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 (Planolaterus) nasilowensis sp. n., Cerithium mazurecki sp. n., Heliculaz pozaryska sp. n., Cultrigera turrisformis sp. n., Columbellaria laevicostata sp. n., Cassidaria truncata sp. n., Biplex cretaceus sp. n., Buccinum giganteum sp. n., Graphidula radvanskii sp. n., Graphidula vistulensis sp. n., Tuditela (Tuditela) globosa sp. n., and Tornatellea kongieli sp. n. The aporrhaid gastropod genus Kaufmanowenia 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 kasimir (KRACH, 1931), Pholadomya (Pholadomya) kasimiri PUSCH, 1887 and Pholadomya (Bucardiomya) esmarki (NILSSON, 1827), the taxonomy of which has often been confused. Discussed is also the occurrence of the two tegulated inoceramids, Spyrideroceras tegulatus (v. HAGENOV, 1842) and Tenuipteria argentea (CONRAD, 1858). The latter species is first recorded in Poland, and it is challenged 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; PLACHETKO 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 infaunal 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 Cretaceous 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 cosmopolitan 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: POZARYSKI 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.

POZARYSKI (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 semiilineata* v. MÜNST., *Voluta debeyi* BINK., *Globiconcha aff. lueneburgensis* STR., and *Rinjicula hagenovi* MÜLL."

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

Finally, POZARYSKA & POZARYSKI (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 semiilineata* v. MÜNSTER and "*Voluta" debeyi BINK-HORST are reported three times by POZARYSKI (1938), PUTZER (1942) and POZARYSKA & POZARYSKI (1951) from the same horizons; most probably they confused them with "*Fusus* procerus KNER and "*Fusus" aequescostatus* FAVRE respectively, which are common species in the uppermost Maastrichtian deposits exposed at the Bochotnica and Naśilów 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.

POZARYSKI (1938) listed 55 bivalve 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 canaliculata GOLDF., Ostrea larva LAM., and Ostrea boucheroni COQ.”.

PUTZER (1942) listed from Bochotnica and Nasilów (horizons x, y, z) 54 bivalve 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 & MATWIEJEWOWA 1937), Ostrea larva LAM., Ostrea similis PUSCH, Gryphaea columba LAM., Cardita angusata PUSCH, and Pectunculus sp.”

POZARYSKA & POZARYSKI (1951) reported 34 bivalve species from Kazimierz, Bochotnica and Nasilów (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 Nasilów [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. akkapschigensis (BOBKOVÁ), 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 POZARYSKA & POZARYSKI 1951).

POZARYSKA & PUGACZEWSKA (1981) identified the teredinid tubes, Kuphus sp. from the greensand (horizon z) exposed at Nasilów 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 Puławksa; 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
The previous works on the Maastrichtian gastropods and bivalves of the Middle Vistula Valley

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

<table>
<thead>
<tr>
<th>Author</th>
<th>Gastropod species</th>
<th>Bivalve species</th>
<th>Gastropod species by the present author</th>
<th>Bivalve species by the present author</th>
</tr>
</thead>
<tbody>
<tr>
<td>PUSCH (1837)</td>
<td>2</td>
<td>7</td>
<td>6</td>
<td></td>
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<tr>
<td>SIEMIRADZKI (1886)</td>
<td>2</td>
<td>8</td>
<td>14</td>
<td></td>
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<tr>
<td>ŁOPUSKI (1912)</td>
<td>-</td>
<td>17</td>
<td>-</td>
<td></td>
</tr>
<tr>
<td>KRACH (1931)</td>
<td>22</td>
<td>12</td>
<td>1</td>
<td></td>
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<tr>
<td>POŻARYSKI (1938)</td>
<td>23</td>
<td>45</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>PUTZER (1942)</td>
<td>28</td>
<td>41</td>
<td>13</td>
<td></td>
</tr>
<tr>
<td>ABDEL-GAWAD (1986, this paper)</td>
<td>92</td>
<td>105</td>
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</table>

(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).
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS 75

Associated fauna and flora


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 Annapol-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).
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 7A) along the Solec — Kłudzie escarpment (horizons u and v of POZARYSKI 1938).
It changes into sandy marly opoka (see Text-figs 4—6 and 8—10), slightly glauconitic, in the uppermost part of the Maastrichtian (see POZARYSKA 1952, GAZDZICKA 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 palaeontological bonanza (see RADWAŃSKI 1985).

Marly chalk lithofacies is characterized by white gray, thin bedded, chalky marls or marly chalk, fossiliferous 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 — Męcierz escarpment (see Text-figs 4 and 7B).

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 burrows of the Thalassinoides-type attributed to the shrimps, and J-shaped ones attributable to the ghost crab Ocypode (see RADWAŃSKI 1985). This hardground was formerly interpreted by POZARYSKA (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...

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

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 guards, brachiopods, sponges, bryozoans and phosphatic steinkerns of some infaunal bivalves and gastropods. According to RADWANSKI (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 1988).

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

![Diagram of stratigraphic range of molluscan species](image)

Fig. 6. Nasiów 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 Valley 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 GAŻDZICKA (1978) and PERYT (1980) based the biozones on calcareous nanoplanktoon and planktic foraminifera, respectively (see Table 2). According to POŻARYSKA (1965, 1967) and POŻARYSKA & PUGACZEWSKA (1981), the so-called Pseudoextractaria 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

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<tr>
<td>U. Maastrichtian 250 m</td>
<td>z</td>
<td>Danian-Montian</td>
<td>Belemnella kazimirovienis</td>
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<td>Nephrolithus frequens</td>
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<td>x</td>
<td>Hoploscaphites constrictus crassus</td>
<td>Belemnella argentea</td>
<td>Guembelia cretacea</td>
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<tr>
<td>w</td>
<td>Belemnitella junior</td>
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<tr>
<th>U. Maastrichtian 120 m</th>
<th>v</th>
<th>Belemnella occidentalis</th>
<th>Belemnella occidentalis</th>
<th>Rugoglobigerina pennyi</th>
<th>Lithospherites quadratus</th>
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<tr>
<td>u</td>
<td>Belemnella lanceolata</td>
<td>Belemnella lanceolata</td>
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<tr>
<td>t</td>
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<td>r</td>
<td>U. Companion L. Maastr.</td>
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<tr>
<td>p</td>
<td>U. Companion L. Maastr.</td>
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BŁASZKIEWICZ (1979, 1980) accepted Hoploscaphites constrictus crassus (ŁOPUSKI) instead of Belemnella kazimirovienis (SKOŁOZDROWNA) as an index for the uppermost Maastrichtian zone in the Middle Vistula Valley, judging from the occurrence of B. kazimirovienis in the greensand which he considered as of Paleocene age (see Table 2), and from the occurrence of two subspecies of this species (B. kazimirovienis s.s. and B. kazimirovienis skolodzrownae 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 Męcierz
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. constric-tus crassus and H. constric-tus anterior BŁASZKIEWICZ (Upper Lower Maastrichtian) fall within the wide range of variation of Hoploscaphites, constrictus (SOWERBY). Hence, the Belemnella kazimiroviensis Zone still has the validity against the Hoploscaphites constric-tus Zone of BŁASZKIEWICZ, and consequently the upper boundary of the Be-lemite junior Zone is herein readjusted (see Table 2) to the level as previously indicated by KONGIEL (1962), BŁASZKIEWICZ (1966), and POZARYSKA (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).


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 assemblages 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 discontinuous hard bands of opoka in the middle and upper parts of the Kazimierz section (the Town Quarry).

Complete and fragmented calcitic shells 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 ("Belemniten-schlachfeld") 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, arcooids and infaunal bivalves). Koch & Sohl (1983) classified the palaeontological 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 infaunal 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, nautilioids, 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 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). Besides, 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's 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);
Bulgaria: Pleven and Somovit (TZANKOV 1981, TZANKOV & MOTEKOVA 1981);
Czechoslovakia: Malnitz, Posteberg, Priesen, Randnitz and Trziblitz in Bohemia (REUSS 1845–46, GEINITZ 1873–1875, FRIC 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), Braunenschweig and Ilsede (GRIEPENKERL 1889, MÜLLER 1898), Lüneburg (STROMBECK 1863, WOLLEMMANN 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. HÄGENOW 1842; WOLANSKY 1932; NESTLER 1965a,b, 1982);
Great Britain (England): Trimingham, Norfolk and Norwich (MANTELL 1822, WOODS 1859–1913);
POLAND: The Middle Vistula Valley (study area); Naleczów, Chelm, Zamość in the Lublin Upland, and Miechów in the Miechów Upland (for location see MARCINSKI & RADWANSKI 1983, RADWANSKI 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; ALT 1850; PŁACHETKO 1863; FAVRE 1869; ROGALA 1911; PASTERNAK & al. 1968), Donbass basin (BLANK 1974, SAVČINSKAJA 1974), Crimea (SOBETSKI 1977), peri-Caspian area (SOBETSKI 1982), and North Caucasus (MOSKVIN 1959);
Yugoslavia: Fruska Gora (PETHÖ 1906).

