p. 23.
1943. *Astarte similis* MÜNSTER; VAN DER WEIJDEN, p. 43, Pl. 2, Figs 12—13.
1977. *Astarte similis* MÜNSTER; SOBETSKI, p. 186, Pl. 16, Fig. 7.
1961. *Astarte (Astarte) similis* MÜNSTER; TZANKOV, p. 134, Pl. 67, Fig. 2.

MATERIAL: 1 from Ciszyca Kolonia (Upper Campanian), 2 from Kazimierz, 1 from Bochotnica (hardground), 2 from Nasiłów (1 opoka, 1 hardground).

REMARKS: The studied specimens are small, with triangle shells, ornamented with 4-6 rounded concentric undulations which are covered by fine growth lines. They agree with those figured by the previous investigators. POŻARYSKI (1938) recorded the species in the Upper Campanian of the study area.

AGE and DISTRIBUTION:Very widely distributed in the Upper Turonian — Upper Maastrichtian of Europe (Temperate and Tethyan), North Africa (Tunisia) and Southern India.

Subfamily **Opinae** CHAVAN, 1952
Genus *Opis* DEFRANCE, 1825
Type species: *Trigonia cardissoides* LAMARCK, 1819; *M*
Subgenus *Opis* DEFRANCE, 1825
Opis (Opis) ventricosa (PUSCH, 1837)
(Pl. 41, Figs 7—8)

1837. *Isocardia ventricosa* m., PUSCH, p. 68, Pl. 7, Figs 8a—b.
(1942) *Isocardia ventricosa* PUSCH; PUTZER, p. 372.

MATERIAL: 12 from Kazimierz, 4 from Bochotnica, 33 from Nasiłów (15 opoka, 18 hardground).

REMARKS: The general form, a well distinct posterior area and the highly curved prominent umbones of the studied species agree with the diagnosis of the genus *Opis* DEFRANCE, 1825.

The studied species closely resembles *Opis ungula* GRIEPENKERL, 1889, from the Lower Campanian of Königslutter, West Germany, in its general form and size; these two species are probably related.

AGE and DISTRIBUTION: Uppermost Maastrichtian of the Middle Vistula Valley.

Superfamily **Carditacea** FLEMING, 1820
Family **Carditidae** FLEMING, 1828
Subfamily **Venericardiinae** CHAVAN, 1969
Genus *Venericardia* LAMARCK, 1801
Type species: *Venericardia umbricata* LAMARCK, 1801; *SD* SCHMIDT, 1818
Venericardia santonensis G. MÜLLER, 1898
(Pl. 40, Fig. 5)

1898. *Venericardia santonensis* G. MÜLLER, p. 55, Pl. 7, Figs 11—12.
1909. *Venericardia santonensis* G. MÜLLER; ROGALA, p. 699, Pl. 28, Fig. 14.
(1911) *Venericardia santonensis* G. MÜLL.; ROGALA, p. 492.
1977. *Venercardia santonensis* MÜLLER; SOBETSKI, p. 193, Pl. 16, Figs 15—16.

MATERIAL: 8 from Ciszyca Górna (Upper Campanian), 2 from Dziurków, 1 from Kazimierz, 9 from Nasiłów (opoka).

REMARKS The studied specimens coincide with those described by MÜLLER (1898) and ROGALA (1909) from the Lower Senonian of West Germany and the Upper Senonian of the Lvov region, respectively.

The species is closely allied to *Venericardia bohemia* (GRIEPENKERL) from the Upper Senonian of West Germany and Bohemia, but the latter has radial ribs larger in size and smaller in number. The species is comparable with *V. tenuicos-*

tata SOWERBY from the Albian of England in general form and numerous radial riblets.

AGE and DISTRIBUTION: Lower Senonian of West Germany, Upper Senonian of the Lvov region, Crimea, and the Middle Vistula Valley.

Superfamily **Cardiacea** LAMARCK, 1809
Family **Cardiidae** LAMARCK, 1809
Subfamily **Cardiinae** LAMARCK, 1809
Genus *Granocardium* GABB, 1869
Type species: *Cardium carolinum* d'ORBIGNY, 1844; *SD* STEWART, 1930
Subgenus *Granocardium* GABB, 1869
Granocardium (Granocardium) alutacium (v. MÜNSTER, 1836)
(Pl. 40, Figs 3—4)

1836. *Cardium alutacium* MÜNSTER; GOLDFUSS, p. 220, Pl. 144, Fig. 5.
1841. *Cardium alutacium* v. MÜNSTER; ROEMER, p. 71.
(1850) *Cardium alutacium* v. MÜNSTER; d'ORBIGNY, p. 241.
1889. *Cardium alutacium* MÜNSTER; FRIČ, p. 77, Text-fig. 58.
1889. *Cardium alutacium v.* MÜNSTER; GRIEPENKERL, p. 63.
1897. *Cardium alutacium* MÜNST.; FRIČ, p. 52.
1911. *Cardium alutacium* MÜNST.; FRIČ, p. 31, Text-fig. 138.
(1938) *Cardium alutacium* GOLDF.; POŻARYSKI, p. 22.
(1942) *Cardium alutacium* GLDF.; PUTZER, p. 371.

MATERIAL: 9 from Kazimierz, 12 from Nasiłów (5 opoka, 7 hardground).

REMARKS: The studied specimens are identified with that figured by GOLDFUSS (1836) from the Campanian deposits of Haldem, West Germany.

The species can be distinguished from *G. productum* (SOWERBY), *G. pustulosum* (v. MÜNSTER) and other Upper Cretaceous cardiids by its almost oval outline and by the numerous and equal rows of fine spines covering the whole shell.

AGE and DISTRIBUTION: Cenomanian — Upper Senonian of Bohemia, Upper Senonian of West Germany, uppermost Maastrichtian of the Middle Vistula Valley.

Granocardium (Granocardium) aff. *pustulosum* (v. MÜNSTER, 1836)
(Pl. 40, Fig. 8)

MATERIAL: 1 from Kazimierz, 5 from Nasiłów (opoka).

REMARKS: The studied specimens are closely similar in general features to *"Cardium" pustulosum* v. MÜNSTER *(see* GOLDFUSS 1836, p. 221, Pl. 144, Fig. 6a-b) from the Coniacian deposits of Postelberg (Czechoslovakia), but the latter possesses distintly coarser radial rows of nodes on the posterior part only, while the studied specimens bear the coarser nodes on both anterior and posterior flanks.

Subgenus *Criocardium* CONRAD, 1870
Type species: *Cardium dumosum* CONRAD, 1870; *SD* STOLICZKA, 1871
Granocardium (Criocardium) productum (SOWERBY, 1832)
(Pl. 40, Figs 6—7)

1844. *Cardium productum* SOWERBY; d'ORBIGNY, p. 31, Pl. 247.

MATERIAL: 1 from Podgórz, 11 from Kazimierz, 3 from Nasiłów (2 opoka, 1 hardground).

REMARKS: The studied specimens are ornamented with primary and secondary rows of spines alternated with smooth radial ribs *(see* Pl. 40, Fig. 6). They agree with *"Cardium productum"* pictured by d'ORBIGNY (1844), which is however quite different, in form and ornamentation, from the specimens of *"Cardium" productum* SOWERBY figured by ZITTEL (1865) and HOLZAPFEL (1889). The latter specimens are ornamented with single rows of small and equal spines alternated with smooth radial ribs. This diference was also mentioned by WOODS (1908, p. 206).

AGE and DISTRIBUTION: Cenomanian of France and Upper Maastrichtian of the Middle Vistula Valley.

Genus *Pleuriocardia* SCOTT, 1978
Type species: *Cardium*(?) *kansasense* MEEK, 1871; *OD*
Subgenus *Pleuriocardia* SCOTT, 1978

DISCUSSION: The genus *Pleuriocardia* (with two subgenera) was introduced by SCOTT (1978), who mentioned that this genus widely occurs in the Lower — Upper Cretaceous (at least Albian — Campanian) of the Euramerican region. The European species *"Cardium" noeggerathi* J. MÜLLER (Upper Turonian — Upper Maastrichtian) and *"Cardium" cottaldinum* d'ORBIGNY (Neocomian) undoubtedly belong to the this genus. Thus, the stratigraphic range of *Pleuriocardia* SCOTT extends from the Lower Cretaceous (Neocomian) to the uppermost Maastrichtian.

Pleuriocardia (Pleuriocardia) noeggerathi (J. MÜLLER, 1851)
(Pl. 40, Fig. 10)

1851. *Cardium Noeggerathi* MÜLLER, p. 65, Pl. 8, Fig. 13.
1887. *Cardium Noeggerathi* JOS. MÜLL.; FRECH, p. 163.
1889. *Cardium Noeggerathi* MÜLL.; HOLZAPFEL, p. 183, Pl. 18, Figs 3—4.
1898. *Cardium Noeggerathi* J. MÜLL.; G. MÜLLER, p. 61, Pl. 9, Figs 5—6.
1934. *Cardium nöggerathi* J. MÜLL.; ANDERT, p. 261, Pl. 12, Fig. 19.
(1938) *Cardium noeggerathi* MÜLL.; POŻARYSKI, p. 21.
(1942) *Cardium noeggerathi* MÜLL.; PUTZER, p. 371.
1943. *Cardium nöggerathi* J. MÜLLER; VAN DER WELJDEN, p. 82, Pl. 2, Fig. 22.

MATERIAL: 7 from Nasiłów (opoka).

REMARKS: Most of the studied specimens are stained by limonitic material; however, their general features as well as their cancellate ornamentation agree with those figured by J. MÜLLER (1851), HOLZAPFEL (1889) and G. MÜLLER (1898) from the Senonian of the Netherlands and West Germany. The species *Pleurocardia cottaldina* (d'ORBIGNY) is closely comparable to the studied species in its general form and ornamentation.

AGE and DISTRIBUTION: Upper Turonian — Lower Senonian of Bohemia, Senonian of the Netherlands and West Germany, uppermost Maastrichtian of the Middle Vistula Valley.

Subfamily **Protocardiinae** KEEN, 1951
Genus *Nemocardium* MEEK, 1876
Type species: *Cardium semiasperum* DESHAYES, 1858; *SD* SACCO, 1899
Subgenus *Nemocardium* MEEK, 1876
Nemocardium (Nemocardium) fenestratum (KNER, 1850)
(Pl. 40, Fig. 9)

1850. *Cardium fenestratum* KNER, p. 25, Pl. 4, Fig. 12.
1850. *Cardium polonicum* ALTH, p. 227, Pl. 12, Fig. 3.

1852. *Cardium fenestratum* m., KNER, p. 20, Pl. 2, Fig. 22.
1869. *Cardium fenestratum* KNER; FAVRE, p. 114, Pl. 2, Fig. 6.
1889. *Cardium (Protocardia) fenestratum* KNER; GRIEPENKERL, p. 61.
(1911) *Protocardium fenestratum* KNER; ROGALA, p. 494.
(1938) *Cardium fenestratum* KNER; POŻARYSKI, p. 21.
(1951) *Cardium fenestratum* KNER; POŻARYSKA & POŻARYSKI, p. 20.
1977. *Granocardium fenestratum* (KNER); SOBETSKI, p. 193, Pl. 16, Fig. 4.

MATERIAL: 5 from Piotrawin (uppermost Campanian), 1 from Dobre, 3 from Męćmierz, 21 from Kazimierz, 1 from Janowiec, 40 from Nasiłów (35 opoka, 5 hardrogund).

REMARKS: The genus *Nemocardium* MEEK is accepted herein for the studied species, which carries the main diagnosis of the genus, particularly the ornamentation (numerous radial riblets more distinct on the posterior part and crossed by fine concentric growth lines).

The species *"Cardium" subalutaceum* VOGEL von FALCKENSTEIN, 1911, from the Lower Senonian is closely similar to the studied species and probably related. WOODS (1908, p. 205) described *"Cardium"* sp. from the Upper Chalk of England Belemnitella mucronata Zone), which is also similar in form and ornamentation to the studied species. The species *"Granocardium" tauricum* SOBETSKI, 1977, from the Maastrichtian of Crimea is closely similar to the studied species. POŻARYSKI (1938) recorded the studied species in the Campanian — Upper Maastrichtian of the study area.

AGE and DISTRIBUTION: Upper Senonian of England, West Germany, the Lvov region, Crimea, and the Middle Vistula Valley.

Superfamily **Solenacea** LAMARCK, 1809
Family **Cultellidae** DAVIES, 1935
Genus *Cultellus* SCHUMACHER, 1817
Type species: *Cultellus magnus* SCHUMACHER, 1817; *M*
Subgenus *Cultellus* SCHUMACHER, 1817
Cultellus(?) *kulczynskii* ROGALA, 1911
(Pl. 41, Figs 1—2)

1911. *Cultellus? kulczynskii* nv. sp.; ROGALA, p. 496, Fig. 4.

MATERIAL: 1 from Podgórz, 25 from Kazimierz, 2 from Janowiec.

REMARKS: The studied specimens are identical with those described by ROGALA (1911) from the Upper Senonian of the Lvov region; however, all they are preserved as steinkerns, and there is no information about the hinge and the internal features. It might be thus better to keep the generic assignment, as originally given by ROGALA (1911).

AGE and DISTRIBUTION: Upper Senonian of the Lvov region and Upper Maastrichtian of the Middle Vistula Valley.

Genus *Leptosolen* CONRAD, 1865
Type species: *Siliquaria biplicata* CONRAD, 1858; *M*
Leptosolen concentristriatus (G. MÜLLER, 1888)
(Pl. 41, Figs 3—4)

1888. *Siliqua concentristriata* G. MÜLLER, p. 491, Pl. 18, Fig. 5.
1898. *Siliqua concentristriata* G. MÜLL.; G. MÜLLER, p. 70, Pl. 10, Fig. 5.
1911. *Leptosolen concentristriatus* G. MÜLL.; ROGALA, p. 495, Fig. 5.
? 1931. *Leptosolen Petersi* REUSS; KRACH, p. 359, Pl. 7, Fig. 4.

MATERIAL: 7 from Kazimierz, 1 from Janowiec, 2 from Nasiłów (opoka).

REMARKS: All the studied specimens are internal molds, with a deep sulcus extending from the umbo ventrally and not reaching the ventral margin, and which is formed by the internal rib.

The studied specimens agree with those described by G. MÜLLER (1898) and ROGALA (1911) from the Lower Senonian of West Germany and the Upper Senonian of the Lvov region, respectively. The studied species is closely similar to *Leptosolen petersi* (REUSS) and most probably related.

AGE and DISTRIBUTION: Lower Senonian of West Germany, Upper Senonian of the Lvov region, and uppermost Mastrichtian of the Middle Vistula Valley.

Superfamily **Tellinacea** de BLAINVILLE, 1814
Family **Tellinidae** de BLAINVILLE, 1814
Subfamily **Tellininae** de BLAINVILLE, 1814
Genus *Linearia* CONRAD, 1860
Type species: *Linearia metastriata* CONRAD, 1860; *M*
Subgenus *Liothyris* CONRAD *in* KEER, 1875
Type species: *Linearia (Liothyris) carolinensis* CONRAD, 1875; *M*
Linearia (Liothyris) gorbatschae SOBETSKI, 1977
(Pl. 41, Fig. 10)

1977. *Linearia (Liothyris) gorbatschae* SOBETSKI, p. 176, Pl. 15, Figs 23—24.
MATERIAL: One specimen from Bochotnica (hardground).

REMARKS: The studied specimen is stainded by limonitic material, but its general features as well as concentric ornamentation coincide with those of *Linearia (Liothyris) gorbatschae* SOBETSKI from the Maastrichtian deposits of Crimea.

AGE and DISTRIBUTION: Maastrichtian of Crimea and uppermost Maastrichtian of the Middle Vistula Valley.

Superfamily **Arcticacea** NEWTON, 1891
Family **Arcticidae** NEWTON, 1891
Genus *Tenea* CONRAD, 1870
Type species: *Mysia parilis* CONRAD, 1860; *M*
Tenea cf. *ovalis* SOBETSKI, 1977
(Pl. 41, Figs 5—6)

cf. 1977. *Tenea ovalis* n. sp., SOBETSKI, p. 202, Pl. 17, Fig. 6.
MATERIAL: 1 from Dobre, 51 from Kazimierz, 20 from Nasiłów (14 opoka, 6 hardground).

REMARKS: Many steinkerns and external molds were collected from the Upper Maastrichtian of the study area, particularly from the Kazimierz section. They are of small-sized, ovate, and moderately inflated shells. The hinge line bears one bifid anterior tooth and weakly defined posterior ones. The studied specimens agree with *Tenea ovalis* SOBETSKI from the Maastrichtian of Crimea; however the species is not fully determined because the studied specimens are badly preserved.

Genus *Venilicardia* STOLICZKA, 1870
Type species: *Cyprina bifida* ZITTEL, 1865; *OD*
Venilicardia aff.*venreyi* (BOSQUET, 1860)
(Pl. 41, Fig. 9)

MATERIAL: One specimen from Nasiłów (opoka).

REMARKS: The studied specimen closely resembles *Venilicardia venreyi* (BOSQUET) from the Campanian greensand of Aachen, as figured by HOLZAPFEL (1889, Pl. 16, Figs. 1-8), but it differs in having the gently curved posterodorsal part and subtruncated posterior margin. The studied specimen shows also many similarites with the Lower Cretaceous species *V. lineolata* (SOWERBY).

Family **Trapeziidae** LAMY, 1920
Genus *Trapezium* MEGERLÉ von MÜHLFELD, 1811
Type species: *Trapezium perfectum* MEGERLÉ von MÜHLFELD, 1811; *SD* STEWART, 1930
Subgenus *Trapezium* MEGERLÉ von MÜHLFELD, 1811
Trapezium (Trapezium) trapezoidale (ROEMER, 1841)
(Pl. 42, Fig. 4)

1841. *Crassatella trapezoidalis* N. ROEMER, p. 74, Pl. 9, Fig. 22.
1904. *Trapezium trapezoidale* (ROEMER); WOODS, pp. 149—150, Pl. 23, Figs 17—19 (*cum syn.*).
1913. *Cypricardia trapezoidalis* A. ROEM.; SCUPIN, p. 164, Pl. 7, Fig. 5.
1918. *Trapezium trapezoidale* ROEM.; WOLDRICH, p. 294, Pl. 5, Fig. 6.
1931. *Trapezium trapezoidale* ROEM.; KRACH, pp. 358—359. Pl. 7, Figs 5—6.
1933. *Cypricardia trapezoidalis* A. ROEMER; WOLANSKY, p. 31, Pl. 3, Figs 18—18a.
1934. *Trapezium trapezoidale* A. ROEMER sp.; ANDERT, p. 268, Pl. 12, Figs 28—30.
(1938) *Cypricardia trapezoidales* ROEM.; POŻARYSKI, p. 22.
(1942) *Cypricardia trapezoides* ROEM.; PUTZER, p. 371.
1951. *Trapezium trapezoidalis* ROEM.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 7, Fig. 7.
1965b. *Cypricardia (Trapezium) trapezoidalis* (ROEMER); CIEŚLIŃSKI, p. 25, Pl. 2, Fig. 5.

MATERIAL: 1 from Podgórz, 2 from Męćmierz, 31 from Kazimierz, 15 from Nasiłów (13 opoka, 2 hardground).

REMARKS: Most of the studied specimens were affected by the plastic deformation. POŻARYSKI (1938) recorded this species in the Upper Campanian — Upper Maastrichtian, and CIEŚLIŃSKI (1965b) also from the Cenomanian deposits of the Middle Vistula Valley.

AGE and DISTRIBUTION: Very widely distributed in the Cenomanian — Upper Maastrichtian of Europe.

Superfamily **Veneracea** RAFINÉSQUE, 1815
Family **Veneridae** RAFINÉSQUE, 1815
Subfamily **Tapetinae** H. ADAMS & A. ADAMS, 1857
Genus *Legumen* CONRAD, 1858
Type species: *Legumen ellipticus* CONRAD, 1858; *SD* STOLICZKA, 1871
Legumen fragilis (d'ORBIGNY, 1845)
(Pl. 42, Figs 2—3)

1845. *Venus fragilis* d'ORBIGNY, p. 446, Pl. 365, Figs 11—12.
1865. *Tapes fragilis* d'ORBIGNY; ZITTEL, p. 18, Pl. 3, Fig. 3.
1889. *Tapes fragilis* d'ORBIGNY; HOLZAPFEL, p. 164, Pl. 13, Fig. 6.
1901. *Venus (Tapes) fragilis* d'ORB.; STURM, p. 82, Pl. 7, Fig. 8.
1912. *Tapes (Baroda) fragilis* d'ORBIGNY; PERVINQUIÈRE, p. 277, Pl. 20, Fig. 10.
1934. *Tapes fragilis* d'ORB.; BLANCKENHORN, p. 256.
1961. *Legumen fragilis* (d'ORBIGNY); TZANKOV, p. 143, Pl. 70, Fig. 4.

MATERIAL: 2 from Kazimeirz, 9 from Nasiłów (7 opoka, 2 hardground).

REMARKS: The studied specimens are characterized by medium-sized, elongated oblong, and compressed shells, ornamented with distinct concentric growth lines. They are identified with those figured by d'ORBIGNY (1845), ZITTEL (1865), and HOLZAPFEL (1889).

AGE and DISTRIBUTION: Lower Turonian of France, Turonian of Bulgaria, Senonian of Austria and West Germany, uppermost Maastrichtian of the Middle Vistula Valley. In the Middle East, Upper Cenomanian — Turonian of Egypt and Jordan, and Maastrichtian of Tunisia.

Order **Myoida** STOLICZKA, 1870
Suborder **Myina** STOLICZKA, 1870
Superfamily **Myacea** LAMARCK, 1809
Family **Corbulidae** LAMARCK, 1818
Genus *Corbula* BRUGUIÈRE, 1797
Type species: *Corbula sulcata* LAMARCK, 1801; *SD* SCHMIDT, 1818
Corbula sp.
Pl. 42, Fig. 1)

REMARKS: Two external molds (right valves) were collected from Nasiłów (opoka). They are of small, rostrated and moderately inflated shells, ornamented with fine concentric riblets, which are more distinct near the ventral margin. Although the studied specimens are not sufficiently well preserved for specific identification, they serve to indicate the presence of this genus within the investigated deposits.