SYSTEMATIC ACCOUNT

Class Scaphopoda BRONN, 1862

Family Dentaliidae GRAY, 1934

Genus Dentalium LINNAEUS, 1758

Type species: Dentalium elephantinum; SD MONFORT, 1910

Subgenus Dentalium LINNAEUS, 1758

Dentalium (Dentalium) multicostatum FAVRE, 1869

(Text-fig. 11 and Pl. 24, Figs 10—11)

1880. Dentalium decussatum SOW.; ALT, p. 236, Pl. 12, Fig. 1 (non SOWERBY).
1883. Dentalium decussatum SOW.; PŁACHETKO, p. 16, Pl. 1, Fig. 13.
1888. Dentalium multicostatum FAVRE, p. 101, Pl. 11, Fig. 7.
(1911) Dentalium multicostatum RAVRE; ROGALA, p. 492.

MATERIAL: 4 from Kazimierz, 3 from Nasłów (2 opoka, 1 hardground).
REMARKS: The studied specimens are poorly preserved and in the majority are fragmented. The species can be distinguished from *Dentatium alternans* J. MÜLLER and *D. decussatum* SOWERBY by alternation of longitudinal riblets 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 Nasilów (hardground)

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

spaces. The ventral riblets are closely spaced. This characteristic ornamentation can easily distinguish this species from *D. multicoatatum* 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.
Abbreviation 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. 48, Pl. 13, Figs 6—8; Pl. 15, Figs 18—49.
1844. Pleurotomaria distincta GOLDFUSS, p. 75, Pl. 187, Fig. 1.
1872. Pleurotomaria linearis MENTELL sp.; GEINITZ, p. 185, Pl. 29, Fig. 10.
1881. Pleurotomaria linearis MANT.; KRACH, p. 271, Pl. 9, Fig. 5.
(1942) Pleurotomaria linearis MANT.; PUTZER, p. 372.
1965b. Pleurotomaria linearis MANT.; CIESLINSKI, p. 35, Pl. 6, Fig. 3.

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

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

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

Conotomaria granulifera (v. MUNSTER, 1844)

(Pl. 1, Fig. 1)

1844. Pleurotomaria granulifera MUNSTER; GOLDFUSS, p. 72, Pl. 187, Figs 3, 3a.
1839. Pleurotomaria granulifera v. MUNSTER; GRIEPENKERT, p. 17.
1896. Pleurotomaria (Leptomarta) granulifera MUNSTER; MÜLLER, p. 85, Pl. 11, Figs 10—13.
1902. Pleurotomaria granulifera MUNSTER; WOLLEMAN, p. 81, Pl. 8, Fig. 1.
1921. Pleurotomaria granulifera MUNSTER; KRACH, p. 370, Pl. 8, Fig. 6.
1937. Pleurotomaria granulifera MUNSTER; KONGIEL & MATWIEJEWOENA, 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); Nasilów opoka (1a apertural, 1b oblique, 1c oblique basal views)

2-3 — *Emarginula costatostrigata* FAVRE; 2 from Nasilów 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 Męcierz (apical view), ×2

7-8 — *Chilodonta (Chilodonta) rudis* (BINKHORST); Nasilów 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
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

1838. Pleurotomaria granulifera MÜNST.; POZARYSKI, p. 23.
1842. Pleurotomaria granulifera MÜNST.; PUTZER, p. 372.
1874. 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 Kludzie, 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 & MATWIEJEWÓWNÁ (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 — Campanian 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 Nasłów (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)

1:44. Pleurotomaria gigantea SOW.; GOLDFUSS, p. 77, Pl. 197, Fig. 8 (non SOWERBY).
1850. Pleurotomaria subgigantea d'ORBIGNY, p. 236.
1851. Pleurotomaria gigantea, SOW.; J. MÜLLER, p. 46.
1888. Pleurotomaria subgigantea d'ORB.; HOLZAPPFEL, p. 175.
1891. 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.
1838. Pleurotomaria subgigantea d'ORB.; POZARYSKI, p. 23.
1942. Pleurotomaria subgigantea d'ORB.; PUTZER, p. 372.

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

REMARKS: This species has unusual large size, if compared with other Upper Cretaceous pleurotomarids. 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 nodoserecticulata KAUNHOWEN is closely allied to this species, but it differs in having small tubercles developed at points of intersection of the colabral 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 **Marginulinae** GRAY, 1834  
Genus *Marginula* LAMARCK, 1801  
Type species: *Marginula conica* LAMARCK, 1801  
*Marginula costatostrigata* FAVRE, 1869  
(Pl. 2, Figs 2–3)

1869. *Marginula costato-strigata* E. FAVRE, p. 87, Pl. 11, Fig. 3.  
1889. *Marginula costato-strigata* E. FAVRE; GRIEPENKERL, p. 76.  
(1911) *Marginula costato-strigata* E. FAVRE; ROGALA, p. 481.

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

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

Superorder **Patellina** VAN IHERING, 1876  
Superfamily **Patellacea** RAFFINESQUE, 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)

1868. Patella striatissima n. sp., G. MÜLLER, p. 88, Pl. 11, Figs 2—5.
(1911) Patella striatissima G. MÜLLER; ROGALA, p. 492.

MATERIAL: 1 from Męcierz, 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. zaevigata BINKHORST and A. rigida KAUNHOWEN from the Maastrichtian stratotype, as well as from A. ovalis 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 RAFFINEAU, 1815
Family Trochidae RAFFINEAU, 1815
Subfamily Chilodontinae WENZ, 1938
Genus Chilodonta ÉTALLON, 1862
Type species: Chilodonta cathartia 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. 46, Pl. 3, Fig. 10.
1861. Turbo bidentatus Nobis, BINKHORST, p. 46, Pl. 3, Fig. 8.
V. 1877. Trochus (Craspedotus) rudis BINKHORST; KAUNHOWEN, p. 38, Pl. 2, Figs 1—3.
MATERIAL: 3 from Nasiłow (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 comparable with Chilodonta cathartia 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. 87, 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.
(1888) Trochus laeviusculus MÖBERG.; LUNDGREN, p. 16 (non v. SCHLOTHEIM).
1874. Trochus laeviusculus MÖBERG.; HÄGG, p. 21.
1874. Atria 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(? ) laevis (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 Planolateratus SOHL, 1960. The nominate subgenus Calliomphalus (s.s.) differs from Planolateratus by its round-sided posteriorly shouldered whorls, which lack either any basal keel or axial sculpture on the base. Moreover, Planolateratus 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.
1890. Turbo Boimstrofensis GRIEPENKERL; WOLLEMMANN, p. 24.
1930. Turbo boimstrofeneni 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.; POZRANSKI, p. 23.
(1974). *Margarttes* (7) *bolmatrofensis* (GRIEPENKERL); *BLANK*, p. 138, Pl. 44, Fig. 9.

**MATERIAL:** 42 from the Upper Campanian opoka (20 from Ciszyca Kolonia, 21 from Ciszyca Góra, 1 from Piotrawin), 2 from Kamen.

**REMARKS:** The studied specimens coincide, in general features and size, with those from the Upper Senonian of West Germany (GRIEPENKERL 1898, MÜLLER 1899) 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.

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**Calliomphalus (Calliomphalus) rimosus granulatus** (KAUNHOWEN, 1897)

(Pl. 2, Fig. 9)


**MATERIAL:** 1 from Piotrawin (uppermost Campanian), 1 from Kamen, 2 from Nasilów (opoka).

**REMARKS:** The studied specimens are incomplete, and one external cast from Nasilów is preserved as a xenomorphic area of *Pycnodonte vesicularis*. This subspecies differs from the nominative subspecies *C. 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.

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**Calliomphalus (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.
(1851) *Trochus dichotomus* ALTH; *ROGALA*, p. 491.
1882. *Margarttes* (7) *dichotomus* (ALTH); *PLAMADIALA*, p. 176, Pl. 17, Fig. 8.

**MATERIAL:** 7 from Ciszyca Kolonia (Upper Campanian), 3 from Kazimierz, 1 from Nasilów (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.

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**Calliomphalus (Calliomphalus) plachetkoi** (FAVRE, 1869)

(Pl. 3, Fig. 7)

1883. *Turbo Astierianus* D'ORB.; *PLACHETKO*, p. 14, Pl. 1, Fig. 9 (non d'ORBEGNY).
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 PLACHETKO (1863) and FAVRE (1869) from the Lvov region. PLACHETKO (1863) erroneously defined this species as *Turbo astierianus* d'ORBIGNY; on the other hand, FAVRE (1869) concluded that PLACHETKO'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* KAUN.: 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 *Planolatera* SOHL, 1960

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

*Calliomphalus (Planolatera) 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.


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.; POZARYSKI, 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 Nasilów (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 (Planolatera) nasilowensis* sp. n.

(Pl. 4, Figs 6—7)

**HOLOTYPE:** The specimen presented in Pl. 4, Fig. 6.

**TYPE LOCALITY:** Nasilów.

**TYPE HORIZON:** Uppermost Maastrichtian (Belemnella kazimieroviensis Zone).

**DERIVATION OF THE NAME:** After the finding place of the type specimen (Nasilów 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 apertural 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 Nasilów 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 (Planolateralis) quadricostatus (J. MÜLLER); 10 stefankern from Nasilów opoka (abapertural view), 11 plaster cast from Kazimierz

All figures taken X2
fa-1b — *Calliomphalus (Planolateralus) fructi* (G. MÜLLER); Kazimierz (side and oblique basal views)

2a-2d — *Calliomphalus (Planolateralus) aff. fructi* (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); Nasilów opoka (3a, 4b apertural views, 3b, 4a abapertural views)

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

6-7 — *Calliomphalus (Planolateralus) nasilowensis* sp. n.; Nasilów 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
**MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS**

**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 Nasilów (8 opoka, 5 hardground).

**MEASUREMENTS:**

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<td>Kazimierz</td>
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**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 Nasilów. 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)

1837. *Trochus Basterotto* BRONGN.; NILSSON, p. 12, Pl. 3, Fig. 1 (non AL. BRONGNIART).
1837. ??*Trochus Basterotto* AL. BRONGN.; PUSCH, p. 107, Pl. 10, Fig. 1.
1844. *Trochus Basterotto* AL. BRONG.; GOLDFUSS, p. 58, Pl. 183, Fig. 7.
1850. *Trochus Basterotto* BRONGN.; KNER, p. 16.
(1860) *Trochus amatus* d'ORBIGNY, p. 224.
1869. *Trochus amatus* d'ORBIGNY; FAVRE, p. 57.
1875. *Trochus amatus* d'ORBIGNY; GEJNITZ, p. 164, Pl. 29, Fig. 7.
1911. *Trochus basterotto* BRONGNIART; HÄGG, p. 21, Pl. 1, Fig. 7.

**MATERIAL:** 1 from Kazimierz, 1 from Bochotnica (hardground), 6 from Nasilów (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 Nasilów 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.
1966. *Trochus miliariformis* ALTH; FAVRE, p. 84, Pl. 9, Fig. 11.
1885. *Trochus miliariformis* ALTH; GRIEPENKERL, p. 75.
(1911) *Trochus miliariformis* ALTH; RAGALA, p. 491.

**MATERIAL:** 1 from Kamień, 3 from Nasilów (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 (Planolateralis) fruchti (G. MÜLLER, 1898)
(Pl. 4, Fig. 1)

1898. Turbo Fruchti n. sp., MÜLLER, p. 89, Pl. 13, 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 Nasilów (opoka).

REMARKS: The species C. (Planolateralis) 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 (Planolateralis) 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. 103, Pl. 10, Fig. 1a, b.
(1842) Turbo reticulatus PUSCH; PUTZER, p. 372.

MATERIAL: 1 from Dobre, 2 from Męcieszę, 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 Trochacanthus DACQUE, 1936

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

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

MATERIAL: 10 from Kazimierz, 1 from Bochotnica, 150 from Nasilów (145 opoka, 5 hard-ground).  
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-spiral. The studied specimens were compared with the original type specimen of *Trochus plicaticarinatus* var. *depressus* GOLDFUSS (1844, Pl. 181, Fig. 11d, e, f) which unfortunately is an incomplete specimen. The other two varieties of *Trochus plicaticarinatus* GOLDFUSS (*monilifer* and *granulatus*) can be distinguished from the studied subspecies by general form and ornamentation.

POZARYSKI (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)

MATERIAL: 1 from Dorotka (low-Upper Campanian), 5 from Piotrawin (uppermost Campanian), 1 from Kazimierz, 9 from Nasilów (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 DISTRIBUTION: 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? Sacherti 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.
1899. Turbo tuberculato-cinctus GOLDF. sp.; GRIEPENKLER, p. 74.
(1838) Trochus tricarinata v. tuberculato-cinctus GR.; POZARYSKI, p. 23.
(1842) Trochus tricarinata v. tuberculato-cinctus GR.; PPTZER, p. 372.

MATERIAL: 2 from Kazimerz, 10 from Nasilów (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 nilssonii (v. MÜNSTER, 1844)

(PL. 6, Figs 4–6)

1844. Trochus Nilsonni MÜNST; GOLDFUSS, p. 58, Pl. 181, Fig. 6.
(1850) Trochus Nilsonni MÜNST; GEINITZ, p. 132.
1902. Turbo Nilssonii MÜNST sp.; WOLLEMANN, p. 96.
(1938) Turbo nilssonii MÜNST.; POZARYSKI, p. 23.
1974. MCLTgarites (?) nilssonii (MÜNSTER); BLANK, p. 128, Pl. 4, Fig. 4.
1982. Margarites nilssonii (MÜNSTER); PLAMADILA, p. 178, Pl. 17, Figs 14, 16.

MATERIAL: 1 from Dobre, 10 from Kazimerz, 12 from Nasilów (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 Solariaeae
Family Solariiidae CHÉNU, 1859
Genus Architectonica BOLTEN in ROEDING, 1798
Type species: Trochus perspectiva LINNAEUS, 1758
Subgenus Solarialis DALL, 1892
Type species: Solarium elaborata CONRAD
Architectonica (Solarialis) granulatocostata (ALTH., 1850)

(PL. 8, Figs 1–2)
1-2 — *Gibbula* (*Coeliculus*) *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.; Nasilów opoka (incomplete, apical and basal views)

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

Figs 1—3 taken X2, Figs. 4—6 in natural size
1-3 — *Trochacanthus tricarinatus tricarinatus* (ROEMER); Nasilów 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 Nasilów 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; POZARYSKA’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 Nasilów hardground (5 steinkern, 6 incomplete external mold); 6 from Męcierz (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 Nasilów opoka (apertural view)

12-14 — Turritella (Haustator) plana (BINKHORST); 12 from Nasilów opoka (abapertural view); 13–14 from Kazimierz (incomplete, abapertural views)

All figures in natural size except Figs 1—2 taken ×2
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

1850. Solarium granulato-costatum m., ALTH, p. 217, Pl. 11, Fig. 13a–d.
1855. Solarium granulato-costatum ALTH; PLACHETKO, p. 14, Pl. 1, Fig. 8.
1859. Solarium granulato-costatum ALTH; FAVRE, p. 70.

MATERIAL: 11 from the Upper Campanian opoka (1 from Ciszyca Kolonia, 10 from Piotravlaun), 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 BOHM (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. 188, Pl. 192, Fig. 5.
1851. Turritella Hagenoviana GOLDF.; J. MÜLLER, p. 28.
1859. Turritella quadricincta GOLDFUSS FAVRE, p. 41, Pl. 5, Figs 4—5 (non GOLDFUSS).
1931. Turritella quadricincta GOLDF.; KRACH, p. 378, Pl. 9, Figs 15, 15a.
(1888) Turritella quadricincta GOLDF.; POZARYSKI, p. 33.
(1946) Turritella quadricincta GOLDF.; PUTZER, p. 372.
1931. Turritella quadricincta GOLDF.; POZARYSKI & POZARYSKI, p. 20, Pl. 6, Fig. 2.
1974. Turritella hagenoviana MÜNSTER; BLANK, p. 131, Pl. 45, Fig. 2.

MATERIAL: 24 from Kazimierz, 85 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. 1867. Turritella (Torcula) plana BINKHORST; KAUNHOWEN, p. 44, Pl. 3, Figs 6—14.
non 1902. Turritella plana BINKHORST; WANNER, p. 138.
1923. Turritella (Tereula) plana BINKHORST; SYNIEWSKA, p. 296.
1931. Turritella (Archimediella) plana BINKHORST; KRACH, p. 377, Pl. 9, Fig. 14.
(1858) Turritella plana BINK.; POZARYSKI, p. 52.
(1861) Turritella plana BINK.; PUTZER, p. 272.
1931. Turritella plana BINK.; POZARYSKI & POZARYSKI, p. 30, Pl. 6, Fig. 1.
1974. Haustrator plana (BINKHORST); BLANK, p. 123, Pl. 13, Fig. 1.

MATERIAL: 6 from Maćmierz, 47 from Kazimierz, 1 from Bochotnica, 48 from Nasilów (49 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 POZARYSKI (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 Nasilów (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)
KAASTRICHIAN NON-CEPHALOPOD MOLLUSKS

1811. Vermetus cochleiformis J. MÜLLER, p. 6, Pl. 3, Fig. 2.


1889. Stiguraria cochleiformis JOS. MÜLLER; GRIEPENKERL, p. 81.

MATERIAL: 1 from Mežmierz, 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 Laxiaria cochleiformis as figured by J. MÜLLER (1889) and HOLZAPFEL (1888) from the Aachen and Vaals greensands. The species L. pinguis HOLZAPFEL and L. trocheleta 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 Confusisicala BOURY, 1910
Type species: Scalaria dupiniana d’ORBIGNY, 1842

Confusisicala decorata (ROEMER, 1841)
(Pl. 9, Figs 6–7)

1981. Melania decorata N., ROEMER, p. 83, Pl. 12, Fig. 11.

1844. Fascia costato-striatula MÜNSTER; GOLDFUSS, p. 23, Pl. 171, Fig. 18.

1859. Scalaria Dupiniana d’ORB.; KNER, p. 14, Pl. 3, Fig. 3.

1869. Scalaria decorata ROEMER sp.; FAVER, p. 45, Pl. 8, Figs 6–9.

1875. Scala decorata A. ROEMER; GIENTZ, p. 25, Pl. 26, Fig. 4.

1877. Scala (Scalari) decorata GIENTZ; FRIČ, p. 104, Text-fig. 41.

1888. Scalaria cf. decorata ROEMER; HOLZAPFEL, p. 105, Pl. 10, Fig. 1.

1889. Scalaria decorata A. ROEMER sp.; GRIEPENKERL, p. 78.


1905. Scalaria decorata ROEM.; DENINGER, p. 28, p. p. 1834. Scalaria decorata A. ROEM. sp.; ANDERT, p. 381, Pl. 17, Fig. 4.