Superfamily **Hiatellacea** GRAY, 1824
Family **Hiatellidae** GRAY, 1824
Genus *Panopea* MENARD, 1807
Type species: *Panopea faujasi* MENARD, 1807; *SD* FLEMING, 1818
Subgenus *Panopea* MENARD, 1807
Panopea (Panopea) mandibula (SOWERBY, 1813)
(Pl. 42, Fig. 8 and Pl. 43, Fig. 3)

1813. *Mya mandibula* J. SOWERBY, Vol. 1, p. 93, Pl. 43.
v. 1840. *Panopaea Baumontii* MÜNSTER; GOLDFUSS, p. 274, Pl. 158, Fig. 4.
1841. *Panopaea Jugleri* N., ROEMER, p. 75, Pl. 10, Fig. 4.
1844. *Panopea mandibula* d'ORBIGNY, p. 344, Pl. 360, Figs 3—4.
1904. *Panopea mandibula* (SOWERBY); WOODS, p. 228, Pl. 37, Figs 1—5 (*cum syn.*).
1909. *Glycimaris mandibula* SOW. sp.; ROGALA, p. 701.
1934. *Panopea mandibula* SOW. sp.; ANDERT, p. 327, Pl. 15, Figs 1—2.
(1936) *Panopea mandibula* SOW.; POŻARYSKI, p. 22.
(1942) *Panopaea mandibula* SOW.; PUTZER, p. 371.
1943. *Panopea mandibula* (SOWERBY); VAN DER WEIJDEN, p. 72, Pl. 5, Fig. 14.
1974. *Panope mandibula* (SOWERBY); SAVCZINSKAJA, p. 106, Pl. 39, Figs 6—7.
1977. *Panopea mandibula* (SOWERBY); SOBETSKI, p. 209, Pl. 17, Fig. 11.
1982. *Panopea mandibula* (SOWERBY); SOBETSKI, p. 161, Pl. 16, Fig. 16.

MATERIAL: 20 from Kazimierz, 1 from Janowiec, 1 from Bochotnica, 50 from Nasiłów (44 opoka, 6 hardground).

REMARKS: The species is considered as one of the predominant bivalves in the uppermost Maastrichtian deposits of the study area.

The species can be easily distinguished from other Upper Cretaceous species by the acute pointed umbo, an oblong or rhomboidal outline and the presence of distinct umbo-postero-ventral furrow (*see* WOODS 1904).

AGE and DISTRIBUTION: Very widely distributed in the Albian — Upper Maastrichtian of Europe.

Suborder **Pholadina** H. ADAMS & A. ADAMS, 1858
Superfamily **Pholadacea** LAMARCK, 1809
Family **Teredinidae** RAFINESQUE, 1815
Teredinid tubes
(Pl. 43, Fig. 4)

1941. *Succinodon putzeri*; v. HUENE, pp. 85—91, Fig. 1.
(1942) *Succinodon putzeri* v. HUENE; PUTZER, p. 370.
1981. *Kuphus* sp.; POŻARYSKA & PUGACZEWSKA, pp. 30—31, Pl. 3, Figs 1—7 and Pl. 4, Figs 1—7.

MATERIAL: 1 from Dziurków, 1 from Kazimierz.

REMARKS: The studied specimens are preserved as fragments of thin calcareous ("teredinid") tubes and their molds embedded in wood fragments. These tubes were misidentified by HUENE (1941) as remains teeth a titanosaurid dinosaur *(sic!)*, called by him as *"Succinodon putzeri HUENE" (see* also PUTZER 1942). POŻARYSKA & PUGACZEWSKA (1981) described these tubes with preserved pallets (which they called "the septa") from Bochotnica and Nasiłów greensands, and attributed them to the bivalve genus *Kuphus*.

It is to note that TURNER (1969) mentioned that the pallets and shells of *Kuphus* have never been found as fossils. Moreover, the mode of life in the genus *Kuphus* is different, and its representatives do not bore in wood *(see* SAVAZZI 1982), and are provided with pallets of a quite different shape *(see* MOLL 1942). Regardless a different attribution of the discussed pallets, it is recommended to determine the tubes, especially those devoid of pallets, only generally as the teredinid tubes *sensu* RADWAŃSKI (1977).

AGE and DISTRIBUTION: Maastrichtian of the Middle Vistula Valley (not Montian as given by POŻARYSKA & PUGACZEWSKA 1981).

Order **Hippuritoida** NEWELL, 1965
Superfamily **Hippuritecea** GRAY, 1848
Family **Monopleuridae** MUNIER-CHALMAS, 1873
Genus *Gyropleura* DOUVILLÉ, 1887
Type species: *Requienia cenomanensis* d'ORBIGNY 1850; *OD*
Gyropleura inequirostrata (WOODWARD, 1833)
(Pl. 42, Figs 5—7)

1886. *Caprotina russiensis* d'ORB.; SIEMIRADZKI, pp. 62—63, Pl. 4, Fig. 1.
1908. *Gyropleura inequirostrata* (WOODWARD); WOODS, p. 209, Pl. 33, Figs 8—13.
1931. *Gyropleura inaequirostrata* WOODWARD; KRACH, p. 357, Pl. 7, Figs 2, 1a—b.
(1938) *Gyropleura inaequirostrata* WOODW.; POŻARYSKI, p. 21.
(1942) *Gyropleura inaequirostrata* WOODW.; PUTZER, p. 370.
1951. *Gyropleura inaequirostrata* WOODW.; POŻARYSKA & POŻARYSKI, p. 20, Pl. 7, Fig. 6.
1965. *Pycnodonta* sp. PUGACZEWSKA, pp. 89—90, Pl. 12, Fig. 1.
1974. *Gyropleura inequirostrata* (WOODWARD); SAVCZINSKAJA, p. 110, Pl. 40, Figs 6—17.

MATERIAL: 1 from Męćmierz, 88 from Kazimierz, 5 from Janowiec, 1 from Bochotnica, 36 from Nasiłów (30 opoka, 5 hardground, 1 greensand).

REMARKS: This species is one of the most common bivalves in marly opoka of the uppermost Maastrichtian deposits in the study area. In highly worn specimens most of the radial ribs are removed and the shell becomes smooth with concentric growth lines. The variability in number and size of the radial ribs, as well as in the width of the interspace is noticed in the studied specimens.

The right valve of this species is commonly attached to the shells of bivalves and cephalopods, particularly to the belemnite quards. RADWAŃSKI (1972) attributed the specimens attached to belemnite quards (collected from the Mielnik chalk, and from the Nasiłów and Bochotnica opoka) to *Gyropleura ciplyana* (de RYCKHOLT). These specimens were formerly misidentified by PUGACZEWSKA (1965) as *"Pycnodonta* sp." *(see* RADWAŃSKI 1972, p. 258). However, the studied specimens agree with those described by WOODS (1908). Indeed, there is no sharp deference between *G. inequirostrata* and *G. ciplyana*, the only difference is that the shells of the latter species have wider interspaces *(see* WOODS 1908). In the author's opinion these two species are probably closely related.

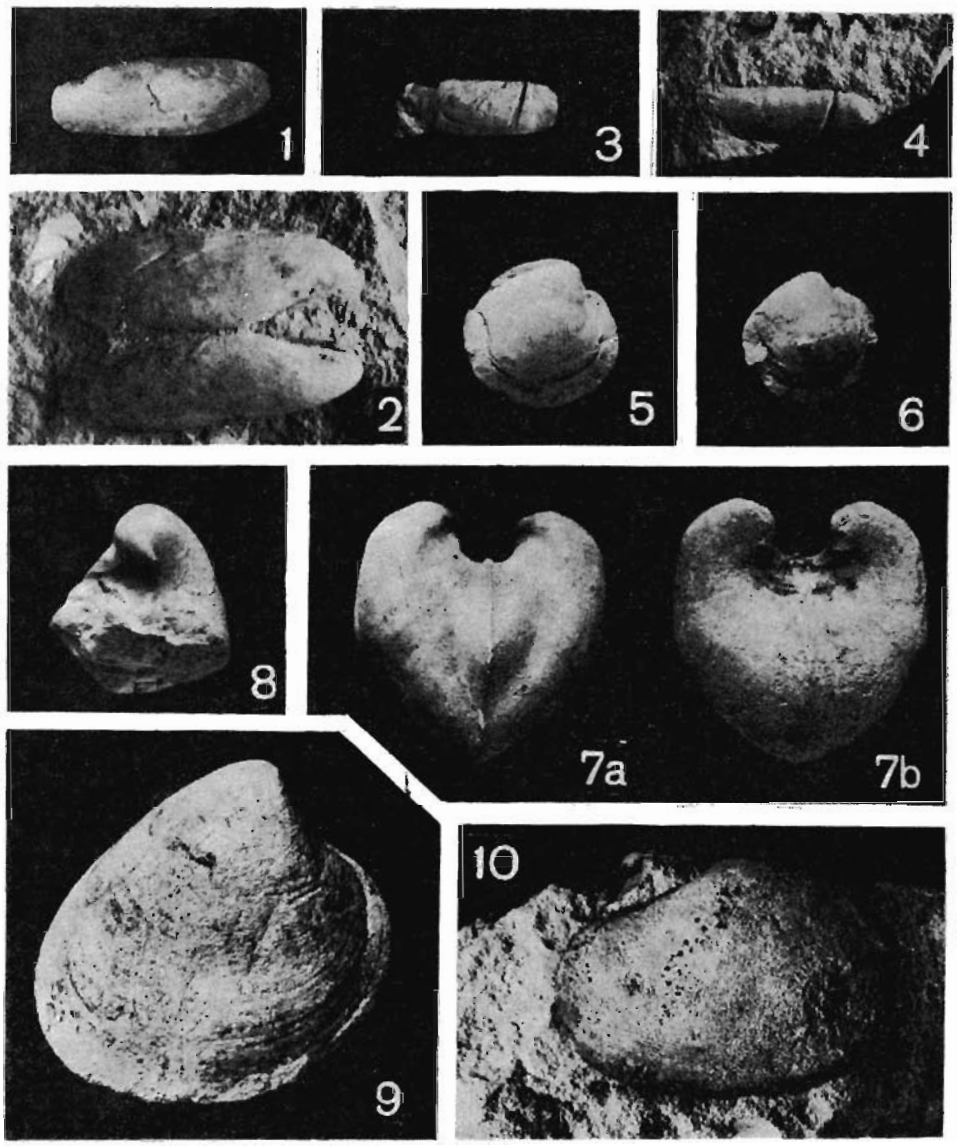
In the Senonian deposits of the North European Province the following species were distinguished: *G. inequirostrata* (WOODWARD) originally described from the Upper Chalk of England, *G. muensteri* (v. HAGENOW) from the Isle of Rügen and Denmark, *G. ciplyana* (de RYCHKOLT) from France and Limburg, *G. costulata* (J. MÜLLER) from Aachen and Maastricht, *G. moritzi* (STROMBECK) from Königslutter, West Germany, *G. russiensis* (d'ORBIGNY) from the Russian Platform, *G. laevis* HOLZAPFEL from Aachen, and *G. lomnickii* ROGALA from the Lvov region. The species *muensteri, costulata, moritzi* were considered as synonyms of *G. ciplyana* by HOLZAPFEL (1889), WOLLEMANN (1902), and WOLANSKY (1932). MORRIS (1854; *fide* WOODS 1908) listed *G. russiensis* as a synonym of *G. inequirostrata.*

The species *G. laevis* HOLZAPFEL and *G. lomnickii* ROGALA are distinguished by their smooth radial ribs; most probably they are highly worn examples of *G. inequirostrata* or *G. ciplyana.*

AGE and DISTRIBUTION: Very widely distributed in the Upper Senonian of the North European Province.

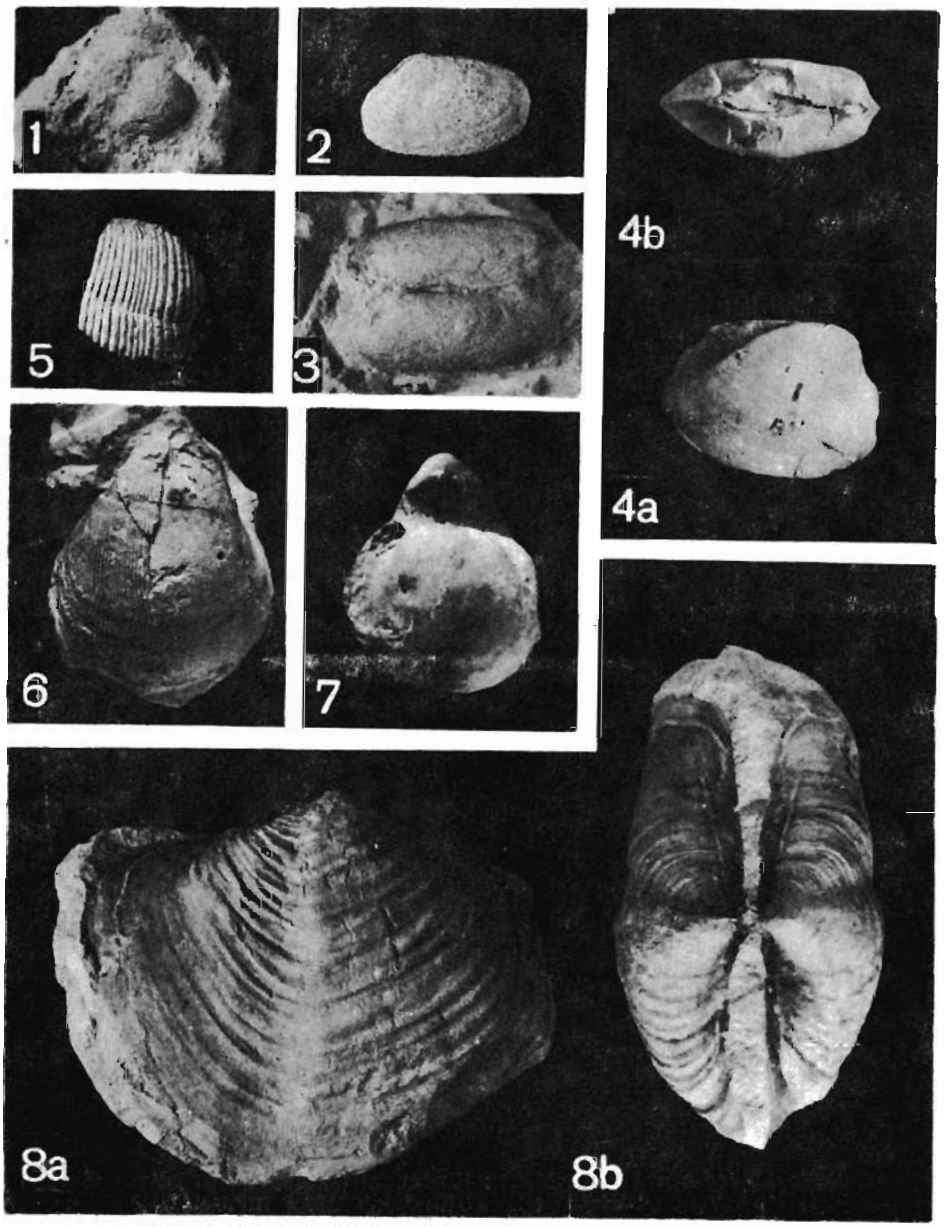
Subclass **Anomalodesmata** DALL, 1889
Order **Pholadomyoida** NEWELL, 1965
Superfamily **Pholadomyacea** GRAY, 1847
Family **Pholadomyidae** GRAY, 1847
Genus *Pholadomya* G. B. SOWERBY, 1823
Type species: *Pholadomya candida* SOWERBY, 1823; *SD* GRAY, 1847
Subgenus *Pholadomya* G. B. SOWERBY, 1823
Pholadomya (Pholadomya) kasimiri PUSCH, 1837
(Pl. 45, Figs 3—4 and Pl. 46, Figs 4—5)

1837. *Pholadomya Kasimiri* m., PUSCH, p. 88, Pl. 8, Fig. 13.
v. 1840. *Pholadomya Esmarkii* PUSCH; GOLDFUSS, p. 272, Pl. 157, Fig. 10a—d.
1850. *Pholadomya Casimiri* PUSCH ?; ALTH, p. 237.
1863. *Pholadomya Casimiri* PUSCH; PŁACHETKO, p. 19, Pl. 1, Fig. 17.
1869. *Pholadomya Esmarki* NILSSON sp.; FAVRE, p. 105, Pl. 11, Fig. 10.
1875. *Pholadomya Esmarki* NILSSON sp.; MOESCH, p. 101, Pl. 33, Fig. 7 and Pl. 34, Fig. 5.
1875. *Pholadomya Kasimiri* PUSCH; MOESCH, p. 111.
1886. *Pholadomya Casimiri* PUSCH; SIEMIRADZKI, p. 65.
1889. *Pholadomya Esmarki* NILSS. sp.; HOLZAPFEL, p. 155, Pl. 14, Figs 1—2.



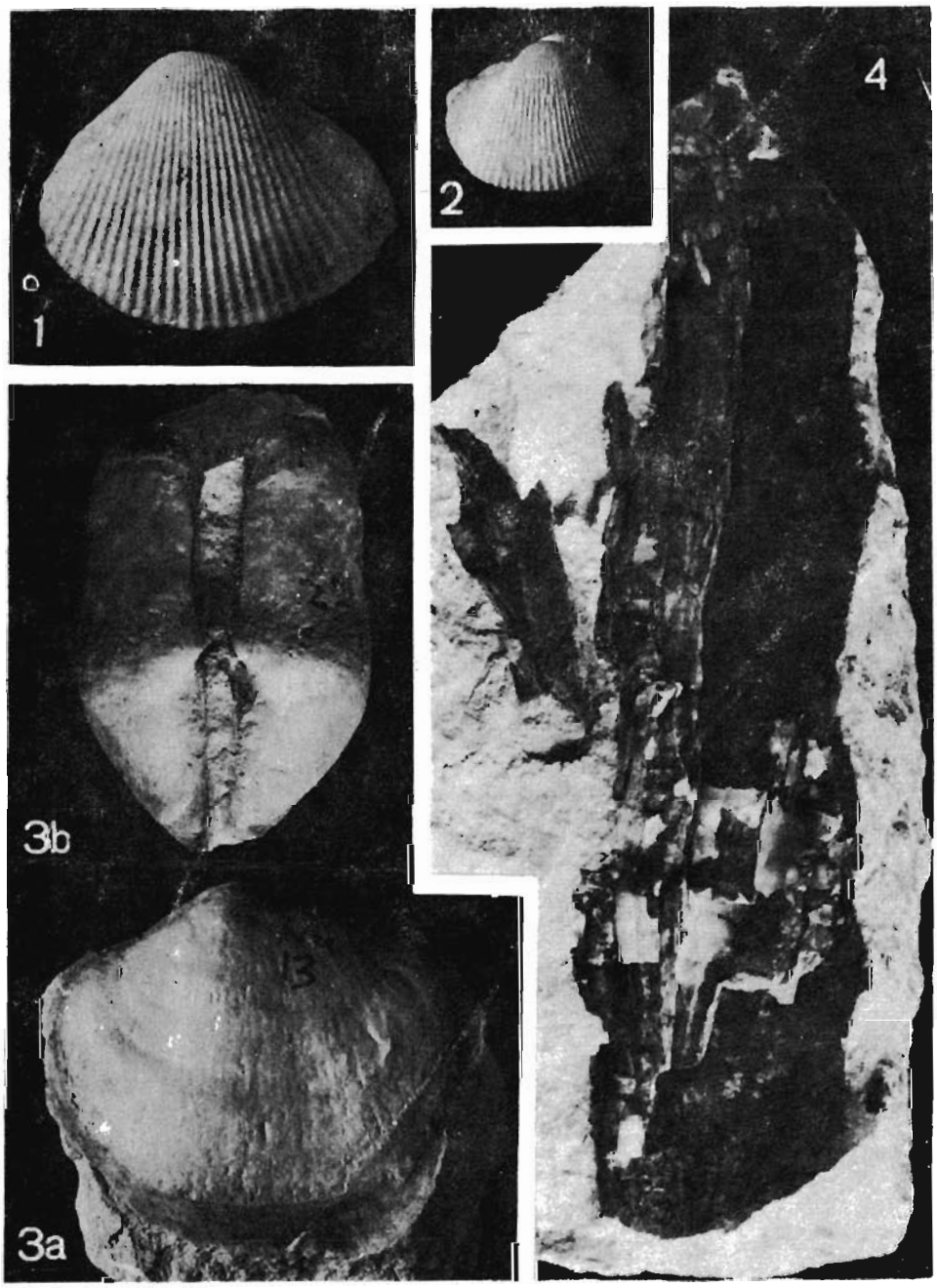
1-2 — *Cultellus*(?) *kulczynskii* ROGALA; Kazimierz (*1, 2* LV, two valves views)
3-4 — *Leptosolen concentristriatus* (G. MÜLLER); *3* from Kazimierz, *4* from Janowiec (steinkerns of RV)
5-6 — *Tenea* cf. *ovalis* SOBETSKI; Kazimierz (steinkerns of RV)
7-8 — *Opis (Opis) ventricosa* (PUSCH); *7* steinkern from Nasiłów opoka (*7a, 7b* anterior and posterior views), *8* steinkern of LV
9 — *Venilicardia* aff. *venreyi* (BOSQUET); Nasiłów opoka (LV view; MACHALSKI's Coll.)
10 — *Linearia (Liothyris) gorbatschae* SOBETSKI; Bochotnica opoka (external mold of RV; MZ-M. 2363)

All figures in natural size



1 — *Corbula* sp.; Nasiłów opoka (external mold of RV), ×2
2-3 — *Legumen fragilis* (d'ORBIGNY); *2* from Nasiłów hardground, *3* from Nasiłów opoka (*2* LV, *3* two valves)
4a-4b — *Trapezium (Trapezium) trapezoidale* (ROEMER); Kazimierz (RV and dorsal views)
5-7 — *Gyropleura inequirostrata* (WOODWARD); Nasiłów opoka, *5* fragment of worn shell, *6* incomplete RV, *7* steinkern of two valves (LV view)
8a-8b — *Panopea (Panopea) mandibula* (SOWERBY); Nasiłów opoka (RV and dorsal views)