(1936) Scalaria decorata ROEM.; POZARSKY, p. 23.

(1942) Scalaria decorata ROEM.; PUTZER, p. 372.

1974. Confusisicala decorata (ROEMER); BLANK, p. 133, Pl. 31, 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 studied 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 Loov 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 Loov region and Donbass basin, Upper Campanian (POZARSKY 1898) — Upper Maastrichtian of the Middle Vistula Valley.

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

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

REMARKS: Only one incomplete specimen collected at Nasiłów is closely similar to that of Scalaria contorta KAUNHOWEN from the Maastrichtian of Kunrada, the Netherlands, in highly convex whors 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 Nasilów (opoka).

REMARKS: The two specimens from Nasilów 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 BINKHORST, p. 24, Pl. 1, Fig. 3.
1897. Cerithium tectiforme BINKHORST; KAUNSHOWEN, p. 60.
non 1906. Cerithium tectiforme BINKHORST; DENINGER, p. 13, Pl. 1, Figs 1—4, 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. 70, Pl. 11, Fig. 16.
1875. Cerithium binodosum A. ROEMER; GEINITZ, p. 178, Pl. 21, Fig. 4.
1888. Cerithium binodosum ROM.; HOLZAPFEL, p. 124, Pl. 19, Figs 10—14; Pl. 21, Fig. 19.
1921. Cerithium binodosum ROEM.; RAVN, p. 33, Pl. 3, Fig. 4.
1888. Cerithium binodosum ROEM.; HŁOS; p. 15, Pl. 1, Fig. 6.
1931. Hemicerithium binodosum ROM.; KRACH, p. 279, Pl. 9, Fig. 13.
(1945) Hemicerithium binodosum ROEM.; PUTZER, p. 279.
MATERIAL: 58 from the Upper Cenomanian 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 Decheni_ MÜNSTER; GOLDFUSS, p. 24, Pl. 174, Fig. 2.

(1850) _Cerithium Decheni_ MÜNSTER; d'ORBIGNY, p. 231.

1889. _Cerithium Decheni_ GOLDFUSS; HOLZAPFEL, p. 126, Pl. 13, Fig. 11.

1888. Cerithium _Decheni_ v. MÜNSTER; GRIEPENKERS, p. 83.

MATERIAL: 7 from Kazimierz, 1 from Jauowic.

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. quadratostratum_ KAUNHOWEN (1897) has similar reticulate ornamentation, but its axial costae are more closely spaced than in _C. decheni_. The species _C. subimbricatum_ G. MÜLLER (1888) 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 DISTRIBUTION: 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. 24, Pl. 174, Fig. 3.

(1850) _Cerithium Nerei_ MÜNSTER; d'ORBIGNY, p. 231.

1889. _Cerithium Nerei_ v. MÜNSTER; GRIEPENKERS, 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. 255, Pl. 11, Fig. 26.

1889. _Cerithium polystropha_ ALTH; FAVRE, p. 25.

(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. peregrinorum* 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 KAUNOWEN (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)


MATERIAL: 1 from Kazmierz, 1 from Nasilów (opoka).

REMARKS: The studied specimens are incomplete with damaged terminals. The specimen collected at Nasilów has compressed and convex whorls ornamented with fine numerous spiral lines and faintly cancelled 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: Nasilów.

TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.

DERIVATION OF THE NAME: In the honour of Dr. A. MAZUREK (1835-1894) 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 Nasilów (2 opoka, 1 hardground, 1 greensand).

MEASUREMENTS:

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<tr>
<td>Holotype (Pl. 10, Fig. 14)</td>
<td>34.0</td>
<td>16.0</td>
<td>20°</td>
<td>Nasilów opoka</td>
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<tr>
<td>Paratype</td>
<td>29.0</td>
<td>14.3</td>
<td>34°</td>
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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)

**MATERIAL:** One specimen from Nasliów (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 *Xenopheridae* 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.
1827. *Trochus onustus* NILS.; GOLOFFUS, p. 99, Pl. 181, Fig. 16.
1839. *Trochus onustus* NILSSON; J. MÜLLER, p. 44.
1839. *Xenophora onusta* NILSSON; BOSQUET, p. 378.
1839. *Xenophora onusta* Noble, BINKHORST, p. 33, Pl. 3, Fig. 14.
1839. *Phorus onustus* NILSSON sp.; FAVRE, p. 68, Pl. 9, Fig. 14.
1839. *Xenophora onusta* NILSSON sp.; HOLZAPPFEL, p. 152, Pl. 14, Fig. 23.
1839. *Xenophora onusta* NILSSON sp.; GREFFENKERL, p. 81.
1897. *Xenophora onusta* NILS.; FRIČ, p. 44, Text-fig. 32.
1897. *Xenophora onusta* NILSSON sp.; KAUNHOWEN, p. 50, Pl. 3, Fig. 15.
1897. *Xenophora onusta* NILSSON sp.; ANDERT, p. 264.
1897. *Xenophora onusta* NILSSON; BLANK, p. 134, Pl. 46, Fig. 11–12.
1898. *Xenophora onusta* (NILSSON); TANUSOV & MOTEKOVA, p. 94, Pl. 14, Fig. 20.

**MATERIAL:** 1 from Kamień, 2 from Nasliów (1 opra, 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 picta* (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)

Aporrhais granulosa (J. MÜLLER, 1851)

(Pl. 10, Figs 9—10)

Aporrhais(?) luganicus BLANK, 1972

(Pl. 10, Figs 12—13)
1—2 — Cerithium paucicostatum FAVRE; Nasilów opoka (1a oblique apertural, 1b oblique abapertural views of incomplete specimen; 2 abapertural view)

3—4 — Cerithium decherti 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 — Confusiscola decorata (ROEMER); 6 from Bochotnica (incomplete specimen; MZ-Mg. 2543); 7 from Nasilów opoka (incomplete, abapertural view)

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

9 — Cerithium griepenkerlii G. MÜLLER; Nasilów opoka (incomplete, apertural view)

10 — Confusiscola cf. contorta (KAUNHOWEN); Nasilów opoka (incomplete specimen)

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

12 — Turritella (Turritella) hagenoviwana v. MÜNSTER; Nasilów opoka (incomplete specimen, to show ornamentation)

All figures in natural size except Figs 4 and 10 taken X2
1 — Bittium (Semibittium) triptychum (KAUNHOWEN); plaster cast from Nasilów 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 Nasilów hardground (incomplete, abapertural views); 7—8 from Kazimierz (abapertural views)
9—10 — Aporrhais granulosa (J. MULLER); Clusyca Górna (9 apertural view; 10 incomplete, abapertural view, MZ-MG. 2533)
11 — Aporrhais (?) najdii BLANK; Męcierz (incomplete, apertural view)
12—13 — Aporrhais (?) luganicus BLANK; Nasilów opoka (incomplete specimens; MA-CHALSKI's Coll.)
14a—14b — Cerithium mazureki sp. n.; Nasilów opoka, holotype (abapertural and apertural views)
15—17 — Helicoulax pozarskii sp. n.; 17 holotype from Podgórz (incomplete apical 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 (Lattia) pelcepyhora (KAUNHOWNEN); Nasilów opoka (abapertural views)
4—7 — Kaunhowenia carinifera (KAUNHOWNEN); 4—6 from Kazimierz (apertural views);
7 external cast from Nasilów opoka
8—10 — Drepanochelus 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 — Cultriger 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 X2
1 — *Xenophora onusta* (NILSSON); Kamień (abapertural view; MZ-Mg. 2523)
2-3 — *Perissoptera emarginulata* (GEINITZ); Nasilów 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
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

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 assignment 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

(Material: 1 from Podgórz, 2 from Nasilów (hardground).

REMARKS: The studied specimens are incomplete, badly preserved, especially those collected from the Nasilów 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.

(Material: 10 from Kazimierz, 1 from Bochotnica, 1 from Nasilów (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 aporrhais, 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. POZARYSKI, 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:

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<th>BH</th>
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<td>Holotype (Pl. 10, Fig. 17)</td>
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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 paralleling 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 Arrhopes GABB, Drepanochelus MEEK, and Heliculaulax 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 all around 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. Aporrhaia (Heliocaulax) carlinifera nov. sp., KAUNHOWEN, p. 72, Pl. 8, Figs 3—4.

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

MEASUREMENTS:

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<td>22.6</td>
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<td>16.4</td>
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</table>

Location:

- Kazimierz
- Nasilów (hardgr.)
- Nasilów (opoka)
- „ (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 Arrhodes 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 Arrhodes 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 subgenus is widely distributed in North America (SOHL 1960, POPENOÉ 1983). In the author's opinion, the following Upper Cretaceous species from Europe belong to this subgenus: "Rostellaria" papillonacea GOLDFUSS, 1844; Aporrhais (Arrhodes) palecyphora KAUNHOWEN, 1897; "Rostellaria" pauperata d'ORBIGNY, 1843; "Rostellaria" coarctata GEINITZ (sensu REUSS 1845); "Lispodeshes" zekelii (GUMBEL, 1861).

Arrhodes (Latiala) palecyphora (KAUNHOWEN, 1897)
(Pl. 11, Figs 2—3)

1861. Rostellaria papillonacea GODDFUSS, variété; BINKHORST, p. 1, Pl. 1 Fig. 11; Pl. 5a, Fig. 18 (non GOLDFUSS).

v. 1897. Aporrhais (Arrhodes) palecyphora 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 Arrhodes (Latiala) papillonacea (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 Latiala 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).

1889. Aporrhais (Dimorphosoma) substenoptera n. sp., G. MÜLLER, p. 114, Pl. 35, Figs 1—3.
1931. Aporrhais substenoptera MÜLL.; KRACH, p. 361, Pl. 9, Fig. 4.
(1936) Aporrhais substenoptera MÜLL.; POZARYSKI, p. 23.
(1942) Aporrhais substenoptera MÜLL.; PUTZER, p. 372.
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

1951. Aporrhais substenoptera MÜLL.; POZARSKY & POZARSKY, p. 20.
1974. Drepanocheilus substenoptera (MÜLLER); BLANK, p. 139, Pl. 47, Fig. 13.

MATERIAL: 1 from Dorotka (low-Upper Campanian), 3 from Plotrawin (uppermost Campanian), 1 from Podgórz, 8 from Kazimierz, 1 from Bochotnica, 2 from Nasilów (1 opoka, 1 hardground).

REMARKS: The majority of the studied specimens are incomplete, with their spurs and terminals damaged. Generally, they agree with the specimens figured by MÜLLER (1958) 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 Perissopera TATE, 1865

Type species: Rostellaria reussi TATE, 1865 (non GEINITZ 1875)

Perissopera emarginulata (GEINITZ, 1850)

(Pl. 12, Figs 2—3)

1850. Rostellaria emarginulata GEINITZ, p. 136, Pl. 9, Figs 7—8.
1863. Rostellaria emarginulata GEINITZ; KNER, p. 15, Pl. 5, Fig. 8.
1869. Aporrhais emarginulata GEINITZ; FAVRE, p. 75, Pl. 10, Fig. 1.
1867. Aporrhais (Dispodesthes) emarginulata GEINITZ sp.; KAUNHOFEN, p. 71, Pl. 8, Figs 5—7.
1833. Aporrhais cf. Schlotheimi ROEM.; KRACH, p. 300, Pl. 9, Fig. 10.
1838. Aporrhais emarginulata GEIN.; POZARSKY, p. 23.
1974. Perissopera emarginulata (GEINITZ); BLANK, p. 120, Pl. 47, Figs 6, 9.

MATERIAL: 23 from Nasilów (31 opoka, 1 hardground).

REMARKS: The three varieties of the apertural outer lip of this species are encountered in Nasilów specimens, which agree with the illustrations presented by GEINITZ (1850). The species Perissopera schlotheimi (ROEMER), as figured by HOLZAPFEL (1889) 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 (1889), 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 cingulata PICTET & ROUX, 1853

DISCUSSION: The genus Cultrigera was introduced by BÖHM (1885), and listed as a synonym of Tridactylus GARDNER, 1875, by COSSMANN (1894) 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 arachnoides** MÜLLER; GEINITZ, p. 138, Pl. 9, Fig. 5.  
1851. **Rostellaria arachnoides** MÜLLER, p. 25, Pl. 3, Fig. 28.  
1855. **Aporrhais arachnoides** MÜLLER; FAVRE, p. 78.  
1856. **Aporrhais arachnoides** MÜLLER, sp.; HOLZAPFEL, p. 122, Pl. 12, Figs 3—6.  
1853. **Aporrhais arachnoides** MÜLLER; FRIC, p. 86, Text-fig. 80.  
1897. **Aporrhais arachnoides** MÜLLER; HOLZAPFEL, p. 45.  
1864. **Aporrhais (Cultrigera) arachnoides** J. MÜLLER, sp.; G. MÜLLER, p. 108, Pl. 15, Fig. 19.  

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

**REMARKS:** The studied specimens coincide with those of the Aachen greensand, and figured by J. MÜLLER (1851) and HOLZAPFEL (1888). The species Cultrigera nüssoni (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)

1893. **Aporrhais nagorzanyensis** E. FAVRE, p. 78, Pl. 10, Fig. 4.  
1889. **Aporrhais Nagorzanyensis** E. FAVRE; GRIEPENKERL, p. 99.  
1890. **Aporrhais** (Dimorphosoma) Nagorzanyensis FAVRE; G. MÜLLER, pp. 113-414. Pl. 15, Fig. 5.

**REMARKS:** Only two incomplete specimens collected at Kazimierz and Nasilów 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 bicornate 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 \( R = 40.2 \text{ mm}, \ D = 11.8 \text{ mm}, \) and \( PA = 10^\circ. \)
DESCRIPTION: The shell is large, with a turret-like, and elevated high spire. The whorls are in number about eight, convex, regularly 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)

1861. Pyrula tuberculosa Nobis, BINKHORST, p. 8, Pl. 3, Fig. 5.
1861. Atellana ventricosa Nobis, BINKHORST, p. 63, Pl. 5a2, Fig. 5; Pl. 5a3, Fig. 12.
1867. Columbellaria tuberculosa BINKHORST sp.; KAUNHOWEN, p. 70, Pl. 9, Figs 7–8.
1868. Columbellaria tuberculosa BINKHORST sp.; G. MÜLLER, p. 118, Pl. 15, Fig. 15.
1883. Columbellaria tuberculosa BINKHORST; SYNEWSKA, p. 298.

MATERIAL: 2 from Plotrawin (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 Plotrawin 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

1897. Columbellaria granulata nov. sp., KAUNHOWEN, p. 90, 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.


DERIVATION OF THE NAME: Latin laevicostata - after its smooth spiral cords.

TYPE LOCALITY: Plotrawin.

TYPE HORIZON: Nostoceras pozarskii Zone (uppermost Campanian).
GOUDA ISMAIL ABDEL-GAWAD

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

MATERIAL: 1 from Piotrawin (uppermost Campsisian), 1 from Kazimierz, 1 from Nasilów (opoka).

MEASUREMENTS:

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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* RÖDING, 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. 226, Pl. 11, Fig. 17a-b.

1859. *Aporrhais laevis* ALTH; FAVSIE, p. 79.

MATERIAL: 1 from Kazimierz, 1 from Bochotnica, 12 from Nasilów (10 opoka, 1 hard-ground).

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 Naticaceae 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)

1844. *Natica cretacea* nobis., GOLDFUSS, p. 119, Pl. 180, Fig. 12.


1890. *Natica cretacea* GOLDFUSS; GRIPPAKENKEL, p. 85.

v. 1887. *Natica cretacea* GOLDFUSS; KAUNHOWEN, p. 54, Pl. 5, Figs 7—11.
Columbellaria cf. granulata KAUNHOFEN; Kazimierz (abapertural view)  

2—4 — Columbellaria tuberculosa (BINKHORST); 2 from Piotrawin (abapertural view; MZ-Mg. 254); 3 from Janowice (incomplete; abapertural view of specimen with well preserved sculpture; MZ-Mg. 252x); 4 from Kazimierz (4a oblique abapertural, 4b oblique apertural views with damaged outer lip)  

5—6 — Columbellaria (exustoidota sp. n.; 5 from Piotrawin, holotype (5a oblique abapertural, 5b oblique apertural views); 6 from Kazimierz, paratype (6a oblique apapertural, 6b apertural views)  

7 — Cultrigera(?) nagorzyniensis (FAVRE); Kazimierz (incomplete; apertural view)  

8 — Cultrigera terriformis sp. n.; Kazimierz, holotype (incomplete apertural digitations)  

8a—9b — Tibia (Tibia) laevi, (ALTH); Nasilow hardground (8a apertural, 8b abapertural views)  

All figures in natural size except Figs 4—6 taken X2
ACTA GEOLOGICA POLONICA, VOL. 36
G. I. ABDEL-GAWAD, PL. 14

1a–1b — Columbellaria lacteocostata sp. n.; Nasilów opoka, paratype (abapertural, apertural views)
2–3 — Natica(?) cretacea GOLDFUSS; Nasilów (2a apertural, 2b abapertural views of specimen from hardground; 3 abapertural view of specimen from opoka)
4–6 — Natica(?) exaltata GOLDFUSS; Nasilów opoka (4, 5, 6a abapertural, 6b 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 (KAUNHOWN); 9 from Kazimierz (incomplete specimen); 10 from Sulejów (abapertural view; MZ-Mg. 2566)
11–12 — Charonia multicosata (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 X2
1. Bepix cretaceus sp. n.; Nasilów hardground, holotype (abapertural view; Machalski's Coll.)

2. Buccinum (Buccinum) giganteum sp. n.; Nasilów Opoka, holotype (abapertural view)

3a-3b. Graphidula aff. Micata (Römer); Kazimierz (3a incomplete; apertural, 3b abapertural views of plaster cast of the same specimen)

4-6. Rotellana aquaeostata (Favre); Nasilów Opoka (4, 5 apertural views; Machalski's Coll.; 6 abapertural view)
1 — Buccinum (Buccinum) giganteum sp. n.; Nasilów opoka, paratype (incomplete, apertural view; MACHALSKI's Coll.)