All figures in natural size except Fig. 1 taken ×2

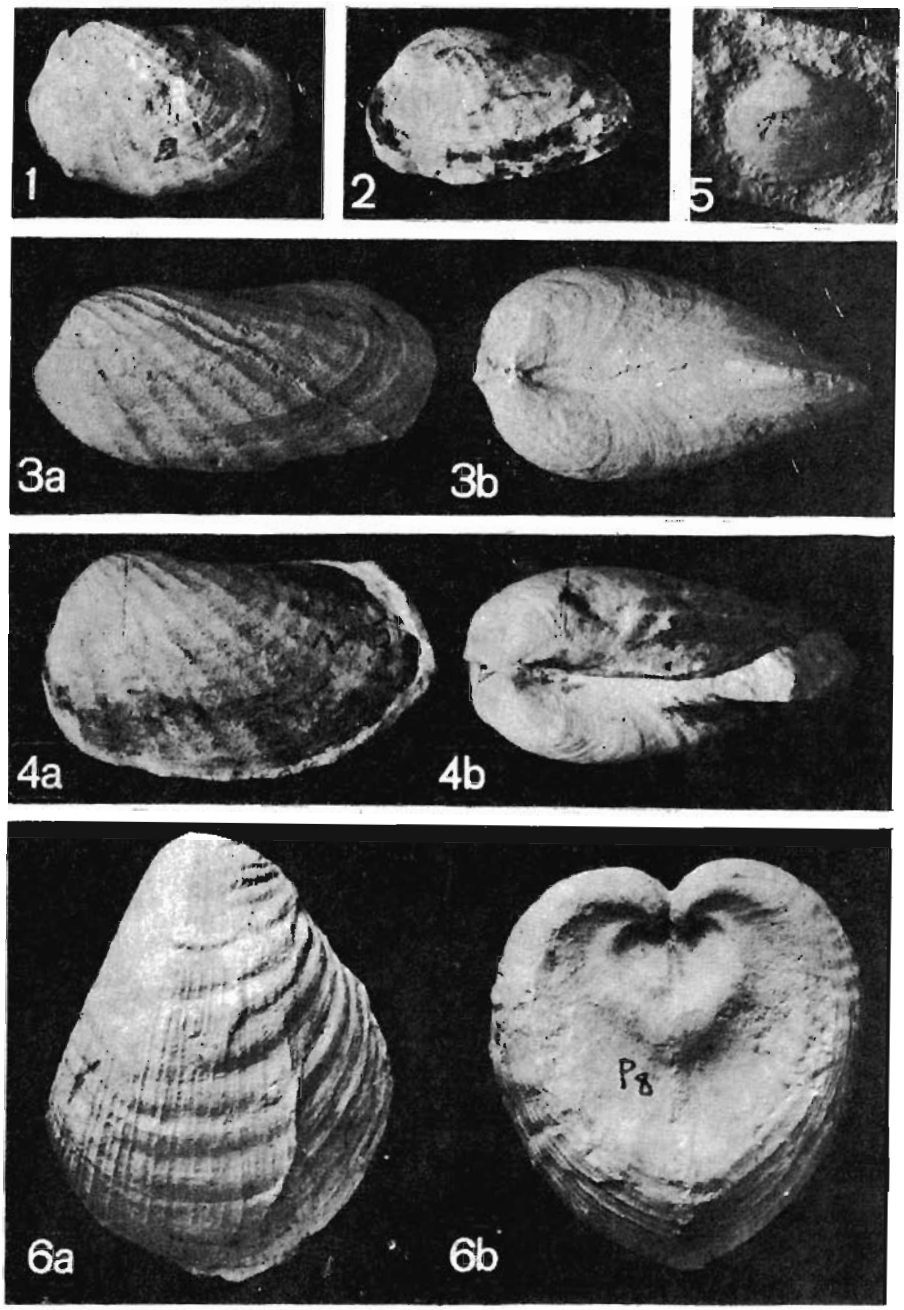


1-2 — *Liopistha (Liopistha) aequivalvis* (GOLDFUSS); Nasiłów opoka (*1, 2* LV and RV views)

3a-3b — *Panopea (Panopea) mandibula* (SOWERBY); steinkern from Nasiłów opoka (LV and dorsal views)

4 — Teredinid tubes in a piece of wood; Kazimierz

All figures in natural size

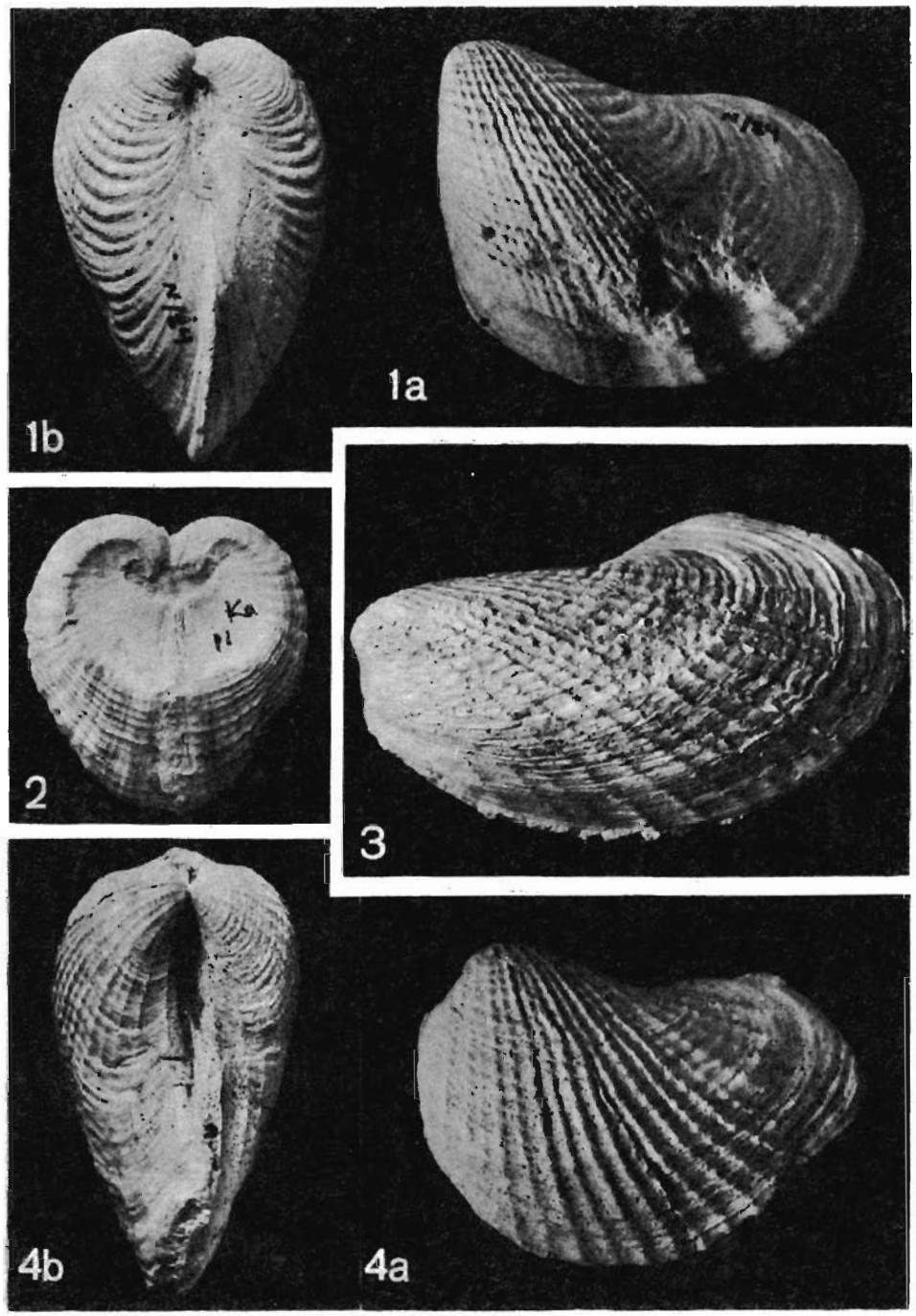


1-4 — *Pholadomya (Pholadomya) salzbergensis* ANDERT; *1—2* from Kazimierz, *3—4* from Nasiłów opoka (*1, 2, 3a, 4a* LV views; *3b, 4b* dorsal views of external molds)

5 — *Periploma (Periploma)* sp.; Kazimierz (LV view)

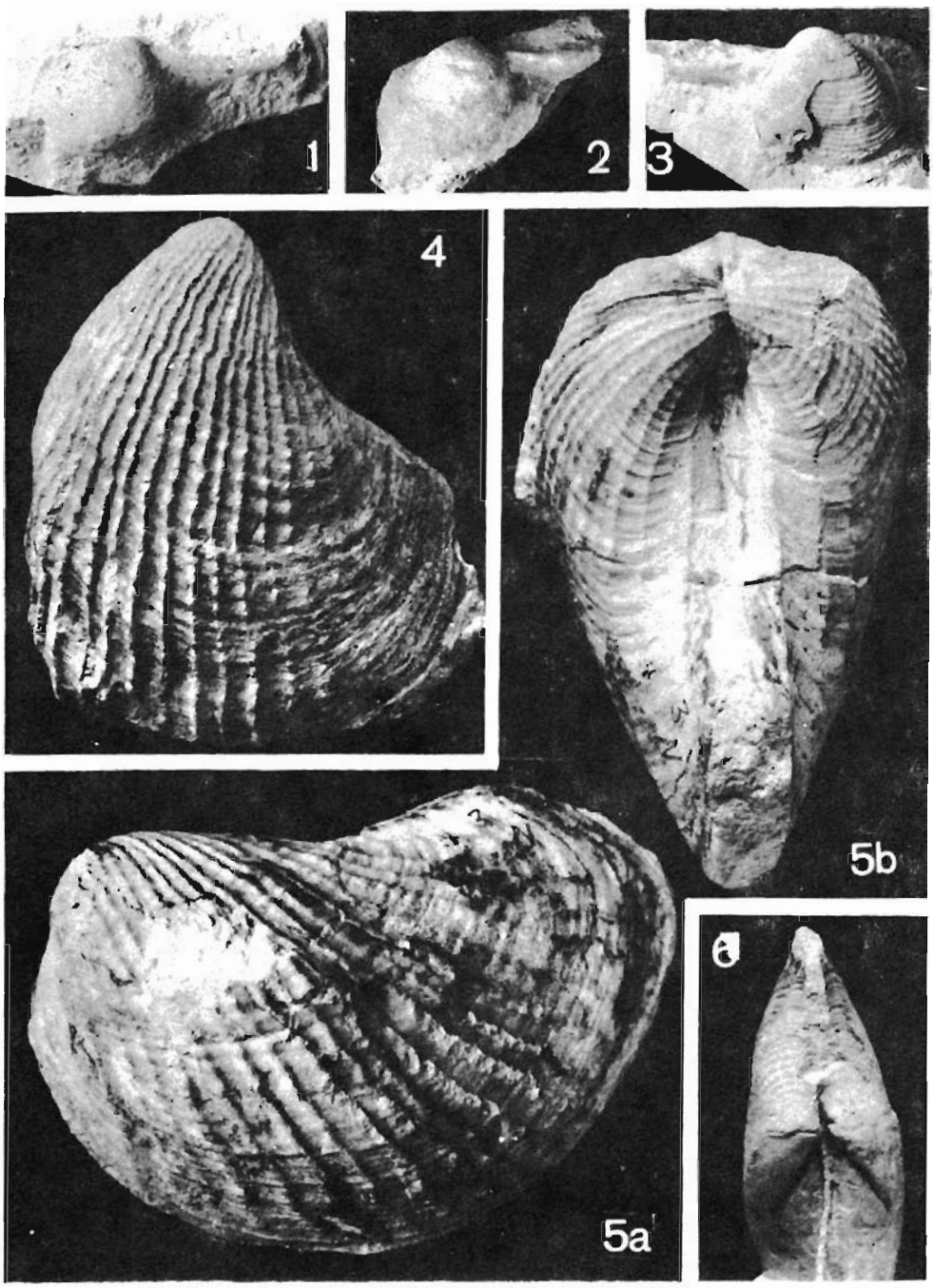
6a-6b — *Pholadomya (Procardia) decussata* (MANTELL); Piotrawin (anterior, LV views of external mold)

All figures in natural size



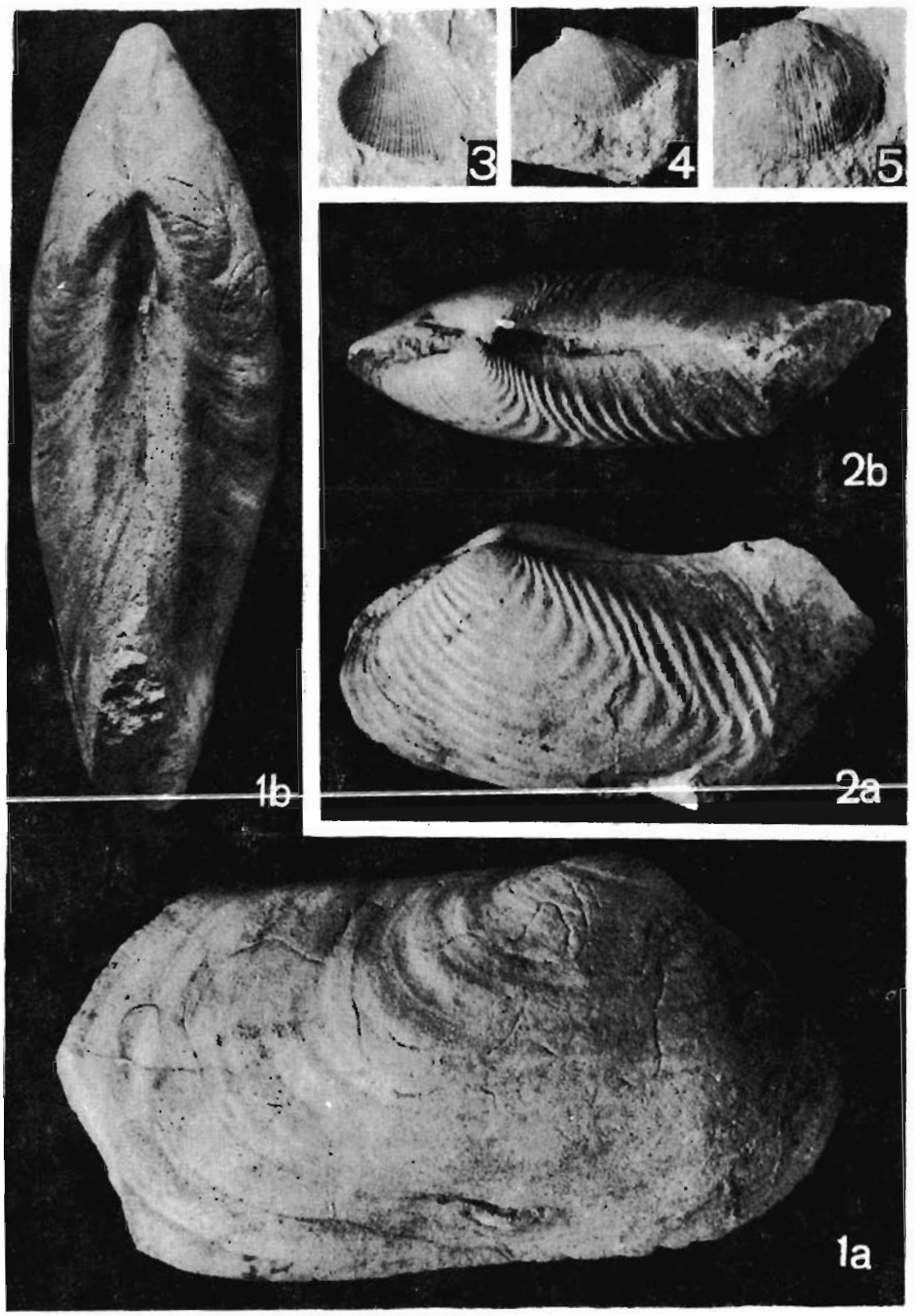
1a-1b — *Pholodomya (Bucardiomya) esmarki* (NILSSON); Nasiłów opoka (LV and dorsal views)
2 — *Pholadomya (Procardia) decussata* (MANTELL); Kazimierz (anterior view)
3-4 — *Pholadomya (Pholadomya) kasimiri* PUSCH; *3* from Nasiłów opoka, *4* from Nasiłów hardground (*3*, *4a* LV views, *4b* dorsal view)

All figures in natural size



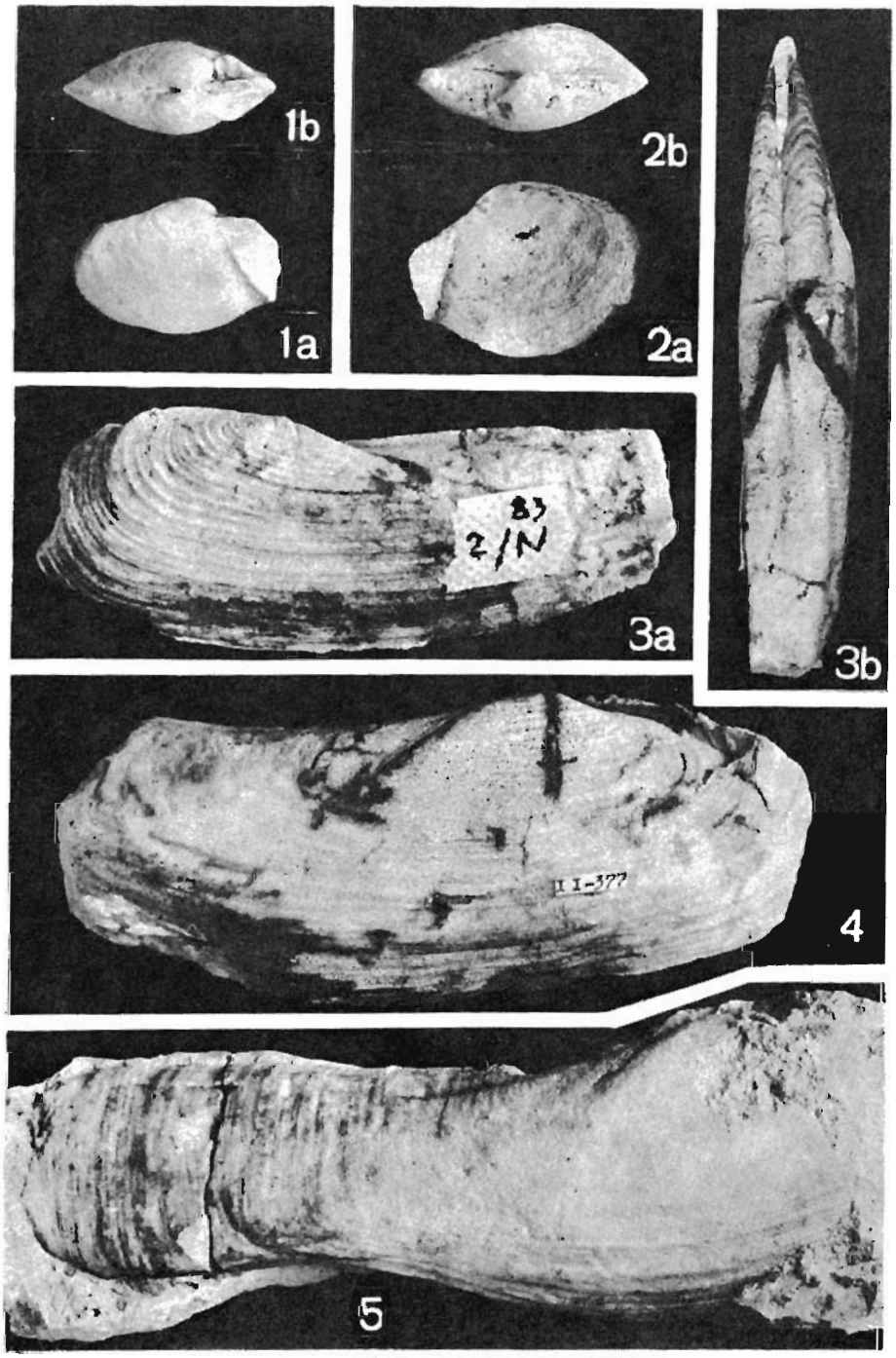
1-3 — *Cuspidaria (Cuspidaria) caudata* (NILSSON); *1—2* from Ciszyca Kolonia (MZ-M. 2365), *3* from Kazimierz (*1*, *2* LV, *3* RV; external molds)
4-5 — *Pholadomya (Pholadomya) kasimiri* PUSCH; *4* from Nasiłów opoka, *5* from Nasiłów handground (*4*, *5a* LV views; *5b* dorsal view)
6 — *Cercomya (Cercomya) harpa* (KNER); Nasiłów opoka (incomplete; dorsal view)

All figures in natural size



1a-1b — *Goniomya (Goniomya) designata* (GOLDFUSS); Nasiłów hardground (RV and dorsal views)
2a-2b — *Goniomya (Goniomya) mailleana* (d'ORBIGNY); Nasiłów opoka (LV and dorsal views)
3-5 — *Liopistha (?Psilomya)* sp.; *3—4* from Nasiłów opoka, *5* from Kazimierz (LV)

All figures in natural size



1-2 — *Thracia (Thracia) carinifera* (SOWERBY); Nasiłów opoka (*1a*, *2a* LV and RV views; *1b*, *2b* dorsal views)
3-4 — *Cercomya (Cercomya) harpa* (KNER); *3* from Nasiłów hardground (*3a*, *3b* LV and dorsal views), *4* from Kazimierz (RV view; IGP II-377)
5 — *Cercomya (Cercomya)* aff. *harpa* (KNER); Nasiłów opoka (incomplete RV)

All figures in natural size

?1889. *Pholadomya Esmarki* NILSSON sp.; GRIEPENKERL, p. 67.
?1902. *Pholadomya Esmarki* NILSSON sp.; WOLLEMANN, p. 80.
1931. *Pholadomya Esmarki* NILSS.; KRACH, pp. 361—362, Pl. 7, Fig. 15 and Pl. 8, Fig. 1.
(1938) *Pholadomya esmarki* NILSS.; POŻARYSKI, p. 21.
(1942) *Pholadomya esmarki* NILSS. var. *kasimiri* PUSCH; PUTZER, p. 370.
1951. *Pholadomya esmarcki* NILSS.; POŻARYSKA & POŻARYSKI, p. 21, Pl. 7, Fig. 9.
1974. *Pholadomya esmarki* NILSSON; SAVCZINSKAJA, p. 109, t. 40, Fig. 1.
1981. *Pholadomya (Pholadomya) esmarkii* NILSSON; TZAKOV, p. 145, Pl. 70, Fig. 9.