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

3—4 — Euthria fusus nereitiformis (KAUNHOWEN); Nasilów 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.; Nasilów, holotype (side view)
2-4 — *Tudicla (Tudicla) carinata* (v. MÜNSTER); 2 from Janowiec (BŁASZKIEWICZ’s Coll.); 3 (incomplete), 4 (complete) from Nasilów 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); Nasilów 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.; Nasilów 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; Nasilów opoka (apertural view)

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

All figures in natural size
1a-1b — Volutispina kasimiri (KRACH); Nasilów opoka
2a-2b — Scaphella sp. 2; Nasilów opoka

All figures in natural size
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

1921. Natica cretacea GOLD.; NAVN, p. 21, Pl. 1, Fig. 8; Pl. 5, Fig. 3.
1931. Natica cretacea GOLD.; KRACH, p. 78, Pl. 8, Figs 5–6a.
1943. Natica cretacea GOLDFUSS; VAN DER WEIJDEN, p. 119.
1954. Natica cretacea GOLDFUSS; HÄGG, p. 23, Pl. 1, Fig. 9.
1974. Natica? cretacea GOLDFUSS; BLANK, p. 135, Pl. 14, Fig. 11.

MATERIAL: 4 from the Upper Campanian opoka (2 from Ciszyca Kolonia, 1 from Kallszany, 1 from Piotrawin), 3 from Kazimierz, 1 from Janowiec, 23 from Nasilów (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 the 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 (POZARYSKI 1938) of the Middle Vistula Valley.

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

1941. Natica lamellosa N., ROEMER, p. 83, Pl. 13, Fig. 13 (nomen oblitum).
V.1944. Natica exaltata GOLDFUSS, p. 118, Pl. 100, Fig. 13.
1959. Natica exaltata GOLDFUSS; GRIEPENKERL, p. 82.

MATERIAL: 17 from Nasilów (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 Gyrododes CONRAD, 1860
Type species: Rapa supraplicata CONRAD, 1858;
(= Natica (Gyrododes) crenata CONRAD, 1860)
Gyrododes hoernesi (FAVRE, 1869)
(Pl. 14, Figs 7–8)
Material: 1 from Sulejów (low-Upper Campanian), 2 from Piotrawin (uppermost Campanian), 1 from Mięcinierz, 1 from Kazimierz.

Remarks: Two specimens collected from the Upper Maastrichtian of the study area, being badly preserved stellkerns, 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 Hermannsen, 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 spirally ornamented.

Material: 2 from Kazimierz.

Measurements:

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<td>Kazimierz</td>
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<td>Paratype (Pl. 14, Fig. 14)</td>
<td>21.9</td>
<td>—</td>
<td>12.4</td>
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</table>

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 ribs. Three spiral ribs 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.
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

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: Naslów.
TYPE HORIZON: Topmost part of the Belennella 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 bicerinate with a relatively long siphonal canal.

MATERIAL: 3 from Naslów (1 opeka, 2 hardground).

MEASUREMENTS: 

<table>
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<td>39°</td>
<td>(hardground)</td>
</tr>
<tr>
<td>Paratype</td>
<td>22.5</td>
<td>10.8</td>
<td>48°</td>
<td>(hardground)</td>
</tr>
</tbody>
</table>

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 bicerinate, 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 (Scheleman) 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... (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. 1887. Tritonium tuberculnum: nov. sp., KAUNHOWEN, p. 77, Pl. 9, Fig. 3.
1892. Triton tuberculnum KAUNHOWEN; WANNER, p. 155, Pl. 19, Figs 3—4.
1893. Tritonium tuberculnum KAUNHOWEN; KRACH, p. 334, Pl. 9, Figs 9—9.

MATERIAL: 1 from Sulejów (low-Upper Campanian), 3 from Kazmierz, 1 from Naslów (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. 13.
1881. Tritonum multicostatum FAVRE; KRACH, p. 383, Pl. 7, Fig. 12.

MATERIAL: 1 from Kazimierz, 4 from Nasilów (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 inter­
section 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 MUN.; POZARSKY, p. 23.
(1942) Buccinum cf. bicarinatum MUNST.; PUTZER, p. 272.

HOLOTYPE: The specimen presented in Pl. 15, Fig. 2.
PARATYPE: The specimen presented in Pl. 16, Fig. 1.
TYPE LOCALITY: Nasilów.
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 Nasilów (opoka).

MEASUREMENTS

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</tr>
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</tr>
<tr>
<td>&quot; &quot;</td>
<td>—</td>
<td>80.0</td>
<td>70°</td>
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</table>

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 unequal 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)

1931. Fusus septemcostatus FAVRE; KRACH, p. 365, Pl. 9, Fig. 17.
(1942) Fusus septemcostatus FAVRE; PUTZER, p. 373.
1974. Volutolithes septemcostatus (FAVRE); BLANK, p. 145, Pl. 92, Fig. 3.

MATERIAL: 4 from Kazimierz, 5 from Nasiów (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 Coastal 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 (Volutolithes) woldemanni” 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. 8.
1974. Voluta? (? ) procerus (KNER); BLANK, p. 146, Pl. 81, Figs 7—8.

MATERIAL: 1 from Kazimirz, 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 allenii (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. RADWANSKI 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 canaliculate suture; sculpture fine with numerous spiral lines; aperture lenticular, angulated posteriorly, siphonal canal of moderate length.

MATERIAL: 1 from Nasiłów (opoka).

MEASUREMENTS:

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<td></td>
<td>54.0</td>
<td>14.0</td>
<td>—</td>
<td>—</td>
<td>29°</td>
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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 Nasilów (opoka).

MEASUREMENTS: The holotype displays $E_1 = 84.8$ mm, $D = 21.0$ mm, $PA = 12^\circ$.

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)" vollemanni 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 Kazmierz.

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. 14, Fig. 15) in a general form, but this species is ornamented with the smaller number of spiral ribbons.

Subfamily Fusininae

Genus EuthriofoSus COSSMANN, 1901

Type species: Fusus burdigalensis BASTEROT, 1825; OD

EuthriofoSus nereidiformis (KAUNHOWEN, 1897)  
(Pl. 16, Figs 3—4)

1881. Pyrula fusiformis Nobis, BINKHORST, p. 9, Pl. 5a, Fig. 7;
1897. Fusus (Hemifusus) nereidiformis nov. nom., KAUNHOWEN, p. 59, Pl. 13, Fig. 13.
(1899) Fusus (Hemifusus) cf. nereidiformis KAUN.; POZARSKY, p. 22.

MATERIAL: 1 from Kazmierz, 1 from Janowiec, 8 from Nasilów (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 Vasicidae**  
**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. *Pyrua carinata* MÜNST.; GODFUS, p. 27, Pl. 172, Fig. 11a-b.  
1850. *Pyrua carinata* GODF.; KNER, p. 22, Pl. 4, Figs 7, 7a.  
1869. *Fusus carinatus* d’ORBIGNY; FAVRE, p. 95, Pl. 10, Figs 12—13.  
1880. *Pyrua carinata* v. MÜNST.; GREEFENKIRL, p. 22.  
1895. *Tudicla carinata* MÜNST.; POZARYSKA & POZARYSKI, p. 20.  
(1938) *Tudicla muensteri* MONST.; POZARYSKA, p. 20.  
1974. *Euthriofusus carinatus* (MÜNSTER); BLANK, p. 142, Pl. 4, Fig. 11a.  
1974. *Tudicla (Pyropsis) carinata* (KNER); BLANK, p. 148, Pl. 52, Fig. 8.  

**MATERIAL:** 1 from Plotrawin (uppermost Campanian), 4 from Kazimierz, 1 from Janowiec, 16 from Nasiów (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 GODFUS (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 GODFUS (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 Althi* m. KNER, p. 17, Pl. 2, Fig. 12.  
1858. *Fusus Althi* KNER; FAVRE, p. 67, Pl. 15, Fig. 14.  

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

**REMARKS:** All the studied specimens are incomplete, with their siphonal canal damaged. The species “*Pyrua* 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. plantisima* (BINKHORST) in having a truncated outer face, but the last two species
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

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. 18, Fig. 3.
_TYPE LOCALITY:_ Nasilów.
_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 Nasilów (hardground).

_MEASUREMENTS:_ The holotype displays _H_ = 34.0 mm, _D_ = 32.0 mm, _Pn_ 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 Nasilów (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, 1901
_Type species:_ _Voluta bronni_ ZEKELI, 1852
_Rostellana aequescostata_ (FAVRE, 1869)

(Pl. 15, Figs 4—6)

1859. _Voluta costata_ m., ALTH, p. 221, Pl. 11, Fig. 18.
1868. _Paxus aequescostatus_ E. FAVRE, p. 32, Pl. 15, Fig. 7.
1869. _Voluta diffusilla_ E. FAVRE, p. 54, Pl. 16, Fig. 21.
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 aequescostatus 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)
1-2 — *Volutispina kasimiri* (KRACH); Nasilów, 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); Nasilów, 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
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

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 veiled. 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 diminished under the subsutural collar and on the basal part of the last whorl. Growth lines are gently opisthochine, more distinct on the shoulder and near the aperture 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 (iii), 12 and 16a (ii), the specific name kazimiiri 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 bodrakensis, 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.: KNEB. p. 21, Pl. 4, Fig. 5 (non d’ORBIGNY).
1869. Voluta Kneri E. FAVRE, pp. 85–86, Pl. 11, Fig. 2.
(1881) Voluta Kneri E. FAVRE; ROGAL, p. 491.
(1930) Voluta kneri FAVRE; POZARYSKI, p. 24.