MATERIAL: 13 from Kazimierz, 2 from Bochotnica, 1 from Janowiec, 140 from Nasiłów (134 opoka, 6 hardground).

DESCRIPTION: The shell is large, variable in shape, subtrigonal to suboval, elongated, equivalve, and strongly inequilateral. Umbones are tumid, subrounded, and prosogyrous. Maximum inflation lies on the anterodorsal part, and it decreases gradually toward the ventral and posteorior margins. Posterodorsal part is straight and bordered by dorsal umbonal ridges. Posterior and anterior gaps are small and dorsally opened. Anterodorsal part is small and curved forming an obtuse angle with the anterior margin. The ventral margin is broadly arched, and the posterior margin is subtruncated.

The shell is ornamented with 16—29 radial ribs or ridges. The ribs are generally more distinct on the mid-shell and die out or become less distinct toward the flanks. They are separated by shallow concave interspaces, being wider toward the margins. The ribs and interspaces are crossed by concentric growth lines, often forming a nodular ornamentation especially on the dorso-umbonal part.

DISCUSSION: PUSCH (1837) introduced *Pholadomya kasimiri* as a new species from the Upper Maastrichtian opoka exposed at Kazimierz, he also illustrated *P. esmarki* (NILSSON), from the Lower Cretaceous(?) sandstone of Käzmark in the Carpathians (Czechoslovakia). Although reported from different ages and localities, these two species of *Pholadomya* were undoubtedly treated by PUSCH (1837) as separate. In the study area these two species really occur, (*see* synonymy of *Pholadomya esmarki*), although the second has never been earlier reported from here. Nevertheless, a misinterpretation of these two species appeared, and this resulted, partly or least, by the fact that GOLDFUSS (1840) who considered *P. kasimiri* PUSCH as a synonym of a part of *Cardita esmarki* NILSSON, described the material from the Quedlinburg greensand under the name of "*P. esmarki* PUSCH". On the other hand, GOLDFUSS described *Cardita esmarki* NILSSON as a species of *Cardita* (see GOLDFUSS 1840, p. 187, Pl. 133, Fig. 14).

The GOLDFUSS' (1840) misinterpretation with attribution of the species *esmarki* to PUSCH, was followed by PŁACHETKO (1863) when he described the Maastrichtian fauna of hte Lvov region, as well as by MOESCH (1875), HOLZAPFEL (1889), GRIEPENKARL (1889) and others. On the other hand, FAVRE (1869) and KRACH (1931) followed GOLDFUSS' misinterpretation, but they concluded that *P. esmarki* identified by PUSCH is completely different from "*P. esmarki* PUSCH" identified by GOLDFUSS.

A plastic cast of the original type specimen of "*Cardita*" *esmarki* NILSSON, kindly sent by Professor K. LARSSON (Lund), shows that it is completely different from *P. kasimiri* PUSCH. Moreover, they are to be classified under two different subgenera of *Pholadomya*.

VARIABILITY: KRACH (1931) reported three variaties of this species from the study area, based on H/L ratio. Histograms of the length and the number of ribs in *P. kasimiri* illustrate a normal unimodal distribution; on the other hand, there is a wide range of variability in length and height as well as in H/L ratio

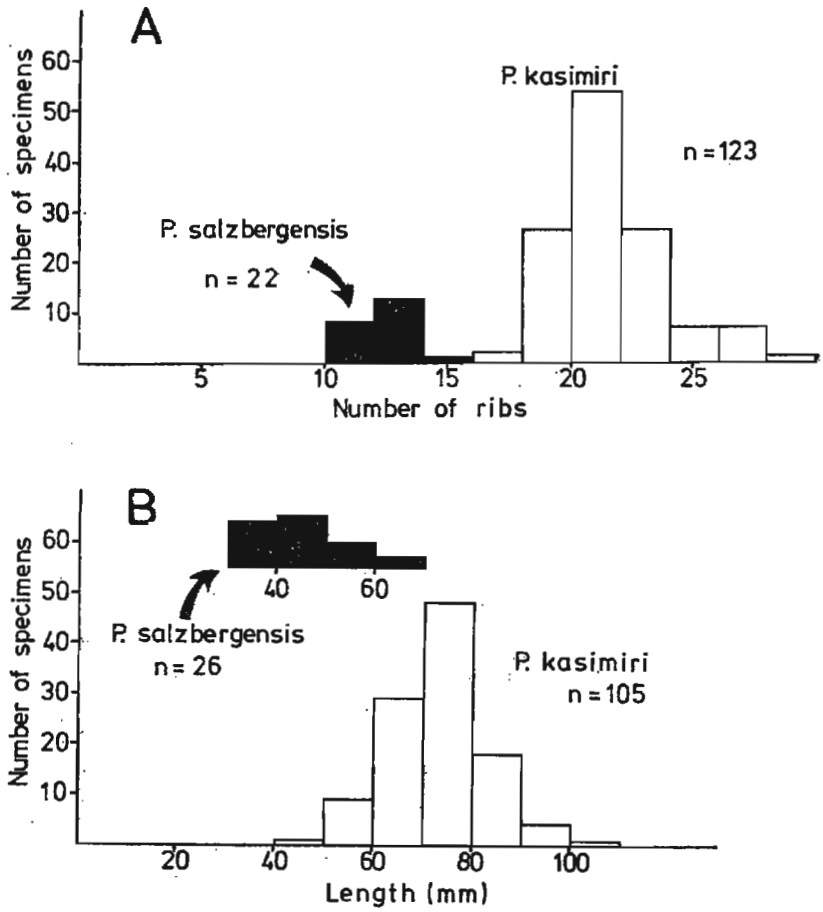


Fig. 16. Histograms of the length and the number of ribs in *Pholadomya kasimiri* PUSCH and *Pholadomya salzbergensis* ANDERT

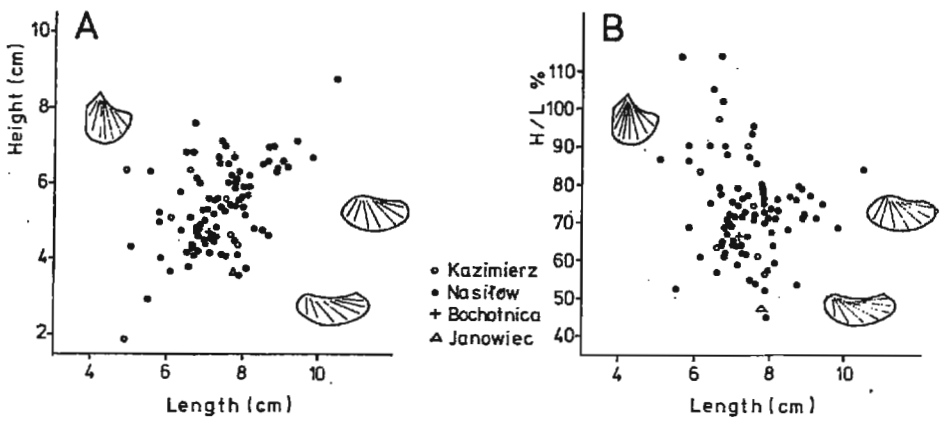


Fig. 17. Height and H/L ratio (in percent) against length in *Pholadomya kasimiri* PUSCH

(*see* Text-figs 16—17). This variability can be defined in the three forms, as follows:

1) Short (Pl. 46, Fig. 4): This form is similar to those figured by PUSCH (1837) and KRACH (1931). It is characterized by higher shells trigonal in shape. It is relatively less common, and about 15 specimens were collected at Nasiłów and Kazimierz.
2) Elongate (Pl. 45, Fig. 3): Shell is elongated, trapezoidal in shape, with long posterodorsal part and terminal umbones. This form is common at Nasiłów and Kazimierz.
3) Intermediate (Pl. 45, Fig. 4 and Pl. 46, Fig. 5): It is the predominant form in the Upper Maastrichtian of the study area as well as in the Upper Cretaceous of Europe. It carries the intermediate characters, and it is similar to those figured by GOLDFUSS (1840).

REMARKS: The species is one of the predominant species characterizing the marly opoka of the Belemnella kazimiroviensis Zone in the study area. It can be easily distinguished by its more anterior umbones and distinct umbonal ridges, as well as larger number of ribs covering the whole shell. The species *P. esmarki* (NILSSON) shows some similarity to *P. kasimiri*, but it differs in having subcordate shape, and its ribs are closely spaced, restricted to the middle part, and in the absence of the umbonal ridges. The species *P. elliptica* v. MÜNSTER differs in having a larger anterior part; however, it seems to be related. The species *P. nodulifera* v. MÜNSTER and *P. granulosa* ZITTEL, differ by a smaller number of ribs and their well developed nodular sculpture. Moreover, the North American species *P. occidentalis* MORTON and *P. tippana* CONRAD from the Ripley Formation (WADE 1926) and Owl Creek (STEPHENSON 1955), respectively, are closely allied to the studied species, both in their general form and in ornamentation.

AGE and DISTRIBUTION: Campanian — Maastrichtian of Limburg, West Germany, the Lvov region and Donbass basin, Bulgaria, and the Middle Vistula Valley.

Pholadomya (Pholadomya) salzbergensis ANDERT, 1934
(Pl. 44, Figs 1—4)

p. p. 1931. *Pholadomya nodulifera* MÜNST. var. *elliptica* (SCUPIN); KRACH, pp. 360—361, Pl. 7, Fig. 11.
1934. *Pholadomya nodulifera* var. *Salzbergensis* ANDERT, p. 333, Pl. 15, Figs 6—7.
1977. *Pholadomya salzbergensis* ANDERT; SOBETSKI, p. 212, Pl. 18, Figs 4—5.

MATERIAL: 16 from Kazimierz, 1 from Bochotnica, 13 from Nasiłów (opoka).

REMARKS: The species is characterized by its moderately large-sized shells, with a small number of radial ribs (*see* Text-fig. 16) and large anterior part. The species closely resembles *P. pedernalis* ROEMER from the Aptian — Cenomanian of the Tethyan deposits, as figured by MOESCH (1875) and ABBASS (1962).

AGE and DISTRIBUTION: Lower Senonian of Bohemia, Maastrichtian of Crimea, uppermost Maastrichtian of the Middle Vistula Valley.

Subgenus *Bucardiomya* ROLLIER *in* COSSMANN, 1912
Type species: *Pholadomya bucardium* AGASSIZ, 1842; *SD* COX, 1969
Pholadomya (Bucardiomya) esmarki (NILSSON, 1827)
(Pl. 45, Fig. 1)

v. 1827. *Cardita Esmarkii* n., NILSSON, p. 17, Pl. 5, Figs 8a—c.
1837. *Pholadomya Esmarkii* m., PUSCH, p. 87, Pl. 8, Fig. 14.
v. 1840. *Cardita Esmarkii* NILSSON; GOLDFUSS, p. 187, Pl. 133, Fig. 14.

?1841. *Pholadomya umbonata* N.; ROEMER, p. 76, Pl. 10, Fig. 6.
1844. *Pholadomya carantoniana* d'ORBIGNY, p. 357, Pl. 385, Figs 1—2.
1863. *Pholadomya Esmarkii* PUSCH; PŁACHETKO, p. 16, Pl. 1, Fig. 16.
v. 1895. *Pholadomya Esmarkii* NILSS.; VOGEL, p. 45, Pl. 3, Fig. 9.
1897. *Pholadomya Esmarkii* NILSS.; HENNIG, p. 90, Pl. 3, Fig. 31.
?1902. *Pholadomya esmarki* (NILSSON); SOBETSKI, p. 162, Pl. 16, Fig. 18.

MATERIAL: 4 from Kazimierz, 12 from Nasiłów (opoka).

MEASUREMENTS:

L	varies from	20.0	to	53.4;	av.	42.51,	n = 12
H	„ „	18.0	to	56.0;	av.	45.18,	n = 14
H/L	„ „	0.71	to	1.22;	av.	1.00,	n = 12
1/2 W	„ „	15.6	to	22.0;	av.	17.83,	n = 13
No. R	„ „	16	to	23;	av.	20,	n = 12
AL	„ „	2.0	to	7.5;	av.	5.9,	n = 10

where AL — anterior length.

DESCRIPTION: The shell is large, subtrigonal, equivalve, inequilateral. Umbones are rounded, incurved, prosogyrous, and located more anteriorly. Maximum inflation appears at the mid-height of the valves slightly displaced towards the umbones, and decreases suddenly toward the anterior margin, but gradually to the posterior and ventral ones. Length and height are nearly equal. The posterodorsal part is flat to shallow concave, upcurved to the umbones, without umbonal ridges. Anterodorsal part is short, concave with an elliptical outline. The anterior surface is flat, broad, forming an almost right angle with the ventral margin. Ventral and posterior margins are well rounded. The posterior gap is small, opened toward the dorsal part.

The shell is ornamented with concentric rings and striae crossed by radial ridges. Concentric rings are broad, rounded and well distinct in the dorsal half, closely spaced on the umbonal part, widely spaced toward the margins. Radial ribs are closely spaced, numbering 16—23, tubercular or nodular at points of intersection with the concentric rings, almost restricted to the middle part of the shell, less distinct on the posterior part and absent on the anterior flat surface.

DISCUSSION: The identification of the studied specimens is based mainly on the comparison with: (1) a plastic cast of the original specimen of NILSSON (1827) preserved at Department of Historical Geology and Paleontology, University of Lund, Sweden, Catalogue number *LO 55T*; (2) original specimen described by GOLDFUSS as *"Cardita esmarkii* NILSSON"; (3) original specimen of VOGEL (1895) from the Kunrade Maastrichtian, deposited in the Rijksmuseum voor Geologie en Mineralogie, Leiden, the Netherlands; (4) two specimens from the EWALD's Collection preserved in the Naturkunde Museum, Humboldt University, East Berlin, and two specimens exposed in the Natuurhistorisch Museum, Maastricht. All these specimens undoubtedly coincide with the studied specimens. Also the specimens figured by PUSCH (1837), PŁACHETKO (1863) and HENNIG (1897) are quite similar to studied specimens. The species *Pholadomya umbonata* ROEMER is most probably related to *P. esmarki* (NILSSON); it differs from the studied species in having a smaller number of nodular ribs which are restricted to the anterior part.

REMARKS: The studied species is closely comparable with the Tertiary species *P. puschi* GOLDFUSS from the Oligocene of Europe and *P. margaritacea* (SOWERBY) from the Upper Eocene of Italy in their general form and the absence of the umbonal ridges.

AGE and DISTRIBUTION: Turonian of France, Campanian of West Germany, Maastrichtian of the Netherlands, Sweden and the Lvov region; uppermost Maastrichtian of the peri-Caspian basin(?) and of the Middle Vistula Valley.

Subgenus *Procardia* MEEK, 1871
Type species: *Isocardia? hodgei* MEEK, 1871; *M*
Pholadomya (Procardia) decussata (MANTELL, 1822)
(Pl. 44, Fig. 6 and Pl. 45, Fig. 2)

1822. *Cardium? decussatum* MANTELL, p. 126, Pl. 25, Fig. 3.
1837. *Pholadomya decussata* PHILLIPS; PUSCH, p. 87.
?1837. *Cardita obliqua* m., PUSCH, p. 67, Pl. 7, Fig. 5a—b.
v. 1837. *Cardium decussatum* MANTELL; GOLDFUSS, p. 222, Pl. 145, Fig. 2.
1875. *Pholadomya decussata* MANTELL; MOECH, p. 107, Pl. 32, Figs 5—6 and Pl. 34, Figs 5—6.
1886. *Pholadomya decussata* MANT.; SIEMIRADZKI, p. 64, Pl. 4, Fig. 8.
1909. *Pholadomya decussata* (MANTELL); WOODS, pp. 250—252, Pl. 41, Figs 7—9; Pl. 42, Fig. 1 (*cum syn.*).
(1911) *Pholadomya decussata* MANT.; ROGALA, p. 492.
(1938) *Pholadomya decussata* MANT.; POŻARYSKI p. 21.
(1942) *Pholadomya decussata* PHIL.; PUTZER, p. 370.
(1942) *Cardita obliqua* PUSCH; PUTZER, p. 372.
(1951) *Pholadomya decussata* MANT.; POŻARYSKA & POŻARYSKI, p. 21.
1974. *Pholadomya decussata* (MANTELL); SAVCZINSKAJA, p. 109, Pl. 39, Figs 8—9.
1977. *Pholadomya decussata* (MENTELL); SOBETSKI, p. 211, Pl. 18, Figs 2—3.
1981. *Pholadomya decussata* (MENTELL); TZANKOV, p. 146, Pl. 71, Figs 1—2.

MATERIAL: 20 from Upper Campanian opoka (6 from Ciszyca Kolonia, 1 from Ciszyca Górna, 13 from Piotrawin), 1 from Solec, 1 from Dobre, 2 from Męćmierz, 11 from Kazimierz, 1 from Bochotnica (opoka).

REMARKS: The studied specimens agree with those described by WOODS (1909). The species *"Cardita obliqua"* established by PUSCH (1837) from the opoka exposed at Kazimierz, most probably concerns badly preserved specimens of the studied species. POŻARYSKI (1938) reported this species from the upper Campanian — Upper Maastrichtian of the study area.

AGE and DISTRIBUTION: Widely distributed in the Albian — uppermost Maastrichtian of Europe.

Genus *Goniomya* AGASSIZ, 1842
Type species: *Mya angulifera* J. de C. SOWERBY, 1819;
SD HERRMANNSEN, 1846
Subgenus *Goniomya* AGASSIZ, 1842
Goniomya (Goniomya) designata (GOLDFUSS, 1834)
(Pl. 47, Fig. 1)

v. 1840. *Lysianassa designata* nobs, GOLDFUSS, p. 264, Pl. 154, Fig. 13.
1841. *Goniomya consignata* ROEMER, p. 75, Pl. 10, Fig. 3.
1869. *Goniomya designata* GOLDF.; HOLZAPFEL, p. 153.
1889. *Goniomya designata* GOLDFUSS sp.; GRIEPENKERL, p. 68.
1895. *Goniomya designata* GOLDF.; VOGEL, p. 46.
1898. *Goniomya consignata* ROEMER; G. MÜLLER, p. 71, Pl. 10, Fig. 7.
(1938) *Goniomya consignata* ROEM.; POŻARYSKI, p. 22.
(1942) *Goniomya consignata* ROEM.; PUTZER, p. 371.
(1951) *Goniomya consignata* ROEM.; POŻARYSKA & POŻARYSKI, p. 21.
1954. *Goniomya designata* (GOLDFUSS); HÄGG, p. 53, Pl. 7, Fig. 85.

MATERIAL: 2 from Bochotnica, 40 from Nasiłów (38 opoka, 2 hardground).

REMARKS: The species is characterized by a large, elongated and compressed shell, ornamented with small V-shaped umbonal plicae which are restricted to the umbonal part.

The species *G. mailleana* (d'ORBIGNY), *G. perlonga* (FRIČ), and *G. americana* MEEK & HAYDEN can be easily differentiated from the studied species by the presence of *V*-shaped plicae, which extend to the margins, and cover the whole shell in all these three species.

AGE and DISTRIBUTION: Santonian — Upper Senonian of West Germany, Upper Senonian of Sweden, Maastrichtian of Kunrade (the Netherlands), uppermost Maastrichtian of the Middle Vistula Valley.

Goniomya (Goniomya) mailleana (d'ORBIGNY, 1845)
(Pl. 47, Fig. 2)

1845. *Pholadomya mailleana* d'ORBIGNY, p. 385, Pl. 364, Figs 1—2.
1909. *Goniomya Mailleana* (d'ORBIGNY); WOODS, pp. 255—256, Pl. 42, Figs 6—7.
?1909. *Goniomya Mailleana* d'ORB.; ROGALA, pp. 701—702, Pl. 28, Fig. 8.
(1938) *Goniomya mailleana* d'ORB.; POŻARYSKI, p. 22.
(1942) *Goniomya mailleana* d'ORB.; PUTZER, p. 371.
1954. *Goniomya mailleana* (d'ORBIGNY); HÄGG, p. 53, Pl. 8, Fig. 86.

MATERIAL: 1 from Kazimierz, 1 from Janowiec, 17 from Nasiłów (14 opoka, 3 hardground).

REMARKS: The studied specimens agree with those figured by WOODS (1909) from the Upper Albian of England and those figured by d'ORBIGNY (1845), but they differ in having stronger *V*-shaped plicae extending to the margins.

The species *G. americana* MEEK & HAYDEN from the Maastrichtian Fox Hills Formation, U.S.A., is highly resembling the studied species, and a slight difference is in the sharpness and direction of the *V*-shaped plicae.

AGE and DISTRIBUTION: Upper Albian of England, Cenomanian of the Baltic region, Turonian — Lower Senonian of France, Upper Senonian of Sweden and the Lvov region, uppermost Maastrichtian of the Middle Vistula Valley.

Superfamily **Pandoracea** RAFINESQUE, 1815
Family **Laternulidae** HEDLEY, 1918
Genus *Cercomya* AGASSIZ, 1843
Type species: *Cercomya pinguis* AGASSIZ, 1843; *OD*
Subgenus *Cercomya* AGASSIZ, 1843
Cercomya (Cercomya) harpa (KNER, 1850)
(Pl. 46, Fig. 6 and Pl. 48, Figs 3—4)

1850. *Anatina? harpa* m., KNER, p. 24, Pl. 4, Fig. 11.
(1850) *Anatina harpa* KNER; GEINITZ, p. 148.
1869. *Anatina harpa* KNER; FAVRE, pp. 107—108, Pl. 12, Fig. 1.
v. 1895. *Anatina millepunctata* spec. nov., VOGEL, p. 47, Pl. 3, Fig. 10.
1909. *Cercomya harpa* KNER; ROGALA, p. 702, Pl. 28, Fig. 8.
(1911) *Cercomya harpa* KNER; ROGALA, p. 492.
1931. *Cercomya harpa* KNER; KRACH, p. 364.
(1938) *Anatina harpa* KNER; POŻARYSKI, p. 22.
(1942) *Anatina harpa* KNER; PUTZER, p. 371.

MATERIAL: 21 from Kazimierz, 2 from Bochotnica (hardground), 8 from Nasiłów (6 opoka, 2 hardground).

REMARKS: KNER (1850) and FAVRE (1869) illustrated incomplete specimens of *Cercomya harpa* from the Upper Senonian of the Lvov region; however, ROGALA (1909) figured a complete specimen from the same area which coincides with the studied specimens.

The type specimen of *Anatina millepunctata* VOGEL from the Maastrichtian of Kunrade, the Netherlands, is preserved in the Rijksmuseum voor Geologie en

Mineralogie, Leiden, the Netherlands (Catalogue number *13450*). It has the same shape and ornamentation as the studied specimens, and thus it is considered herein, without doubt, a junior synonym of *C. harpa* (KNER).

The species *Cercomya holzapfeli* G. MÜLLER from the Lower Senonian of Braunschweig, West Germany, is quite comparable with *C. harpa*, but it differs in having its anterior part larger. The species *C. lanceolata* (GEINITZ) from the Lower Senonian of Bohemia differs by its wedge-shaped and more tapering posterior part.

AGE and DISTRIBUTION: Upper Senonian of the Lvov region; Maastrichtian of Kunrade, the Netherlands; uppermost Maastrichtian of the Middle Vistula Valley.

Cercomya (Cercomya) aff. *harpa* (KNER, 1850)
(Pl. 48, Fig. 5)

REMARKS: Only one incomplete specimen collected from the Nasiłów opoka is closely allied to *Cercomya harpa* (KNER), but its posterior part is more elongated with a broad and truncated posterior margin, and its ventral margin is broadly arched with a distinct sinus.

Family **Periplomatidae** DALL, 1895
Genus *Periploma* SCHUMACHER, 1817
Type species: *Periploma inaequivalvis* SCHUMACHER, 1817
(= *Corbula margaritacea* LAMARCK, 1801); *M*
Subgenus *Periploma* SCHUMACHER, 1817
Periploma (Periploma) sp.
(Pl. 44, Fig. 5)

MATERIAL: 5 from Kazimierz.

REMARKS: The studied specimens are of moderately large-sized, compressed and inequilateral shells of a subtrapezoidal shape and with rounded anterior and ventral margins. The posterior margin is subtruncated with a slightly tapering posterior end.

The studied specimens are comparable with those of *Periploma subgracile* (WHITFIELD) as described by SPEDEN (1970b) from the Maastrichtian Fox Hills Formation, U.S.A. They are closely similar in form to those of *P. ambigua* TASHIRO, 1976, from the Maastrichtian (Upper Hetonian), Japan.

The specific identification of these badly preserved specimens is impossible, but they are suitable to record the occurrence of the genus.

Family **Thraciidae** STOLICZKA, 1870
Genus *Thracia* G. B. SOWERBY, 1823
Type species: *Mya pubescens* PULTENEY, 1799;
SD ANTON, 1839
Subgenus *Thracia* G. B. SOWERBY, 1823
Thracia (Thracia) carinifera (J. de C. SOWERBY, 1826)
(Pl. 48, Figs 1—2)

1826. *Lutraria? carinifera* J. de C. SOWERBY, Vol. 6, p. 66, Pl. 534, Fig. 2.
1845. *Lyonsia carinifera* d'ORBIGNY, p. 385, Pl. 373, Figs 1—2.
1852. *Lyonsia carinifera* d'ORB.; KNER, p. 19.
1893. *Lyonsia carinifera* d'ORB.; FRIČ, p. 97, Text-fig. 115.

1909. *Thracia carinifera* (SOWERBY); WOODS, p. 244, Pl. 40, Figs 10—13 (*cum syn.*).
1909. ? *Cypricardia parallela* ALTH; ROGALA, p. 701, Pl. 25, Fig. 7.
1923. *Thracia carinifera* SOW.; SYNIEWSKA, p. 294.

MATERIAL: 1 from Podgórz, 1 from Męćmierz, 8 from Kazimierz, 2 from Janowiec, 2 from Nasiłów (opoka).

REMARKS: The studied specimens are identical with those described by d'ORBIGNY (1845) and WOODS (1909). They have medium-sized shells, with well rounded anterior and ventral margins, and a short rostrated posterior part. Ornamentation is composed mainly of numerous fine radial striae crossed by concentric growth striae.

AGE and DISTRIBUTION: Cenomanian of England, Turonian — Lower Senonian of France, Lower Senonian of Bohemia, Upper Senonian of the Lvov region, Upper Maastrichtian of the Middle Vistula Valley.

Superfamily **Poromyacea** DALL, 1886
Family **Poromyidae** DALL, 1886
Genus *Liopistha* MEEK, 1864
Tyype species: *Cardium elegantulum* ROEMER, 1852; *OD*
Subgenus *Liopistha* MEEK, 1864
Liopistha (Liopistha) aequivalvis (GOLDFUSS, 1834)
(Pl. 43, Figs 1—2)

1834. *Corbula aequivalvis* nobis, GOLDFUSS, p. 250, Pl. 151, Fig. 15.
1841. *Pholadomya caudata* A. ROEMER, p. 76 Pl. 10, Fig. 8.
1889. *Liopistha aequivalvis* GOLDF. sp.; HOLZAPFEL, p. 150, Pl. 9, Figs 4—6.
1898. *Liopistha aequivalvis* GOLDF. sp.; G. MÜLLER, p. 76, Pl. 10, Fig. 9.
1934. *Liopistha aequivalvis* GOLDF. sp.; ANDERT, p. 335, Text-fig. 38, Pl. 15, Fig. 9 (*cum syn.*).
1937. *Liopistha aequivalvis* GOLDF.; LEHNER, p. 161, Pl. 25, Fig. 30.
v. (1938) *Liopistha aequivalvis* GOLDF.; POŻARYSKI, p. 23.
(1942) *Liopistha aequivalvis* GOLDF.; PUTZER, p. 371.
1943. *Liopistha aequivalvis* (GOLDFUSS); VAN DER WEIJDEN, p. 76, Pl. 6, Figs 7—8.
1954. *Liopistha aequivalvis* (GOLDFUSS); HÄGG p. 53.
1977. *Liopistha aequivalvis* (GOLDFUSS); SOBETSKI, p. 218, Pl. 17, Fig. 13 and Pl. 18, Fig. 1.
1981. *Liopistha aequivalvis* (GOLDFUSS); TZANKOV, p. 147, Pl. 71, Figs 4—6.

MATERIAL: 1 from Bochotnica, 8 from Nasiłów (1 opoka, 7 hardground).

REMARKS: The studied specimens agree with those described by GOLDFUSS (1834), VOGEL (1895), and others. The species *Pholadomya caudata* ROEMER is undoubtedly a junior synonym of the studied species, as recognized by HOLZAPFEL (1889). The species *Liopistha inflata* WHITFIELD, as figured by WADE (1926) from the Maastrichtian Ripley Formation, U.S.A., is similar to *L. aequivalvis*, but it differs in having almost smooth flanks.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — uppermost Maastrichtian of (Temperate and Tethyan) Europe, and Senonian of Southern India.

Subgenus *Psilomya* WHITE, 1874
Type species: *Liopistha (Psilomya) meeki* WHITE, 1874; *M*
Liopistha (?Psilomya) sp.
(Pl. 47, Figs 3—5)

MATERIAL: 1 from Dobre, 1 from Podgórz, 2 from Męćmierz, 16 from Kazimierz, 9 from Nasiłów (opoka).

REMARKS: The shape, ornamentation, the distinct posterior furrow and posterior area of the studied specimens are quite similar to those of *Liopistha aequivalvis* GOLDFUSS, but they differ in having numerous scally radial riblets. The studied specimens are probably related to the subgenus *Psilomya* WHITE, as they display the same ornamentation as *L. (Psilomya) meeki*, the type species, from the Upper Cretaceous of North America.

Family **Cuspidariidae** DALL, 1886
Genus *Cuspidaria* NARDO, 1840
Type species: *Cuspidria typus* (= *Tellina cuspidata* OLIVI, 1792); *M*
Subgenus *Cuspidaria* NARDO, 1840
Cuspidaria (Cuspidaria) caudata (NILSSON, 1827)
(Pl. 46, Figs 1—3)

1827. *Corbula caudata* n., NILSSON, p. 18, Pl. 3, Fig. 18.
v. 1834. *Corbula caudata* NILSSEN; GOLDFUSS, p. 251, Pl. 151, Fig. 17.
1846. *Corbula caudata* NILSSON; REUSS, p. 20, Pl. 36, Fig. 23.
1850. *Corbula caudata* NILSSON; KNER, p. 25, Pl. 5, Fig. 3.
1850. *Corbula caudata* NILSSON; ALTH, p. 237, Pl. 12, Fig. 22.
1869. *Neaera caudata* NILSSON; FAVRE, p. 102, Pl. 11, Fig. 19.
1897. *Cuspidaria caudata* NILSS.; HENNIG, p. 62, Pl. 3, Fig. 28.
1898. *Neaera caudata* NILSS.; G. MÜLLER, p. 77, Pl. 10, Figs 10—11.
1902. *Neaera caudata* NILSS. sp.; RAVN, p. 133, Pl. 4, Fig. 24.
1935. *Cuspidaria caudata* (NILSSON); HÄGG, p. 51, Pl. 7, Fig. 8.
(1938) *Neaera caudata* NILS.; POŻARYSKI, p. 22.
(1942) *Neaera caudata* NILS.; PUTZER, p. 371.
1974. *Cuspidaria caudata* (NILSSON); SAVCZINSKAJA, p. 110, Pl. 40, Figs 2—5.
1977. *Cuspidaria caudata* (NILSSON); SOBETSKI, pp. 219—220, Pl. 18, Fig. 11.
1982. *Cuspidaria caudata* (NILSSON); SOBETSKI, p. 163, Pl. 16, Fig. 19.

MATERIAL: 6 from Upper Campanian opoka (2 from Ciszyca Kolonia, 3 from Ciszyca Górna, 1 from Piotrawin), 1 from Dobre, 4 from Męćmierz, 3 from Kazimierz, 10 from Nasiłów (7 opoka, 3 hardground).

REMARKS: The studied specimens agree with those described by the previous investigators from the Senonian of northern Europe, with a slight variation in the length of the rostrum and the strength of the concentric riblets.

The specimens described as *"Cuspidaria caudata?"* by HEINBERG (1979c) from the hardground at Stevens Klint, Denmark, differ from the studied ones in having two distinct ridges cutting the concentric lamellae on the rostrum. HEINBERG (1979c) also introduced six new species of *Cuspidaria* from the same hardground which can be easily distinguished by their diagnostic ornamentation. WOODS (1909) mentioned that the species *C. pulchra* (SOWERBY) from the Upper Chalk of England is closely allied to *C. caudata* (NILSSON) and probably related. The species *C. grigorijevae* SOBETSKI, 1977, from the Maastrichtian of Crimea, is closely similar to the studied species, but differs in having numerous concentric lamellae.

AGE and DISTRIBUTION: Very widely distributed in the Turonian — Upper Maastrichtian of the North European Province, and the Maastrichtian of Crimea.

COMPARISON WITH NON-CEPHALOPOD FAUNAS OF OTHER AREAS

The area of the present-day outcrops of the Middle Vistula Valley is located in the central part of the North European Province (European Boreal, the former name), as identified by KAUFFMAN (1973). This chapter presents the comparison between the studied faunas and those of the other Maastrichtian localities out side Poland with a special emphasis to those from the Euramerican region, and taking in the consideration the following two points:

(1) The Cretaceous paleogeographic units, as identified by KAUFFMAN (1973) based on bivalves, are accepted in this study and may also be delineated by the paleogeographic distribution of gastropods (*see* SOHL 1971);
(2) The state of preservation of the comparable collections should be taken in the consideration, because the better preserved collections (*i.e.* those which contain both calcitic and aragonitic shells) will yield more taxa (diversity) and include faunal elements not found in collections of lesser preservational quality (*see* KOCH & SOHL 1983).

GASTROPODA

The Maastrichtian deposits of the Middle Vistula Valley yield 49 genera and subgenera and they are characterized by the predominance of the Mesogastropod genera (45.16%). The Archaeogastropod (27.95%), Neo-

Table 3

Distribution of the studied Maastrichtian gastropods and their relation with other faunal biogeographic units

World-wide genera	Euramerican genera	North European genera
Emarginula	Acmaea	Conotomaria
Architectonica (Solariaxis)	Calliomphalus s.s.	Leptomaria
Turritella s.s.	Calliomphalus (Planolateralus)	+Loxotoma
Turritella (Haustator)	+Atria	+Chilodonta
Cerithium	+Laxispira	Margarites ?
Xenophora	Bittium	Gibbula
Aporrhais	+Arrhoges (Latiala)	+Trochacanthus
Drepanochellus	Charonia (Sassia)	Lemintina
+Helicaulax	+Bellifusus	+Confusiscala
Natica	Euthriofusus	•Kaunhowenia
+Gyrodes	+Graphidula	+Perissoptera
Volutilithes	Cancellaria	+Cultrigera
Turricula		+Columbellaria
Tornatellaea		Tibia
Avellana	Note:	•Cassidaria
Cylichna	+Extinct genera	•Biplex
	•First recorded genera	Buccinum
		Tudicla
		+Rostellana
		Volutispina
		Scaphella

gastropod (21.5%) and Opisthobranch genera (5.37%) are subordinate (*see* Text-fig. 18B). The distribution of the studied genera in other faunal provinces (Table 3) allows a brief comparison with other Maastrichtian areas in the North European Province, the North American Province and in the other realms.

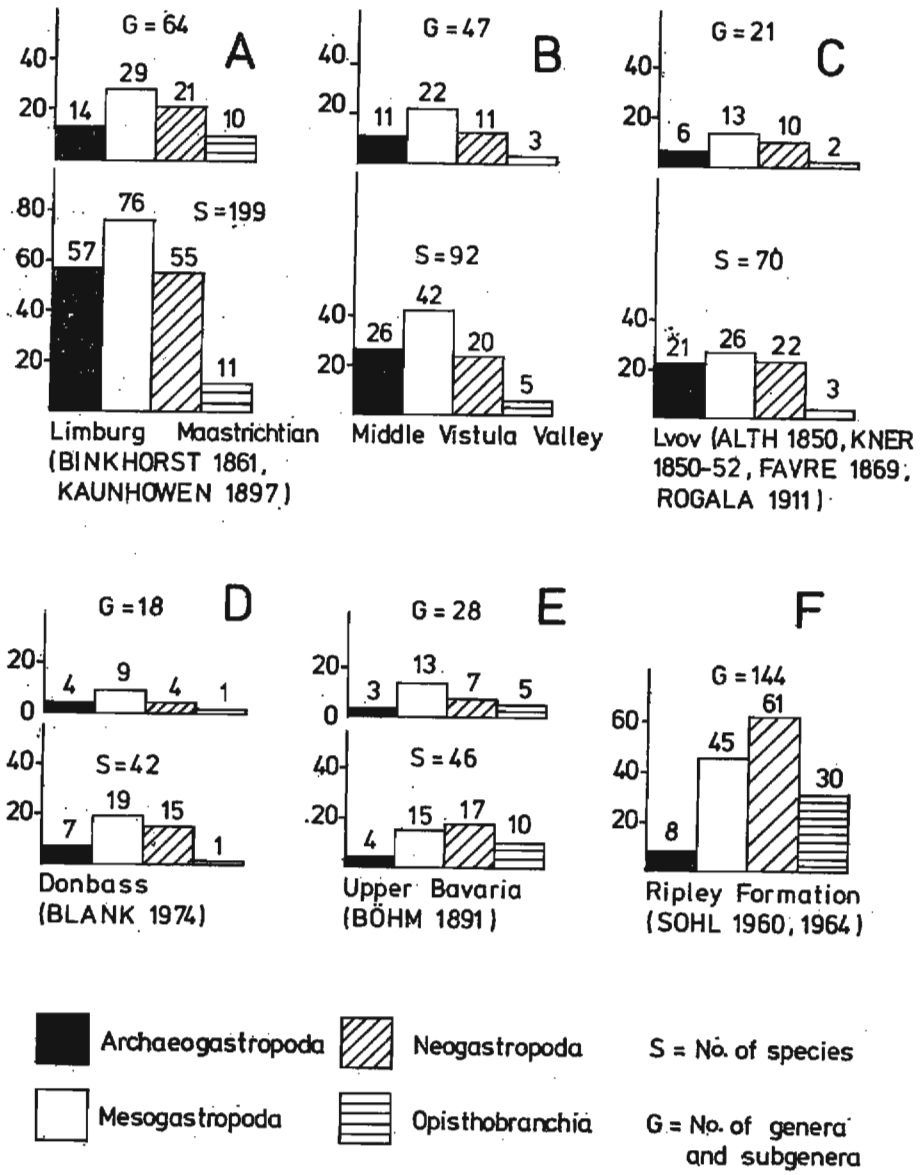


Fig. 18. Comparison between the Maastrichtian gastropods of the Middle Vistula area and those of the other Maastrichtian localities in Europe and North America

NORTH EUROPEAN PROVINCE

The most important genera distinguishing this province during Late Cretaceous time are *Conotomaria, Leptomaria, Bathotomaria, Trochacanthus, Confusiscala, Perissoptera, Cultrigera, Columbellaria, Tudicla, Volutispina,* and *Buccinum.*

There are three main facies prevailing during the Late Senonian in North Europe, particularly during the Maastrichtian: the calcarenite facies in the western part (Limburg), the chalk facies which extends from England to northeastern Poland passing through Denmark and the Isle of Rügen, and the opoka-marl facies which extends from Central Poland (Middle Vistula Valley) to the peri-Caspian basin, passing through the Lvov, Donbass and Crimea areas.

OPOKA-MARL FACIES. The Upper Senonian gastropods of the Lvov region, as well as of the Donbass and peri-Caspian basins have been described by KNER (1850, 1852), ALTH (1850), PŁACHETKO (1863), FAVRE (1869), ROGALA (1911), BLANK (1974), and PLAMADIALA (1982). The Mesogastropods comprise a large number of species and genera *(see* Text-fig. 18*C—D*). These areas and the area of the Middle Vistula Valley are sharing in forty gastropod species, 16 of which being restricted therein, viz. *Emarginula costatostriata, Calliomphalus (Calliomphalus) dichotomus, Architectonica (Solariaxis) granulatocostata, Cerithium paucicostatum, C. polystropha, Aporrhais pyriformis, A.*(?) *najdini, Tibia laevis, Charonia multicostata, Bellifusus septemcostatus, Graphidula procera, Tudicla althi, Rostellana aequecostata, Volutilithes kneri,* and *Volutispina kasimiri.*

The similarity in the facies development and the gastropod fauna of these areas can be ascribed to the similarity of the environment and one must conclude that these faunas belong to the same faunal province.

CHALK FACIES. The gastropod faunas are appearantly rare in the Maastrichtian chalk of Denmark and Isle of Rügen due to the unsuitable bottom conditions of the carbonate mud for larval settlements, and due to the dissolution of the aragonitic shells (*see* KENNEDY 1969, KAUFFMAN 1979, JABLONSKY & BOTTJER 1983).

CALCARENITE FACIES. The gastropods of the Maastrichtian stratotype and the Kunrade Limestone were described by BINKHORST (1861) and KAUNHOWEN (1897). They are characterized by the predominance of rock-cliging genera as *Emarginula* (20 species), *Patella* (3 species), *Acmaea* (3 species) and *Nerita* (2 species) indicating extreme shallow water conditions. The Mesogastropod genera are dominant besides Archaeogastropoda and Neogastropoda *(see* Text-fig. 18*A).* There are 20 gastropod species which were recorded both in the Maastrichtian of Limburg and in the Middle Vistula Valley, and 8 of them are on-

ly restricted to these two areas, viz. *Calliomphalus (Calliomphalus) rimosus granulatus, Chilodonta rudis, Lemintina nodosa, Cerithium tectiforme, Bittium triptychum, Arrhoges (Latiala) pelecyphora, Kaunhowenia carinifera,* and *Charonia tuberculosa.*

Generally, the two areas are sharing in the important endemic genera characterizing the North European Province, but the Limburg fauna possesses a higher number of endemic species of such genera as *Astralium, Nerita, Hipponix, Littorina, Nerinea, Cypraea, Clavella, Fasciolaria,* and *Turbinella.* This means that this area is considered as an endemic center, which continued since the Campanian (the Aachen Greensand), as indicated by the gastropods described by MÜLLER (1851) and HOLZAPFEL (1888). This fauna has close affinity to that of the North American Ripley Formation (*see* SOHL 1964).

NORTH AMERICAN PROVINCE

The gastropod fauna of the Ripley, Owl Creek and Prairie Bluff formations (Maastrichtian) of the northern Mississippi and southern Tennessee is one of the largest and most diversified fossil assemblages to be found in strata of Late Cretaceous age anywhere in the world, as indicated by SOHL (1960, 1964), who described and revised about 150 gastroped genera and subgenera. These assemblages possess a high percentage of endemic genera, 42 of which are restricted to the Gulf and Atlantic Coastal Plains. These gastropod faunas are characterized by the predominance of the Neogastropoda (42%) over Mesogastropoda (31%), and by the higher percentage of the Opisthobranchia (20%). The Archaeogastropoda have smallest number of genera (*see* Text-fig. 18F).

SOHL (1967) and ERICKSON (1974) monographed the gastropods from the Pierre Shale and Fox Hills formations, the Western Interior. These are characterized by the dominance of the Meso- and Neogastropoda; and the Archaeogastropoda are poorly represented either in terms of diversity or in terms of individual specimens. The genera *Euspira* and *Drepanocheilus* are the most abundant (*see* SOHL 1967) in this fauna. SOHL (1964, 1971) discussed also the characters and the endemic gastropod genera of the Atlantic Coastal Plain as well as of the West Coast.