MATERIAL: 8 from Kazimiirz, 4 from Nasław (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. POZARYŃSKI (1968) 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 junoia CHEMNITZ; SD HERRMANNSEN, 1848
Scaphella sp. 1
(Pl. 23, Fig. 1)

MATERIAL: 1 from Janówiec, 1 from Nasłów (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 Nasłów (opoka, 1 marlground).

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 colomellar 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 species: 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 Nasłów (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 KAUNHOWNEN (1897) from the Maastrichtian of Kunrade. Its aperture is however different, being narrow lanceolate in KAUNHOWNEN'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. J; 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; Kazimierz (abapertural view), × 1
2 — *Cancellaria nitidula* (J. MÜLLER); plaster cast from Kazimierz (apertural view), × 1
3—4 — *Atellana (?)* sp. 2; Nasilow opoka (abapertural views), × 1
5a—5b — *Tornatellina* komplet sp. n.; Nasilow hardground, holotype (abapertural and apertural views), × 2
6—7 — *Cylindrella fusa* (KNER); Nasilow opoka (abapertural views), × 2
8 — *Atellana (?)* sp. 1; Nasilow opoka (oblique abapertural view; MACHALSKI's Coll.), × 1
9 — *Atellana (?)* inversestripata KNER; Kazimierz (abapertural view; MACHALSKI's Coll.), × 1
10—11 — *Dentatulum (Dentatulum) multistatum* FAVRE; 10 external mold from Kazimierz MACHALSKI's Coll., 11 steinkern from Nasilow 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. 29, Pl. 8, Figs 4–6; Pl. 216, Figs 9–10.
1889. Cancellaria nitidula MÜLLER; GRIPENKERL, p. 84.
1891. Cancellaria (Adestes) nitidula MÜLLER; KRACH, p. 388, Pl. 7, Fig. 13.
(1945) Cancellaria nitidula MÜLLER; 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: Nasilów.

TYPE HORIZON: Uppermost part of the Belemnella kazimiroviensis Zone.

DERIVATION OF THE NAME: In the honour of Professor N. KONGEL (1804—1860) for his contributions on the stratigraphy of the Upper Cretaceous deposits in the Middle Vistula Valley.

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

MATERIAL: 2 from Nasilów (hardground).

MEASUREMENTS: H D PA
Holotype (Pl. 24, Fig. 5) 12.2 8.3 90°
Paratype 12.0 8.1 90°

DESCRIPTION: The shell is small, subovoid, with a moderately high spire. The spire contains three convex whors 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 adical half of the last whorl. The aperture is pear-shaped with two columnellar 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. vibragena (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: Auricularia incrassata SOWERBY, 1817

DISCUSSION: The ringiculids globose genera Avellana d'ORBIGNY, 1843, Cinula GRAY, 1847, and Oligopyscha MEER, 1876, are a matter of discussion by different workers. MEER (1876) introduced Oligopyscha as a subgenus of Cinula 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 Oligopyscha MEER by having one columellar and generally two parietal folds, and in having a dentate outer lip. The genus Oligopyscha 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 ? ro, KNER, p. 11, Pl. 2, Fig. 4.
1863. Avellana cassis d'ORB.; PLACHETKO, p. 13, Pl. 1, Fig. 6.
1869. Avellana inversestriata KNER; FAVRE, p. 33, Pl. 7, Figs 7–8.
1890. Avellana inversestriata KNER; GRIEPENKERL, p. 58.
1891. Cinula inversestriata KNER sp.; BÖHM, p. 54.
1891 Avellana inversestriata KNER sp.; ROGALA, p. 92.
1891. Cinula (Avellana) inversestriata KNER; KRACH, p. 368, Pl. 7, Fig. 7.
1930 Cinula (Avellana) inversestriata KNER; POZARYSKI, p. 54.
1942 Cinula inversestriata KNER; PUTZER, p. 272.
1951 Cinula inversestriata KNER; POZARYSKA & POZARYSKI, p. 20.
1974. Avellana(?) inversestriata KNER; BLANK, p. 211, Pl. 20, Fig. 4.

MATERIAL: 2 from Dorotka (low Upper Campanian), 3 from Kalszany (uppermost Campanian), 1 from Męcmierz, 2 from Kazimierz, 2 from Bochotnica, 2 from Nasilów (opoka).

REMARKS: Although the aperture of the studied specimens is destructed or masked, their shape and ornamentation coincide with those of the specimens figured by KNER (1852) and PLACHETKO (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 Cinula bistriata (GUMBEL), 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 Nasilów (opoka).
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

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 spaced 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 cyindracea* 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. *Volva faba* ALTH, p. 233, Pl. 11, Fig. 7.
1850. *Volva faba* ? KNER; ALTH, p. 213.
1852. *Volva faba* KNER, p. 11.
1859. *Bulla faba* KNER sp.; FAVRE, p. 31, Pl. 7, Fig. 5.
1860. *Bulla faba* (Cylichna) KNER sp.; GRIEPENKERL, p. 92.
1881. *Cylichna faba* KNER sp.; BÖHM, p. 53.
(1911) *Bulla faba* KNER; ROGALA, p. 401.
(1956) *Acteonella? faba* (KNER); SOHL & KOLLMANN, p. 79.

**MATERIAL:** 1 from Plotrawin (uppermost Campanian), 6 from Kazimierz, 3 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 ornamentation 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 (1881), differs 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 Paleotaxodontia KORBOKOV, 1954**

**Order Nuculoida DALL, 1889**

**Superfamily Nuculacea GRAY, 1824**

**Family Nuculidae GRAY, 1824**

**Genus Nucula LAMARCK, 1799**

Type species: *Arca nucleus LINNAEUS, 1758*

Subgenus Nucula LAMARCK, 1799

**Nucula (Nucula) truncata NILSSON, 1827**

(Pl. 25, Figs 1—2)

1827. *Nucula truncata* n., NILSSON, p. 16, Pl. 5, Fig. 6.
1830. *Nucula pectinata* SOW.; ALTH, p. 231, Pl. 12, Fig. 10.
1899. *Nucula truncata* NILSSON; FAVRE, p. 126, Pl. 12, Fig. 10.
1911 *Nucula truncata* NILSS.; ROGALA, p. 942.
1835. *Nucula truncata* NILSSON; RÄGG, p. 12.
1838 *Nucula truncata* NILS.; POZARYSKI, p. 22.
1893 *Nucula truncata* NILS.; PUTZER, p. 371.
1894. *Nucula truncata* NILSSON; RÄGG, p. 29.
1877. *Nucula truncata* NILSSON; SOBIESKI, p. 13, Pl. 1, Fig. 2.
1892. *Nucula truncata* NILSSON; SOBIESKI, p. 73, Pl. 6, Fig. 2.

**MATERIAL:** 3 from Piotrawin (uppermost Campanian), 7 from Kazimierz, 6 from Nasliów (5 opoka, 1 hardground).

**REMARKS:** The studied specimens are of medium-sized, subtrigonal 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 coarse 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.
1865. *Nucula ascendens* ALTH; PASTERNAK, p. 90, Pl. 7, Figs 11–12.
1903. *Nucula ascendens* ALTH; SOBIESKI, p. 73, Pl. 6, Fig. 2.

**MATERIAL:** 11 from Kazimierz, 6 from Nasliów (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 margin 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  —  *Arca* (*Ecomunicia*) granulostrotiadiata ALTH; plaster cast of LV from Nasilów opoka, × 3

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

3  —  *Pseudogrammatodon* tornae HEINBERG; Nasilów opoka (external cast and internal mold of LV), × 3

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

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

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

9—10  —  *Cucullaea* (Cucullaea) jeopolensis (ALTH); 9 from Nasilów opoka (steinkern of LV), × 1; 10 from Podgórze (steinkern of LV), × 2

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

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

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

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

15—16  —  *Barbata* (Barbatia) tenulistrata (v. MUNSTER); Nasilów opoka (external molds of RV), × 1
1a-1b — *Modiolus (Modiolus) radiatus* (v. MÜNSTER); Nasilów opoka (lateral and dorsal views of steinkern)

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

4 — *Inoperna flagellifera* (FORBES); Kazimierz (external mold of LV; MA CHALSKT’s Coll.)