The area of the Middle Vistula Valley and those of the North American Province are sharing in the Euramerican genera (*see* Table 3) and the wide spread genera as *Turritella, Cerithium, Xenophora, Gyrodes, Natica*(?), *Aporrhais, Drepanocheilus, Helicaulax, Volutilithes, Tornatellaea,* and *Cylichna.* The large volutids are also common both in the North European and the North American Provinces.

TETHYAN REALM

The Tethyan Realm is characterized by the predominanse of the acteonellid and nerineid gastropods (warm-water tropical). The Upper Cretaceous gastropods of the Northern Tethyan (Southern Europe) have been described by ZEKELI (1852) and STOLICZKA (1865) from the Turonian of Austria, by PETHÖ (1906) from the Upper Senonian of Yygoslavia, by TZANKOV & MOTEKOVA (1981) from the Upper Cretaceous of Bulgaria, and by BÖHM (1891) from the Middle Maastrichtian of Upper Bavaria.

The Late Cretaceous gastropods from the Middle East (North Africa, Syria and Lebanon) have been described by THOMAS & PERON (1889), PERNIVINQUIÈRE (1912) from the Maastrichtian of Tunisia; WANNER (1902), QUASS (1902) and ABBASS (1963) from the Upper Cretaceous of Egypt; BLANCKENHORN (1890, 1927), DELPEY (1939) and PICARD (1930) from the Upper Cretaceous of Palestine, Syria and Lebanon.

Recently, SOHL & KOLLMAN (1985) monographed the acteonellid gastropods also from the Caribbean province, and discussed the paleogeographic distribution of all the Cretaceous acteonellids.

Generally, the Maastrichtian gastropods in the discussed areas of the Tethyan Realm, although not well recognized, are fairly remote from those of the Middle Vistula Valley, being represented by the entirely different elements except of such several world-wide genera as *Emarginula, Turritella, Cerithium, Aporrhais, Gyrodes,* and others (*see* Table 3).

SOUTH TEMPERATE REALM

The Upper Cretaceous gastropods of Southern India (STOLICZKA 1967—1968), Madagascar (DILPEY 1949; COLLIGNON 1931, 1933, 1951a, b) are closely related and belonging to the same province, whereas those of South Africa, West Coast of Africa, South America and New Zealand are closely similar (for details *see* SOHL 1964).

A fair number of genera occur in the Maastrichtian deposits of both the Southern Temperate Realm and in the area of the Middle Vistula Valley, but these are widely distributed genera and have little significance when the provincial relationships are concerned .

BIVALVIA

The Maastrichtian deposits of the Middle Vistula Valley yield 105 bivalve species belonging to 65 genera and subgenera. It ic clear (*see* Table 4) that there are no endemic genera characterizing the Maastrichtian of the Middle Vistula Valley, and that cosmopolitan and trans-tempera-

te genera are dominant over the other groups. The subordinance in the genera characterizing the North European Province is noticeable herein (*see* Table 4). This observation agrees well with that of KAUFFMAN (1973) who reported the sudden decrease in endemism of the North Eu-

Table 4

Distribution of the studied Maastrichtian bivalve genera and subgenera and their relation with other faunal biogeographic units, based on the scheme of KAUFFMAN (1973)

Cosmopolitan genera	Widespread and trans-temperate genera	Euramerican genera
Nucula s.s. Nuculana s.s. Barbatia s.s. Cucullaea Limopsis Septifer +Inoperna Modiolus Pinna s.s. Gervillia +Inoceramus +Oxytoma (Hypoxytoma) +Entolium Propeamussium (Parva.) +Camptonectes Mimachlamys ? +Neithea s.s. Spondylus Limatula Plagiostoma Pycnodonte +Placunopsis Astarte Lucina +Granocardium s.s. Nemocardium Pholadomya s.s. +Pholadomya (Procardia) Cercomya Goniomya s.s.	Phelopteria + Syncyclonema Lyropecten (Aequipecten) Agreostrea Gryphaeostrea Hyotissa + Mutiella + Opis Venericardia Leptosolen Corbula Venelicardia Panopea + Gyropleura Periploma + Liopistha s.s.	+Tenuipteria Acutostrea +Granocardium (Criocardium) Pleuriocardia s.s. Linearia (Liothyris) Cuspidaria
North temperate genera		**North European genera**
Pinna (Plesiopinna) Pseudoptera + Spyridoceramus + Atreta + Legumen Tenea Thracia Liopistha (Psilomya)		Arca (Eonavicula) Barbatia (Acar) Chlamys (Lyriochlamys) +Merklinia Pseudolimea Limea Ctenoides ?+Trapezium Cultellus Pholadomya (Bucardiomya) Note: +Extinct genera

ropean genera particularly after the Cenomanian. This is due to the east--west exchange of invertebrate taxa between Europe and North America which was probably greater than west to east, and thus increasing in the number of widespread Euramerican taxa (for details *see* KAUFFMAN 1979).

NORTH EUROPEAN PROVINCE

During the Senonian, particularly the Maastrichtian, this province is characterized by the predominance of the pteriomorphids (*see* Text-fig. 19) in chalk, calcarenite, opoka and marls facies. The endemic genera are rare if compared with other provinces during the Maastrichtian. The

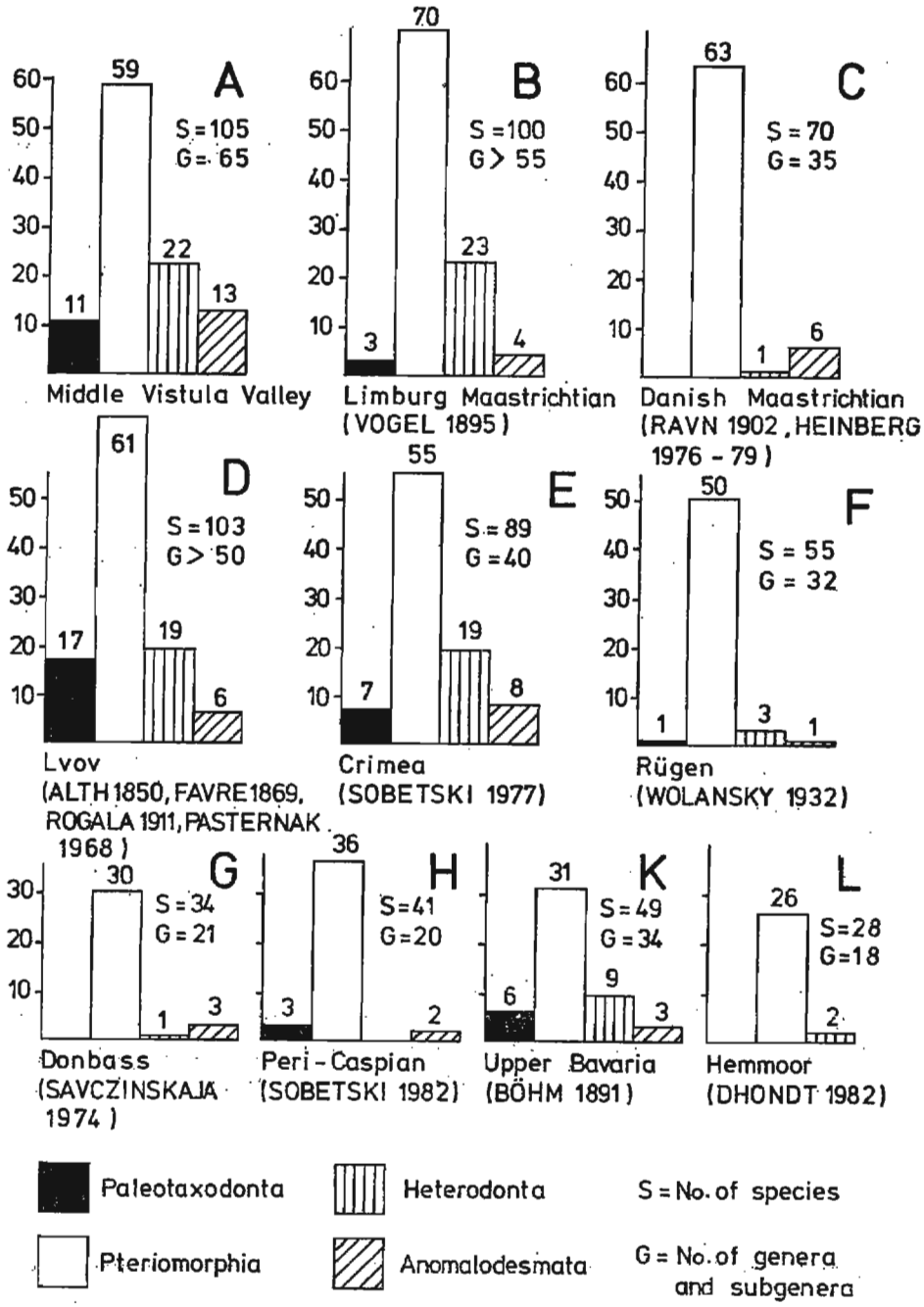


Fig. 19. Comparison between the Maastrichtian bivalves of the Middle Vistula area and those from the other Maastrichtian localities in Europe

most important genera and subgenera characterizing this province are: *Arca (Eonavicula), Lyropecten (Aequipecten), Mimachlamys, Chlamys (Lyriochlamys), Merklina, Limea, Pseudolimea* (?), *Ctenoides, Trapezium,* and *Pholadomya (Bucardiomya).*

OPOKA-MARL FACIES. The Upper Senonian bivalves of the Lvov region, the Donbass and peri-Caspian basins, and of Crimea have been described by ALTH (1850), KNER (1850, 1852), PŁACHETKO (1863), FAVRE (1869), ROGALA (1909, 1911), PASTERNAK (1968), SAVCZINSKAJA (1974), and SOBETSKI (1977, 1982). These bivalves, particularly those from the Lvov region, coincide without any doubt with those of the Maastrichtian of the Middle Vistula area; this is especially well demonstrated by the predominance of the infaunal genera *(see* Text-fig. 19 *D—E, G—H).* The species *Nuculana brevirostris* (ALTH) and *Lyropecten (Aequipecten) wisniowskii* (PASTERNAK) are restricted to the Upper Senonian of the Lvov region and of the Middle Vistula area. The majority of the genera known from the Maastrichtian deposits of the Russian Platform and Crimea were recorded in the Middle Vistula Valley, except for a few genera, such as *Trigonia* and *Crassatella.*

CHALK FACIES. The bivalves of the Maastrichtian chalk of England (WOODS 1899—1913), Denmark (RAVN 1902; HEINBERG 1976, 1978, 1979 a, b, c), Isle of Rügen (v. HAGENOW 1842, WOLANSKY 1932) and Hemmoor (DHONDT 1982) are characterized by the predominance of the active and epifaunal genera rather than the infaunal genera *(see* Text-fig. 19*C, F, L).* The majority of these genera were encountered in the Maastrichtian of the Middle Vistula area.

CALCARENITE FACIES. VOGEL (1895) described about 100 bivalve species from the Maastrichtian deposits of Limburg (Maastricht, Kunrade und Geulhem). Most of these species, especially the pectinids, have been revised and modernized by DHONDT (1971—1983). The Maastrichtian bivalves of the Middle Vistula area are similar to them, particularly by the predominance of the pteriomorphids. However, the Limburg Maastrichtian differs in having a smaller number oof the nuculid and pholadomyid species *(see* Text-fig. 19 *A—B).* The two areas are sharing in 35 bivalve species. Such genera as *Pectenuclus, Lithophaga, Trigonia, Crassatella, Corbis,* and *Gastrochaena* are present in the Maastrichtian of Limburg but absent in the Middle Vistula area. On the other hand, however, the genera *Trapezium, Thracia, Venericardia, Mutiella, Nemocardium* and *Vnilicardia* are absent in Limburg, but they are present in the Middle Vistula area. The species *Lyropecten (Aequipecten) acuteplicatus* (ALTH) abundant in the uppermost Maastrichtian deposits of the Middle Vistula area is less common, or replaced by *L. (A.) pulchellus* (NILSSON) in the Maastrichtian stratotype, as noticed by DHONDT

(1982). Generally, the infaunal bivalves are more common in the opoka and marls of the Middle Vistula area than in the calcarenite facies of the Maastrichtian stratotype.

NORTH AMERICAN PROVINCE

SPEDEN (1970b) revised the bivalves of the Maastrichtian Fox Hills Formation, the U.S. Western Interior; they are characterized by the predominance of the Heterodonta (Text-fig. 20*B*) instead of the Pteriomorphia in the Middle Vistula area. The pectinid, chlamiid and limid genera are almost absent in the Western Interior, whilst they are in dominance in the Middle Vistula area. The following are the most important

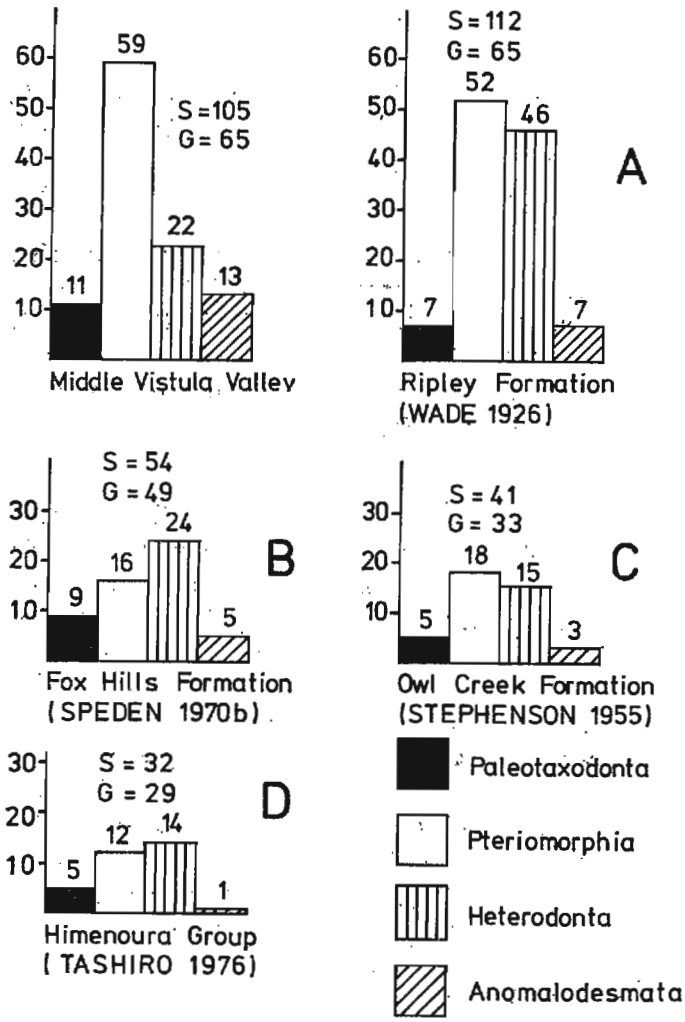


Fig. 20. Comparison between the Maastrichtian bivalves of the Middle Vistula area and those of North America and Japan

genera characterizing the Maastrichtian of the Fox Hills Formation: *Nucula (Jupiteria), Yoldia, Malletia, Solemya, Parallelodon, Corbicula, Spaniorinus, Sourimis, Spicula, Nymphalucina.* The two areas are sharing only in the cosmopolitan genera and other common genera of the Euramerican region, such as *Spyridoceramus, Tenuipteria. Pseudoptera,* and *Cuspidaria.*

WADE (1926) described the fauna of the Ripley Formation (Maastrichtian), and correlated the North American genera with those of the North European Province. The bivalves of the Ripley Formation are discriminated by a lack of chlamiid, pectinid and limid genera, whilst the Pteriomorphia and Heterodonta are nearly equal *(see* Text-fig. 20*A).* Such genera as *Inoperna, Pycnodonte, Leptosolen, Legumen, Panopea, Pholadomya* and *Liopistha* occur in both the Ripley Formation and the Middle Vistuula area, whilst the important genera of the Ripley Formation *(Yoldia, Nemodon, Protocardia, Icanotia, Aenona, Corbulamella, Martesia, Etea, Scmbula, Unicardium,* and *Aphrodina)* are absent in the investigated area.

The bivalves of the Owl Creek Formation, Southern Missouri (STEPHENSON 1955) are quite similar to those of the Ripley Formation *(see* Text-fig. 20*C)* due to the predominance of the Heterodonta and a lack of pectinid, chlamiid and limid genera. Such genera as *Cuneolus, Anatimya, Veniella, Brevicardium,* and *Aphrodina* are the most important genera characterizing the Owl Creek Formation.

NORTH PACIFIC PROVINCE

This province includes the Northeast Pacific and the Japanese — East Asian subprovinces (KAUFFMAN 1973).

The bivalves of the Himenoura Group (Campanian — Maastrichtian) Kyushu, Japan, were described by TASHIRO (1976, 1982), TASHIRO & OTSUKA (1980, 1982), TASHIRO & *al.* (1980) and others. Such genera as *Izumia, Pleurogrammatodon, Nippononectes, Apiotrigonia, Microtrigonia, Steinmanella, Agnomyax, Fleiastexte,* and *Mesochione* are the most important and they characterize the Himenoura Group. The Middle Vistula area and Kyushu are sharing in the cosmopolitan genera as well as those of the North Temperate Realm *(see* Table 4). The genera *Tenuipteria, Pholadomya,* and *Liopistha* as well as the pectinids and limids, which are common in the Maastrichtian of the Middle Vistula Valley, are not found in the Himenoura Group. TASHIRO (1976) indicated also that the bivalve faunas from the Upper Cretaceous of California *(see* STEWART 1930, POPENOE 1937, ANDERSON 1958) are similar to that of the Himenoura Group in the abundant occurrence of *Acila, Glycymerita, Nanonavis, Tenea, Leptosolen, Agnomyax, Cymbophora, Loxo, Steinmanella,* and *Sphenoceramus.*

TETHYAN REALM

The Upper Senonian bivalves of southern Europe (Northern Tethys) have been described by ZITTEL (1865—1866) from Austria, BÖHM (1891) from Bavaria, TZANKOV (1981) from Bulgaria, and PETHÖ (1906) from Yugoslavia. These faunas, featured by the predominance of the Hippuritoida, resemble that of the Middle Vistula area to a limited extent, only by the coexistence of cosmopolitan as well as trans-temperate genera, such as *Mutiella, Phelopteria, Syncyclonema, Hyotissa, Leptosolen, Opis, Liopistha,* and others. Many cosmopolitan bivalve species were recorded in southern Europe (Senonian) and the Maastrichtian of the Middle Vistula area.

The bivalve fauna of the Upper Cretaceous deposits of Egypt (WANNER 1902, QUASS 1902, ABRASS 1962), Tunisia (PERVINQUIÈRE 1912), Algeria and Morocco (FRENEIX 1972), Palestine (BLANCKENHORN 1934), Jordan, Syria and Lebanon are discriminated from the Middle Vistula fauna in lacking the genera belonging to the Limidae, Oxytomidae and Noetidae, although, such cosmopolitan species as *Camptonectes virgatus, Neithea sexcostata, Pycnodonte vesiculare, Hyotissa semiplana, Gryphaeostrea canaliculata, Legumen fragilis, Spondylus dutempleanus, Inoceramus regularis, Exogyra decussata, Lucina subnumismalis, Astarte similis* and *Nucula tenera* occur in the both discussed regions.

ŁOPUSKI (1912) and DHONDT (1972b) considered *Pecten farafraensis* ZITTEL from the Upper Maastrichtian of southern Egypt as a synonym of *Lyropecten (A.) acuteplicatus* (ALTH), the species so common in the investigated area of the Middle Vistula Valley.

SOUTH TEMPERATE REALM

The endemic bivalve genera as well as the evolution of this realm were concisely discussed by KAUFMANN (1973).

The Cretaceous bivalves of Southern India were described by STOLICZKA (1870—1871). Some widespread bivalve species occur commonly both in the Maastrichtian deposits of the Middle Vistula area and in the Upper Cretaceous of Southern India. Such species as *Inoperna flagellifera, Pinna cretacea, Gervillia solenoidea, Camptonectes virgatus, Pycnodonte vesiculare, Gryphaeostrea canaliculata, Astarte similis, Liopistha aequivalvis,* and the cosmopolitan genera occur in the both areas. This means that the Southern Indian bivalve faunas have some affinity to those from the Middle Vistula area.

BASSE (1933) and COLLIGNON (1951 a, b) correlated the Cretaceous fauna from Madagascar with that of Southern India. Of the European species, only *Camptonectes virgatus* was recorded in the Upper Cretaceous deposits of South Africa.

PALEOECOLOGICAL ACCOUNT

The gastropod and bivalve assemblages of the Maastrichtian opokas and marls exposed along the Middle Vistula Valley reflect influences of the North Temperate Realm, as indicated in the preceding chapter. According to POŻARYSKA & PERYT (1979), neither benthic nor planktic foraminifera typical of the Boreal Realm have been found in the Late Cretaceous deposits of Central Poland (geotectonic area of the Danish-Polish Trough; *see* Text-fig. 2).

The following is a brief discussion on the macroinvertebrate benthic assemblages[1] (with a special emphasis on the non-cephalopod mollusks) prevailing during the deposition of the Late Campanian-Maastrichtian sequence in the study area (*see* Tables 5—9). The terminology used herein for the describing of the paleoecological variables is a relative and not an absolute one.

Table 5

Ranked abundance of the studied gastropods by families, and their trophic groups D — deposit feeders, S — suspension feeders, H — herbivores, P — predators

Family	Trophic groups	No. of genera	No. of species	No. of specimens
Aporrhaidae	D	7	13	380
Turritellidae	S	1	3	222
Nododelphinulidae	H?	1	3	205
Trochidae	H	5	15	114
Volutidae	P	4	5	104
Naticidae	P	2	3	56
Cerithiidae	H	2	9	44
Pleurotomariidae	H?	2	4	43
Vasidae	P	1	5	26
Vermetidae	S	2	2	23
Ringiculidae	P	1	3	22
Fasciolariidae	P	3	6	21
Acteocinidae	P	1	1	14
Strombidae	P?	1	1	12
Cymatiidae	P	2	3	11
Columbellariidae	?	1	3	10
Buccinidae	P	1	1	9
Scalidae	?	1	2	7
Fissurellidae	H	2	2	7
Cancellariidae	P	1	1	3
Turridae	P	1	2	3
Xenophoridae	?	1	1	3
Acteonidae	P	1	1	2
Solariidae	?	1	1	2
Acmaidae	H	1	1	2
Cassididae	P	1	1	2

[1] The term *assemblage* is used the same as identified by FAGERSTROM (1964), together with additional remarks given by JABLONSKI & BOTTJER (1983).

Table 6

Ranked abundance of the dominant and most common gastropod species and subspecies

Species	No. of specimens
Aporrhais pyriformis	247
Trochacanthus tricarinatus tricarinatus	171
Turritella (Turritella) hagenoviana	119
Turritella (Haustator) plana	102
Volutispina kasimiri	48
Perissoptera emarginulata	38
Rostellana aequecostata	37
Arrhoges (Latiala) pelecyphora	31
Natica(?) cretacea	27
Calliomphalus fruchti	28
Conotomaria linearis	23

Table 7

Ranked abundance of the studied bivalves by superfamilies

Superfamily	No. of families	No. of genera	No. of species	No. of specimens
Pectinacea	6	13	20	1387 v
Limacea	1	5	7	346 v
Pholadomyacea	1	2	6	276
Ostreacea	2	5	5	263 v
Limopsacea	1	1	4	210
Pteriacea	2	5	6	203 v
Mytilacea	1	3	6	180
Hippuritacea	1	1	1	128
Arcacea	3	4	8	123
Arcticacea	2	3	3	119
Cardiacea	1	3	5	116
Nuculanacea	1	1	6	116
Lucinacea	2	2	3	114
Hiatellacea	1	1	1	71
Crassatellacea	1	2	2	55
Poromyacea	2	2	3	54
Pandoracea	3	3	4	51
Nuculacea	1	1	5	48
Solenacea	1	2	2	41
Pinnacea	1	1	2	15
Carditacea	1	1	1	12
Veneracea	1	1	1	11
Myacea	1	1	1	2
Pholadacea	1	1	1	2
Tellinacea	1	1	1	1

v - separate valves

Table 8

Ranked abundance of the dominant and most common bivalve species

Species	No. of specimens
Lyropecten (Aequipecten) acuteplicatus	660 (valves)
Pycnodonte (Phygraea) vesiculare	160 (valves)
Pholadomya kasimiri	158
Gyropleura inequirostrata	128
Gervillia solenoidea	115 (valves)
Limopsis sacheri	114
Oxytoma (Hypoxytoma) danica	109 (valves)
Plagiostoma hoperi	108 (valves)
Spondylus dutempleanus	100
Mutiella coarctata	95
Merklinia variabilis	92 (valves)
Gryphaeostrea canaliculata	79 (valves)
Modiolus elongatus	75
Nuculana producta	74
Panopea mandibula	73
Nemocardium fenestratum	66
Tenuipteria argentea	65
Limatula kunradensis	63 (valves)
Spondylus trancatus	61
Chlamys (Lyriochlamys) septemplicata	60 (valves)

Table 9

Ecological classification of the studied bivalve genera and subgenera

I Infaunal labial-palp deposit feeders: Nucula, Nuculana

II Infaunal non-siphonate suspension feeders: Pseudogrammatodon, Cucullaea, Limopsis, Mutiella, Venericardia, Astarte, Opis ?, Granocardium ?, Pleuriocardia ?. Nemocardium ?

III Infaunal siphonate suspension feeders: Cultellus, Leptosolen, Linearia, Tenea, Venilicardia, Trapezium, Legumen, Corbula, Panopea, Pholadomya, Goniomya, Cercomya, Periploma, Thracia, Liopistha, Cuspidaria ?

IV Infaunal mucus-tube feeders: Lucina

V Semi-infaunal suspension feeders: Inoperna, Modiolus, Pinna, Gervillia

VI Epifaunal recliners (iceberg) suspension feeders: Neithea

VII Epifaunal byssally attached suspension feeders: Arca, Barbatia, Septifer, Pseudoptera, Phelopteria, Spyridoceramus, Tenuipteria, Oxytoma, Syncyclonema, Camptonectes, Chlamys (Lyriochlamys), Mimachlamys, Merklinia, Limatula, Limea, Pseudolimea, Plagiostoma, Ctenoides

VIII Epifaunal cemented suspension feeders: Spondylus, Placunopsis, Atreta, Pycnodonte, Hyotissa, Gryphaeostrea, Acutostrea, Agerostrea, Gyropleura

IX Free-living suspension feeders: Entolium, Propeamussium, Lyropecten (Aequipecten)

The lithofacies, to which the investigated asssemblages are confined, and the depositional environment of the hardground and greensands were described in the preceding chapters.

UPPERMOST CAMPANIAN OPOKA ASSEMBLAGE

Dominant taxa: sponges, and *Inoceramus* spp.

Common taxa (in decreasing abundance): ***Nuculana producta, Pycnodonte vesiculare, Pholadomya decussata, Echinocorys*** sp., and ***Spondylus dutempleanus.***

This assemblage is characterized by the predominance of the epifaunal suspension-feeders *Inoceramus* spp. which exhibit flattened, vastly expanded shells realizing the „snowshoe strategy" *(sensu* RHOADS 1970, *and* CARTER 1972), and which adapted themselves for living on a soft substrate *(see* Text-fig. 21). The deposit-feeder *Nuculana producta* and

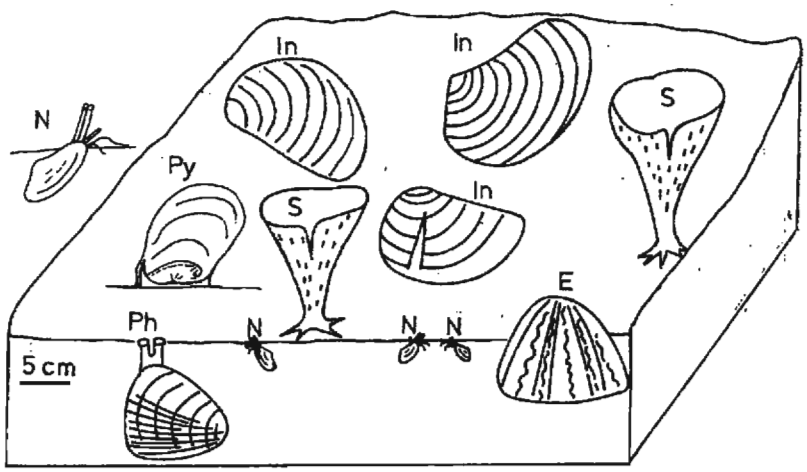


Fig. 21. Schematic sketch of the benthic assemblage of uppermost Campanian opoka, as exposed at Piotrawin

In — *Inoceramus* sp., **Py** — *Pycnodonte vesiculare*, **N** — *Nuculana producta*, **Ph** — *Pholadomya decussata*, **S** — sponges, **E** — *Echinocorys* sp. (see Table 11)

the suspension-feeder *Pholadomya decussata* are the common infaunal species in this assemblage. Most of the left valves of *Pycnodonte vesiculare* possess a „hippopodium" form with a broad xenomorphic area, most probably adapted for the soft bottom habitat. The gastropods are rather rare in this assemblage, and only some specimens of *Cerithium binodosum Architectonica granulatocostata,* and *Tudicla carinata* were recorded.

The echinoids of the genus *Echinocorys* lived herein probably partly buried, ploughing through sediment and feeding on detritus *(see* ERNST & SEIBERTZ 1977, KENNEDY 1978).

Brachiopods, serpulids and ahermatypic corals have frequently also occurred in this environment.

Camparable cup- and vase-shaped sponges are recently observed in the Rockall Bank, notheast Atlantic (*see* SCOFFIN & *al.* 1980), accompa-

nied by bryozoans and serpulids at depths of 104 m, and they dominate at depths of 150 m (temperate, sub-photic zone and carbonate substrate).

The discussed opokas were apparently deposited at mid- to outer-shelf depths and under warm water conditions.

EARLY MAASTRICHTIAN OPOKA ASSEMBLAGE

These opokas are similar to those of the uppermost Campanian, but their faunal content is, however, quite different. There is a remarkable decrease in the frequency of inoceramids and in the absence of *Echinocorys* sp. Nevertheless, the epifaunal suspension-feeding pteriomorphid bivalves are the most common taxa in this assemblage (*see* Text-fig. 22), viz. *Mimachlamys cretosa cretosa, Spyridoceramus tegulatus* (fragments), *Propeamussium (Parvamussium) inversum, Pseudolimea*(?) *granulata, Acutostrea incurva, Hyotissa semiplana,* and *Neithea sexcostata.*

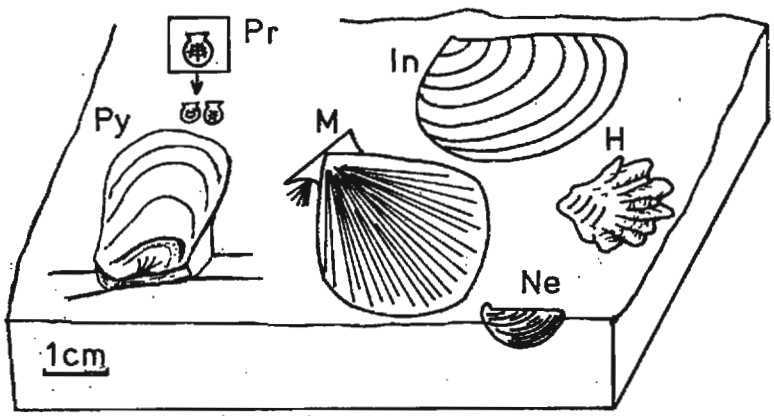


Fig. 22. Schematic sketch of the benthic assemblage of Lower Maastrichtian opoka, as exposed at Dziurków

In — *Inoceramus* sp., **Py** — *Pycnodonte vesiculare*, **Ne** — *Neithea sexcostata*, **M** — *Mimachlamys cretosa cretosa*, **Pr** — *Propeamussium inversum*, **H** — *Hyotissa semiplana* (see Table 11)

All these benthic elements frequently adapted themselves for living on a soft substrate. The free-living species *P. (P.) inversum* and *Lyropecten (Aequipecten) wisniowskii* are characterized by the relatively light shell, wide apical angle, and by the presence of gaps on the anterior and posterior margins which allow the ejection of propulsive current jets (*see* KAUFFMAN 1969, STANLEY 1970, CARTER 1972). The species *Neithea sexcostata* possesses an inflated highly convex left (lower) valve and flat right (upper) valve. This species exhibits an "iceberg strategy" (*sensu* THAYER 1975, *and* JABLONSKI & BOTTJER 1983) resulting in a characteristic morphology of the species living as recliners on soft substrates.

The species *Hyotissa simplana* is another example for adaptation of the epifaunal habit on such soft bottoms. It exhibits a flat, strongly sculptured shell suitable for fixation; the forms of such morphology are termed as „fan-shaped recliners" by SEILACHER (1984).

The environment of deposition of the Early Maastrichtian opokas of the study area was similar to that of the Late Campanian.

LOW-UPPER MAASTRICHTIAN MARLY CHALK ASSEMBLAGE

Dominant taxa: *Oxytoma (Hypoxytoma) danica* and *Nuculana producta.*
Common taxa: *Phelopteria pectinoidea, Plagiostoma hoperi, Turritella plana,* and *Aporrhais pyriformis.*

This assemblage is dominated (*see* Text-fig. 23) by the epifaunal byssally attached suspension-feeders, such as *Oxytoma (Hypoxytoma) danica* (epibyssate) and *Phelopteria pectenoidea* (endobyssate). The deposit-feeders are represented by the protobranch bivalve *Nuculana producta* and the gastropod *Aporrhais pyriformis.* The other gastropods are rare in this assemblage, being represented by *Turritella plana* and *Helicaulax pozaryskii.*

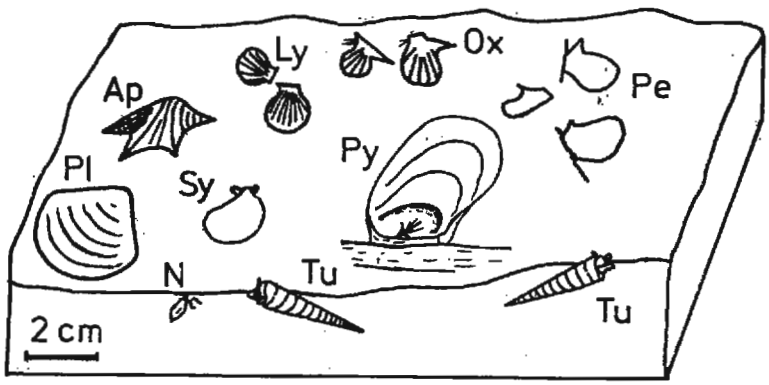


Fig. 23. Schematic sketch of the benthic assemplage of Upper Maastrichtian marly chalk, as exposed at Mędmierz

GASTROPODS: **Ap** — *Aporrhais pyriformis,* **Tu** — *Turritella plana*

BIVALVES: **Ox** — *Oxytoma danica,* **Pe** — *Phelopteria pectenoidea,* **Py** — *Pycnodonte vesiculare,* **Ly** — *Lyropecten (A.) pulchellus,* **Pl** — *Plagiostoma hoperi,* **N** — *Nuculana producta,* **Sy** — *Syncyclonema nilsoni*

The species *Oxytoma (Hypoxytoma) danica* (strongly inequivalve), according to SEILACHER (1984), is considered as a „byssate outriggered recliner"; it has a long hinge line which alloows to prolongate into a narrow auricle, which may have had a stabilizing function (*see* SEILACHER 1984). The species *Phelopteria pectinoidea* is an example of endobyssate „mud stikers", as defined by SEILACHER (1984).

As a conclusion, the benthic fauna of this marly chalk lithofacies is apparently smaller if compared with that of opoka and marly opoka lithofacies. Most probably, this marly chalk was deposited in an offshore, warm water, mid- to outer-shelf environment.

UPPERMOST MAASTRICHTIAN MARLY OPOKA ASSEMBLAGE AT KAZIMIERZ TOWN QUARRY SECTION)

Dominant taxa: *Gyropleura inequirostrata, Gervillia solenoidea, Oxytoma (Hypoxytoma) danica, Spondylus dutempleanus, Plagiostoma hoperi, Aporrhais pyriformis, Turritella (Haustator) plana, Turritella hagenoviana*; besides the dominance of sponges, brachiopods and bryozoans.

Common taxa: *Nuculana producta, Tenea sp., Pycnodonte vesiculare, Limopsis sacheri* and *L. radiata*, together with serpulids.

This assemblage is dominated by the epifaunal suspension-feeding bivalves along with the infaunal deep-burrowing suspension feeders such as *Pholadomya, Panopea, Cercomya* and the deposit-feeding nuculids, and with a pronounced occurrence of the shallow infaunal suspension-feeding limopsids (*see* Text-fig. 24).

The cemented cup-shaped (*sensu* SEILACHER 1984) *Gyropleura inequirostrata* is the dominant species together with the endobyssate mud-sticker *Gervillia solenoidea* and the byssate outrigger *Oxytoma (Hypoxytoma) danica*. The most common free-living genera, such as *Entolium, Syncyclonema,* and *Lyropecten (Aequipecten)* are characterized by a wider apical angle which offers several hydrodynamic advantages for swimming (STANLEY 1970). On the other hand, such genera as *Chlamys, Mimachlamys* and *Merklina* (common epifaunal elements in this assemblage) possess an elongate anterior auricle and a distinct byssal notch, which both have a function of a stabilizing mechanism (STANLEY 1970, 1972).

The gastropods are represented here by the dominant deposit-feeder *Aporrhais pyriformis,* along with *Turritella plana* and *Turitella hagenoviana* which certainly were mucus-net suspension feeders in soft substrates (*see* JABLONSKI & BOTTJER 1983). The Recent aporrhaid species *Aporrhais pespelecani* (LINNAEUS) lives buried in sandy bottoms of shallow, warm seas (*see* POPENOE 1983).

Turritellas, as found in temperate seas, live buried just below the surface in soft substrate, from below low tide to depths of 100 meters or more (THORSON 1957; *and* SAUL 1983, references therein). As buried ciliary feeders, the Cretaceous turritellas would have required a substrate similar to that inhabited by the present-day forms: a bottom soft enough to burrow into, but firm enough to preserve the constructed inhalant canal, leaving the foot unclogged and the exhalant canal unblocked (SAUL 1983).

The cerithiid and trochid gastropods, the pronounced herbivorous feeders, are common in this marly opoka assemblage, which indicates the presence of algae and/or seagrasses within their biotopes.

As a conclusion, from the higher percent of infaunal suspension feeders, the dominance of aporrhaids and turritellids as well as the occurrence of algal-feeding gastropods, it seems that the Kazimierz marly opoka (the Town Quarry section) represents a mid- to inner-shelf environment, situated probably near to the shore, with a firm substrate with plant vegetation. The depth did not exceed 100 m, and it was decreasing towards the upper part of the sequence.

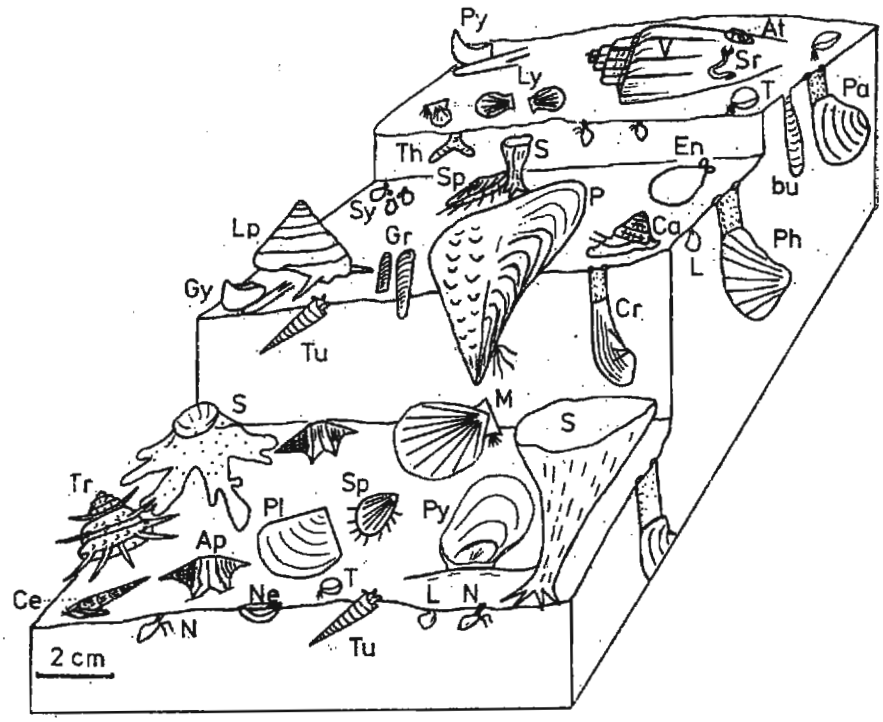


Fig. 24. Schematic sketch of the benthic assemblage of uppermost Maastrichtian marly opoka, as exposed at Kazimierz

GASTROPODS: **Ap** — *Aporrhais pyriformis* (18%), **Tu** — *Turritella hagenoviana* and *T. plana* (18.6%), **Ca** — *Calliomphalus fruchti* (4.7%), **Ce** — *Cerithium nerei* (4.5%), **Lp** — *Leptomaria subgigantea*, **V** — *Volutispina kasimiri*

BIVALVES: **Gy** — *Gyropleura inequirostrata* (6.8%), **Gr** — *Gervillia solenoidea* (6.4%), **Ox** — *Oxytoma danica* (6%), **Sp** — *Spondylus dutempleanus* (5%), **Pl** — *Plagiostoma hoperi* (4%), **N** — *Nuculana producta* (3.5%), **L** — *Limopsis sacheri* and *L. radiata* (5.5%), **Py** — *Pycnodonte vesiculare* (3.5%), **M** — *Mimachlamys cretosa cretosa*, **At** — *Atreta nilssoni*, **En** — *Entolium membranaceum*, **Pa** — *Panopea mandibula*, **Ph** — *Pholadomya kasimiri*, **Cr** — *Cercomya harpa*, **P** — *Pinna (Plesiopinna) kasimirensis*

OTHERS: **S** — sponges, **Sr** — serpulids, **T** — brachiopods, **bu** — burrows, in general, **Th** — *Thalassinoides*-type burrows

UPPERMOST MAASTRICHTIAN MARLY OPOKA ASSEMBLAGE AT NASIŁÓW

Dominant taxa. *Lyropecten (Aequipecten) acuteplicatus, Pholadomya kasimiri, Merklinia variabilis, Trochacanthus tricarinatus tricarinatus, Turritella hagenoviana, T. plana,* and *Aporrhais pyriformis*; besides the dominance of sponges, brachiopods and bryozoans.

Common taxa: *Modiolus radiatus, M. elongatus, Pycnodonte vesiculare, Mutiella coarctata, Volutispina kasimiri, Rostellana aequecostata,* and *Pressioptera emarginulata.*

This assemblage is highly diversified, and strongly dominated by the suspension-feeding, both infaunal and epifaunal bivalves with equal frequency *(see* Text-fig. 25).

The gastropods are dominated by the nododelphinulid *Trachacanthus tricarinatus tricarinatus* (the most interesting taxon which has elongated rows of spines, and which is most probably herbivorous) and turri-

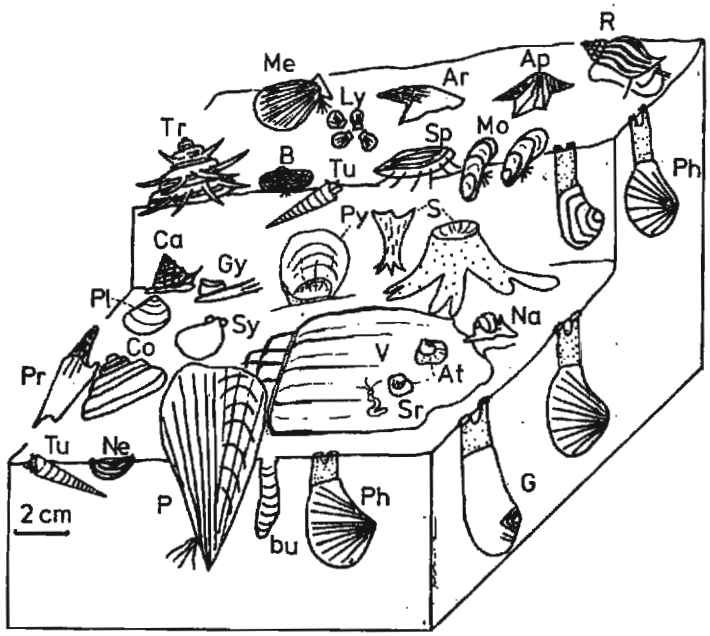


Fig. 25. Schematic sketch of the benthic assemblage of uppermost Maastrichtian marly opoka, as exposed at Nasiłów

GASTROPODS: **Tr** — *Trochacanthus tricarinatus tricarinatus* (33%), **Tu** — *Turritella hagenoviana* and *T. plana* (30%), **Ap** — *Aporrhais pyriformis* (9%), **R** — *Rostellana aequecostata* (7.7%), **V** — *Volutispina kasimiri* (7.7%), **Pr** — *Perissoptera emarginulata* (7%), **Ar** — *Arrhoges pelecyphora* (3.5%), **Na** — *Natica*(?) *cretacea* and *N. exaltata* (6%), **Ca** — *Calliomphalus fruchti*, **Co** — *Conotomaria linearis*

BIVALVES: **Ly** — *Lyropecten (A.) acuteplicatus* (13%), **Ph** — *Pholadomya kasimiri* (7.3%), **Me** — *Merklinia variabilis* (4.6%), **Mo** — *Modiolus elongatus* and *M. radiatus* (8.5%), **Py** — *Pycnodonte vesiculare* (4%), **Gy** — *Gyropleura inequirostrata*, **B** — *Barbatia tenuistriata*, **Sy** — *Syncyclonema nilsoni*, **Pl** — *Plagiostoma hoperi*, **Ne** — *Neithea sexcostata*, **At** — *Atreta nilssoni*, **P** — *Pinna cretacea*, **Sp** — *Spondylus dutempleanus*, **G** — *Goniomya designata*

OTHERS: **S** — sponges; **Se** — serpulids; **T** — brachiopods; **bu** — burrows, in general

tillids along with aporrhaids. The gastropod predators are the common elements in this assemblage, and this notably concerns naticids and volutids (*see* Table 5). Herbivorous gastropods are represented by the trochids and cerithiids. The most important gastropod species is the volutid *Volutispina kasimiri* which exhibits an unusual large shell, and which most probably lived partly or wholly buried, because its shell possesses broad axial costae, probably adapted for a burrowing mode of life (*see* GRAUS 1974).

The vermetids (suspension feeders) and pleurotomariids (sponge-grazing, *see* KENNEDY 1978) are also remarkable in this assemblage.

The endobyssate suspension feeders *Modiolus radiatus* and *M. elongatus* represent the adaptation of the shell shape to the mud sticking (*see* STANLEY 1970, 1972; SEILACHER 1984); they are the most common bivalves in this assemblage.

The cardiids in this assemblage, although represented by a smaller number of specimens, possess a higher diversity (5 species; *see* Tables 7 and 9). They are infaunal shallow burrowers and, most probably, non-siphonate suspension feeders (*see* SCOTT 1978). The genus *Granocardium* has numerous radial rows of spines covering the whole shell, and used for rapid burrowing and stabilization in a soft substrate (*see* SCOTT 1978), together with some other adaptive advantages (*see* STANLEY 1970).

The present-day communites dominated by *Turritella*, and *Aporrhais* together with *Natica* are found in warm offshore, sandy bottoms at depths to 40—85 m (*see* TAYLOR & *al.* 1983, references therein).

Serpulids are common, while ahermatypic corals are rarely represented in this assemblage.

As a conclusion, this assemblage is highly diversified, not only in the benthic fauna but also in nektic and planktic associations, and also in different mode of habitats and different trophic groups. Such environmental heterogeneity occurs in shallow water (inner shelf) rich with nutrients, ubiquitous plant vegetation, firm substrate, and near to the shore. Such an environment is also indicated by the dominant occurrence of all growth stages, the juveniles including, of the belemnites (*see* CHRISTENSEN 1976, JARVIS 1980), and by the abundance of the terrestrial plant remains in these deposits.

UPPERMOST MAASTRICHTIAN HARDGROUND ASSEMBLAGE

Dominant taxa: ***Aporrhais pyriformis, Lyropecten (Aequipecten) acuteplicatus, Limopsis sacheri, Turritella hagenoviana,*** and ***T. plana;*** besides sponges and brachiopods.

Common taxa: ***Opis ventricosa, Natica(?) cretacea, Pycnodonte vesiculare,*** and ***Mutiella coarctata.***

The faunal assemblage of the hardground is dominated by the epifaunal suspension-feeders along with the infaunal suspension-feeders

(*see* Text-fig. 26). This assemblage represents a highly diversified fauna which possesses the best preserved molds of the aragonitic shells, together with the calcitic shells. The British investigators informally used the term *reussianum* for describing such a hardground faunal assemblage (*see* CARTER 1972).

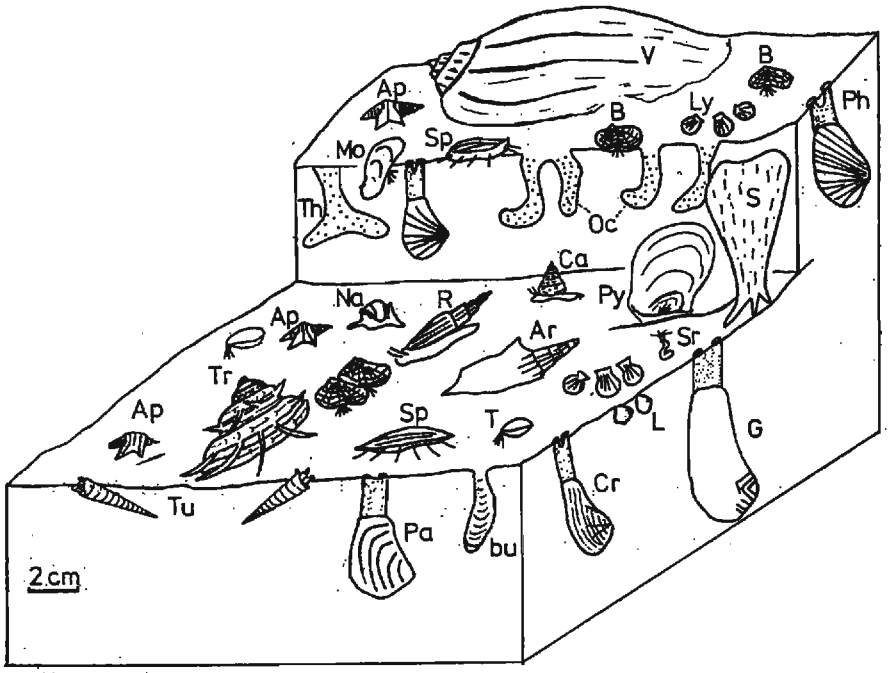


Fig. 26. Schematic sketch of the benthic assemblage of uppermost Maastrichtian hardground, as exposed at Nasiłów

GASTROPODS: **Ap** — *Aporrhais pyriformis* (56%), **Tu** — *Turritella hagenoviana* and *T. plana* (9%), **Na** — *Natica*(?) *cretacea* (4.3%), **Ar** — *Arrhoges pelecyphora* (4%), **Tr** — *Trochacanthus tricarinatus tricarinatus* (2%), **Ca** — *Calliomphalus nasilowensis* (2%), **V** — *Volutispina kasimiri*

BIVALVES: **Ly** — *Lyropecten (A.) acuteplicatus* (50%), **L** — *Limopsis sacheri* (8%), **Py** — *Pycnodonte vesiculare* (2.5%), **Mo** — *Modiolus elongatus* (1.8%), **Sp** — *Spondylus dutempleanus*, **Pa** — *Panopea mandibula*, **Cr** — *Cercomya harpa*, **G** — *Goniomya designata*, **B** — *Barbatia tenuistriata*

OTHERS: **S** — sponges; **Sr** — serpulids; **T** — brachiopods; **bu** — burrows, in general; **Th** — *Thalassinoides*-type burrows; **Oc** — *Ocypode*-type burrows

The limopsids are the most common element in this hardground assemblage, similarly to that of the hardground exposed at Stevns Klint, Denmark, which was precisely studied by HEINBERG (1976—1979) who also discussed the evolution and paleoecology of the contained limopsids.

TOPMOST MAASTRICHTIAN GREENSAND ASSEMBLAGE

Dominant taxa: *Lyropecten (Aequipecten) acuteplicatus*, *Pycnodonte vesiculare* and *Gryphaeostrea canaliculata*; besides brachiopods, bryozoans and serpulids.

This assemblage is dominated by epifaunal suspension-feeders. Some phosphatized and limonitized steinkerns of nuculids (deposit-feeders) frequently occur here, but the gastropods are poorly represented. All the growth stages of the dominant species, the same as of *Belemnella kazimiroviensis*, are recognized in this assemblage.

CONCLUSION

The reconstruction of the depositional environment of the Late Cretaceous opokas and marls of the present-day Middle Vistula area is not easy, because there are no Recent counterparts, and this facies is unknown through any other geologic ages, and the same is true for the white chalk facies (*see* SURLYK & BIRKELUND 1977).

The main environmental conditions accompanied with the deposition of opokas and marls during the Late Campanian and Maastrichtian (*see* Table 10) are taken from the data on the nannoplankton and foramini-

Table 10

The main variations of the paleoenvironmental conditions in the Late Campanian — Maastrichtian deposits of the study area

Note: all terms are relative; temperature based mainly on the previous works on belemnites (BOWEN 1961, 1966; KONGIEL 1962), ostracodes (CLARKE 1962), flora (CIEŚLIŃSKI 1964, GAŻDZICKA 1978); environments of the hardground and greensand are taken from RADWAŃSKI (1985)

Age	Local hor.	Zone	Temperature (°C)	Distance to shore	Water depth (m)	Substrate	Environment
Late Maastrichtian	z	Belemnella kazimiroviensis = Tenuipteria argentea	> 10	near	20–50	? firm	inner shelf
	y		> 10	near	0–10	hard	tidal flat
	x		> 10	near	20–80	firm	inner shelf
	w	Belemnitella junior	warm	off	100–150	soft	mid to outer shelf
Early Maastrich.	v	Belemnella occidentalis	> 10	off	100–150	firm	mid to outer shelf
	u	Belemnella lanceolata	> 10	off	100–150	firm	mid to outer shelf
	t						
L. Camp.	s	Nostoceras pozaryskii	warm	off	100–150	firm	mid to outer shelf

fera which indicate warm and normal marine water (*see* GAŹDZICKA 1978, POŻARYSKA & PERYT 1979), and also from the data on paleotemperature (*see* BOWEN 1961, 1966; CIEŚLIŃSKI 1964). The occurrence of the genus *Belemnella* in the early and topmost Maastrichtian deposits indicates a relative decrease in water temperature, not less than 10° C (*see* KONGIEL 1962), as recently evidenced (Ass.-Professor J. SZCZECHURA *pers. comm.; see also* CLARKE 1982, ROBACZYŃSKI & *al.* 1985) by the frequent occurrence of the ostracode genus *Cytherollodea*.

On the other hand, the studied gastropod and bivalve faunal assemblages, particularly those from the uppermost Maastrichtian marly opoka and hardground (high diversity) indicate warm water and good photic conditions, if they are compared with the modern communities. Moreover, JELETZKY's (1951) opinion about the association of the genus *Belemnitella* with warm water, and of the genus *Belemnella* with „cold" water conditions, should be taken with some reserve in interpreting the

Table 11

Trophic groups and diversity among the non-cephalopod mollusk assemblages of the studied topmost Campanian — Maastrichtian deposits

S — suspension feeders, **P** — predators, **H** — herbivores, **D** — deposit feeders, **ID** — infaunal deposit feeders, **IS** — infaunal suspension feeders, **SI** — semi-infaunal suspension feeders, **ES** — epifaunal suspension feeders, **F** — free-living

Age	Zone	Assemblage		Diversity (no. of species)		Density (total no. of specimens)		Trophic groups in percent or (bracketed) in number of specimens								
								Gastropods				Bivalves				
				Gastr.	Bivalv.	Gastr.	Bivalv.	S	P	H	D	ID	IS	SI	ES	F
Late Maastrichtian	Belemnella kazimiroviensis (Tenuipteria argentea)	Greensand*			11	—	239	—	—	—	—	—	—	—	57	43
		Hardground		40	44	233	304	10	17	8	65	13	40	4	63	33
		marly opoka	Nasiłów	63	88	653	1590	21	28	39	18	2	33	11	39	15
			Kazimierz	67	98	389	1302	21	13	33	32	6	34	8	42	10
	Belemnitella junior	marly chalk	Męćmierz	9	28	18	112	(7)	(2)	(3)	(6)	19	16	—	56	—
			Podgórz	8	20	11	30	—	—	(5)	(6)	(15)	(8)	—	(5)	(2)
			Dobre	8	23	12	41	—	—	(6)	(6)	(5)	(15)	—	(16)	(5)
E. Maastricht.	Belemnella occidentalis	opoka	Kłudzie	1	12	1	23	—	—	(1)	—	(5)	—	—	(16)	(2)
	Belemnella lanceolata		Dziurków	—	—	—	15	—	—	—	—	(4)	—	—	(9)	(2)
			Solec	—	11	4	27	(1)	—	(3)	—	—	(5)	—	(16)	(6)
Topmost Camp.	Nostoceras pozaryskii		Piotrawin	18	20	49	239	—	(9)	(34)	(6)	16	8	—	75	—

* For this member the given numbers do not actually represent the occurrence of the gastropods and infaunal bivalves because of the taphonomic loss

paleotemperature, because the representatives of both *Belemnitella* and *Belemnella* have been found together in the Maastrichtian deposits of Poland and of Western Europe (*see* KONGIEL 1962, p. 131; *and* CHRISTENSEN 1976). Even the isotopic temperatures obtained from belemnite guadrs are now under discussion (*see* CHRISTENSEN 1976; *and* BOUCOT 1981, references therein).

It is clear from the studied faunal assemblages (*see* Table 11) that the diversity (number of species) increases with continuous shallowing which reflects the major regressive phase of the mid- to Upper Cretaceous trangression.

The predominance of the infaunal suspension feeders, including the bivalves (*see* Table 11) and turritellids and aporrhaids (infaunal deposit--feeders) in the studied faunal assemblages is commonly connected with the near-shore environments; on the other hand, the epifaunal suspension feeders are commonly associated with off-shore environments.

It is also important to note the pronounced increase of the infaunal siphonate bivalves in the studied assemblages, along with the epifaunal bivalves. This observation agrees well with the radiation of siphonate bialves since the Cretaceous through the Tertiary (*see* STANLEY 1968, JABLONSKY & BOTTJER 1983).

FINAL REMARKS

A little, indeed, is recognizable about the environmental conditions of the Late Cretaceous opokas and marls which occupy the central and south-eastern parts of the Danish-Polish Trough. In the Russian Platform, the coeval opokas subjected to several paleontological and paleoecological studies which indicated that these opokas were apparently deposited at mid- to outer-shelf depths (*see* SOBETSKI 1978, NAIDIN & *al.* 1980).

It should be stressed that the paleoecological implication in this study is a tentative attempt, based solely upon the studied gastropod and bivalve assemblages. However, in order to maintain a logical picture about the paleoecological conditions prevailing during the deposition of the Maastrichtian opokas, a quantitative investigation of their full faunal content, rather than the traditional macrofaunal and microfaunal sammling is recommended, similarly to that done for the Danish Maastrichtian (*see* SURLYK & BIRKELUND 1977), Hemmoor Chalk (*see* SCHMID 1982), and Limburg Maastrichtian (*see* ROBASZYNSKI & *al.* 1985). Such quantitative analysis is important to evaluate the faunal assemblage along the section, and to discover their possible repetitions. Moreover, an analysis of the trace fossils, as well as petrographical and geochemical studies are recommended for further, more detailed investigations.

Finally, this study indicates that both the status and generic attribution of many gastropod and bivalve species described from the Upper Cretaceous of Europe require a revision, similar to that presented by DHONDT (1971—1973) for the pectinids. Moreover, the closely related and probably related species, as used in this work, will certainly be deleted in future, if the original type specimens of all these species are revised, particularly those from older collections as well as those recently introduced for specimens occurring in peculiar facies, *e.g.* in the Soviet Union (BLANK 1974; SOBETSKI 1977, 1982) and in Denmark (HEINBERG 1976, 1978, 1979c).

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Institute of Geoogy
of the University of Warsaw,
Al. Żwirki i Wigury 93,
02-089 Warszawa, Poland

Present address:
Departmetn of Geology
of the University of Cairo,
Giza, A. R. Egypt

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G. I. ABDEL-GAWAD

NIE-GŁOWONOGOWA FAUNA MIĘCZAKÓW (ŁÓDKONOGI, ŚLIMAKI I MAŁŻE) MASTRYCHTU Z PROFILU W PRZEŁOMIE WISŁY

(Streszczenie)

Przedmiotem pracy jest analiza paleontologiczna, ekologiczna i biogeograficzna nie-głowonogowej fauny mięczaków występującej w osadach mastrychtu odsłaniających się wzdłuż przełomu Wisły przez Pas Wyżyn Polski Środkowej, od Piotrawina aż po okolice Kazimierza nad Wisłą (*patrz* fig. 1—10 oraz tab. 1—2). Utwory najwyższego mastrychtu kończą tutaj jedyny w Europie ciągły profil osadów środkowej i górnej kredy (*por.* POŻARYSKI 1938, KONGIEL 1962, MARCINOWSKI & RADWAŃSKI 1983, RADWAŃSKI 1985). Analizowana fauna, która w porównaniu z innymi kredowymi faunami Europy jest bardzo bogata i pod wieloma względami unikalna (składu taksonomicznego, rozmaitości grup ekologicznych, obecności elementów typowych dla innych prowincji, pojawienia się szeregu form charakterystycznych dla kenozoiku), reprezentowana jest przez 2 gatunki łódkonogów, 92 ślimaków oraz 105 małży, z których wszystkie zostały rozpatrzone w systematycznej części pracy (*patrz* fig. 11—17 oraz pl. 1—48). Wśród ślimaków ustanowiono 13 gatunków dla nauki nowych, a mianowicie: *Loxotoma multiradiata* sp. n., *Calliomphalus (Planolateralus) nasilowensis* sp. n., *Cerithium mazureki* sp. n., *Helicaulax pozaryskii* sp. n., *Cultrigera turriformis* sp. n., *Columbellaria laevicostata* sp. n., *Cassidaria truncata* sp. n., *Biplex cretaceus* sp. n., *Buccinum giganteum* sp. n., *Graphidula radwanskii* sp. n., *Graphidula vistulensis* sp. n., *Tudicla (Tudicla) globosa* sp. n., oraz *Tornatellaea kongieli* sp. n. Ustanowiono także nowy rodzaj, *Kaunhowenia* gen. n., który obejmuje jeden gatunek z rodziny Aporrhaidae, *K. carinifera* (KAUNHOWEN, 1897), o bardzo specyficznym urzeźbieniu, a opisywany dotychczas tylko z osadów stratotypu mastrychtu w Holandii. Wśród małży ustanowiono jako nowy jeden gatunek, *Pinna (Plesiopinna) kasimirensis* sp. n.

Zważywszy, że dotychczasowa znajomość nie-głowonogowej fauny mięczaków z osadów mastrychtu przełomu Wisły była bardzo skąpa (*patrz* PUSCH 1837, ŁOPUSKI 1912, POŻARYSKI 1938, PUTZER 1942), a tylko stosunkowo nieliczne formy były przedmiotem monograficznego ujęcia (KRACH 1931), opracowanie niniejsze stanowi *pendant* do istniejących już opracowań faun głowonogowych —

łodzików (ŁOPUSKI 1912), amonitów (POŻARYSKI 1938, BŁASZKIEWICZ 1980), oraz belemnitów (KONGIEL 1962).

W systematycznej części pracy szczególną uwagę zwrócono na kilka gatunków typowych dla utworów mastrychtu okolic Kazimierza, takich jak wielki ślimak *Volutispina kasimiri* (KRACH, 1931), oraz małże *Pholadomya (Pholadomya) kasimiri* PUSCH, 1837, i *Pholadomya (Bucardiomya) esmarki* (NILSSON, 1827), przedstawiając rewizję ich taksonomii, która była poprzednio przedmiotem rozbieżnych ujęć. Podobną uwagę zwrócono na dwa gatunki inoceramidów, *Spyridoceramus tegulatus* (v. HAGENOW, 1842) i *Tenuipteria argentea* (CONRAD, 1858), oraz ich następstwo stratygraficzne (*patrz* fig. 15); drugi spośród tych gatunków nie był dotychczas w Polsce notowany, zaś jego zasięg stratygraficzny rozpoznany na świecie (Europa, Azja, Ameryka Północna) pozwala uznać go dla najwyższej zony mastrychtu za gatunek indeksowy, lepszy niż stosowany dotychczas belemnit *Belemnella kazimiroviensis* (SKOŁOZDRÓWNA, 1932) charakteryzujący się dość ograniczonym rozprzestrzenieniem geograficznym.

Analiza biogeograficzna badanej fauny mięczaków wskazuje (*patrz* fig. 18—20 oraz tab. 3—4) na przynależność jej do prowincji północno-umiarkowanej.

Analiza ekologiczna bentonicznych zespołów faunistycznych w obrębie całego mastrychtu, od jego granicy z kampanem aż po najwyższy mastrycht (*patrz* fig. 21—26 oraz tab. 5—9), wskazuje na wyraźny wzrost ilościowy oraz jakościowy poszczególnych zespołów, połączony z pojawianiem się stopniowo coraz bardziej różnorodnych grup troficznych, m.in. licznych form roślinożernych. Zmiany tych zespołów odpowiadają stopniowemu zmniejszaniu się głębokości basenu, połączonemu z przybliżaniem się jego stref brzegowych (*patrz* tab. 10—11). Wymienione czynniki środowiskowe, związane z regresją morza górnokredowego, były zapewne główną przyczyną rozwoju, zwłaszcza w najwyższym mastrychcie, zespołów faunistycznych odmiennych od znanych dotychczas z innych obszarów występowania osadów kredowych w Europie.