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

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

All figures in natural size
1 — Septifer (Septifer) lineatus (SOWERBY); Nasilów opoka (LV view)
2 — Septifer (Septifer) scalaris (J. MÜLLER); Nasilów opoka (LV)
3 — Pinna (Plesiopina) kasimirensis sp. n.; Kazimierz, paratype (IGP II-356)
4-5 — Phelopteria pectinoidea (REUSS); 4 incomplete LV from Kazimierz, 5 LV from Męcierz

All figures in natural size
1 — *Pinna (Plesiopinna) kazimirensis* sp. n.; Kazimierz, holotype

2-3 — *Phelopteria cincta* (ALTH); Ciszyca Kolonia (2 LV, 3 steinkern of LV; MZ-M. 2370)

4 — *Pseudoptera coerulescens* (NILSSON); Nasilów opoka (LV)

All figures in natural size
1 — *Pinna (Pinna) cretacea* (v. SCHLOTHEIM); Nasilów opoka (steinkern)

2-3 — *Gervillia (Gervillia) solenoides* DEFRANCE; Kazimierz (2 LV, 3 group of valves)
1-2 — Spiroloceras tegulatus (v. HAGENOW); Chelm (1 dorsal view of 2V steinkern, 2 fragment of steinkern)

3-4 — Tenuliprtea argentea (CONRAD); Nasilów opoka (3a, 3c, 4a RV; 3b, 4b LV views)

All figures in natural size
1–2 — Lyropecten (Aequipecten) wisloujewski (PASTERNAK); 1 from Kludzie (internal view of RV), 2 from Piotravin (internal view of LV), × 4
3–4 — Netthea szecostata (WOODWARD); Nasilów opoka (3 RV, 4 LV), × 1
5–6 — Propemusium (Parapemusium) inversum (NILSSON; Ciszyca Górna (Incomplete valves)), × 4
7–8 — Oxytoma (Hyporhytoma) danica (RAVN); 7 from Nasilów opoka (external view of LV), 8 from Kazimierz (internal view of LV), × 1.5
9–10 — Syncyclonema niagoni (GOLDFUSS); Kazimierz (9 internal view of RV, 10 internal view of LV), × 1
11–12 — Syncyclonema heegii DHONDIT; 11 from Podgorz (internal view of RV), 12 from Kazimierz (external view of RV), × 3
13–14 — Syncyclonema gansmensia DHONDIT; 13 from Męcierz (internal view of RV), 14 from Kazimierz (internal view of LV), × 25
15 — Merkinia variabilis (V. HAGENOW); Nasilów opoka (internal view of LV), × 1
16 — Campbonectes (Campbonectes) variabilis (NILSSON); Nasilów 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.  
1912. *Nucula tenera* J. MÜLLER; PERVINQUIÈRE, p. 94, Pl. 7, Figs 8, 14.  
1965. *Nucula tenera* MÜLLER; FASTERNAK, p. 69, Pl. 7, Fig. 7.  
1998. *Nucula tenera* MÜLLER; SOBIESKI, p. 72, Pl. 5, Fig. 1.  

**MATERIAL:** 1 from Łęczno, 2 from Kazimierz, 1 from Nasłów (opoka).  

**REMARKS:** 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-topped radial ribs crossed by regular growth steps.

**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. 10, Pl. 6, Fig. 5 (non MANTELL 1822).  
1827. *Nucula ovata* NILSS.; HENNIG, p. 83, Pl. 3, Fig. 21.  
1855. *ucula ovata* NILSSON; HIEGG, p. 12.  
1866. *Nucula ovata* NILSSON; FASTERNAK, p. 90, Pl. 12, Figs 9–9.  
1977. *Nucula ovata* NILSSON; SOBIESKI, p. 12, Pl. 1, Fig. 1.  

**MATERIAL:** 2 from Dobroje, 1 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:** 1 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 steps 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.
1847. Nucula producta NILSSON; PUSCH, p. 47, Pl. 6, Fig. 19.
(1880) Nucula producta NILSSON; d’ORBIGNY, p. 258.
1850. Nucula producta NILS.; KNER, p. 87.
1855. Nucula producta DITH.; ALTZ, p. 233, Pl. 12, Figs 14—15.
1885. Nucula producta NILS.; FECHTENKO, p. 17.
1886. Nucula producta NILS.; FAVRE, p. 118, Pl. 12, Fig. 9.
1886. Nucula producta NILS.; SIEMIRADZKI, p. 83, Pl. 5, Fig. 17.
1889. Ledo producta NILSSON; GRIEPFENKERT, p. 77.
1897. Nucula producta NILS.; HENNY, p. 64.
1901. Ledo producta NILSSON sp.; WOLLEMAN, p. 22.
1905. Ledo producta NILSSON sp.; WOLLEMAN, p. 74.
1838. Ledo producta (NILSSON); HAGG, p. 16, Pl. 5, Figs 19—20.
(1898) Ledo producta NILS.; POZARYSKI, p. 22.
1904. Ledo producta (NILSSON); HAGG, p. 30.
1908. Ledo producta (NILSSON); PASTERNAK, p. 82, Pl. 6, Figs 7—8.
1897. Nuculana producta (NILSSON); ROBERTS, p. 15, Pl. 1, Fig. 4.
1865. Nuculana producta (NILSSON); ROBERTS, p. 75, Pl. 4, Fig. 7.

MATERIAL: 48 from Upper Campanian oposa (5 from Dorotka, 4 from Cisyca Kolonia, 4 from Cisyca Górna, 35 from Plotrawin), 2 from Dzarków, 8 from Kudzia, 2 from Dobr, 7 from Podgorze, 15 from Męcniarz, 20 from Kazimierz, 12 from Nasłów (oepos).

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 (NILSSON), 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, per-Caspian basin; in Poland it is noted from the Middle Vistula Valley (POZARYSKI 1886), and environs of Zamość (PUSCH 1837) and of Chełm.

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

1837. Nucula siliqua nova, GOLDFUSS, p. 156, Pl. 15, Fig. 13.
1849. Nucula siliqua GOLDFUSS; REUSS, p. 7, Pl. 34, Fig. 11.
(1880) Ledo siliqua d’ORBIGNY, p. 250.
1881. Nucula siliqua GOLDFUSS; J. MÜLLER, p. 84.
1877. Ledo siliqua GOLDF.; FRIČ, p. 117, Text—fig. 81.
1880. Ledo siliqua GOLDF. sp.; HOLZAPFEL, p. 263.
1886. Nucula siliqua GOLDFUSS; GRIEPFENKERT, p. 87.
1893. Ledo siliqua GOLDF. sp.; FRIČ, p. 92.
1895. Ledo siliqua GOLDF.; VOGEL, p. 71.
1899. Ledo siliqua GOLDF. sp.; ROGALA, p. 680. Pl. 28, Fig. 18.
1891. Ledo siliqua GOLDF.; ROGALA, p. 482.
1934. Ledo siliqua GOLDF. sp.; ANDERT, p. 311, Pl. 11, Fig. 8.
1936. Ledo siliqua GOLDF.; HAGG, p. 30, Pl. 5, Fig. 22.
1904. Ledo siliqua GOLDF.; HAGG, p. 30, Pl. 5, Fig. 27.
1968. Ledo siliqua (GOLDFUSS); PASTERNAK, p. 86, Pl. 9, Figs 2—3.

MATERIAL: 1 from Podgorze, 3 from Męcniarz, 6 from Kazimierz, 3 from Nasłów (opos).

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:** Cenomânian -- 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)

1869. *Leda Puschi* ALTH; FAVRE, p. 119.  
1881. *Leda Puschi* ALTH; ROGALA, p. 402.  
1909. *Leda puschi* (ALTH) FASTERNAK, p. 80, Pl. 9, Fig. 1.

**MATERIAL:** 1 from Plotrawin (uppermost Campanian), 1 from Dziurków, 2 from Podgórz, 4 from Kazimierz, 2 from Nasiłów (1 opake, 1 hardground).

**REMARKS:** The studied specimens are of medium-sized, elongated shell, with rounded anterior and posterior margins; height nearly of half total length, umbo-nose small, hinge line long with a long posterior segment, and the inner margin smooth. The species can be easily differentiated from *Nuculana silicula* (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. 18, Pl. 2, Fig. 1.  
1850. *Leda Försteri* D'ORBIGNY, p. 236.  

**MATERIAL:** 1 from Dobrc, 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 Vistula Valley.

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

aff. 1934. *Leda carinata m. sp.* ANDERT, p. 212, Pl. 11, Figs 9–18.

**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 1969).

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

1850. *Nucula* (*Daemyomya*) *brevirostris* m., ALTH, p. 243, Pl. 13, Fig. 16.  
1869. *Neaera brevirostris* ALTH sp.; FAVRE, p. 103.  
(1911) *Neaera brevirostris* ALTH; ROGAŁA, p. 492.  
1969. *Leva brevirostris* (ALTH); PASTERNAK, p. 97, Pl. 9, Figs 4—6.  

**MATERIAL:** 1 from Piotrav (uppermost Campanian), 1 from Dzurów, 1 from Podgora, 2 from Męcierny, 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 ROGAŁA (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 *Arcoidea* 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 quadriraculata* J. de C. SOWERBY, 1824; OD  
*Arca* (*Eonavicula*) *propinquus* REUSS, 1846  
(Pl. 26, Figs 5—6)

1846. *Arca furcigera* MÜNSTER; GOLDFUSS, p. 142, Pl. 131, Fig. 14.  
1846. *Arca* (*Cucullaea*) *propinquus* REUSS, p. 13, Pl. 34, Fig. 34.  
1869. *Arca furcigera* v. MÜNSTER; GRIEPENKERL, p. 34.  
1883. *Arca* (*Cucullaea*) *propinquus* REUSS; FRIČ, p. 34, Text-fig. 110.  
1883. *Arca* *propinquus* REUSS; SYNEWEBSKA, p. 280.  
1929. *Arca* (*Cucullaea*) *propinquus* REUSS; ANDERT, p. 225, Pl. 11, Fig. 22.  

**MATERIAL:** 1 from Dorotka (Upper Campanian), 5 from Kazimierz, 1 from Nasilów (opoka).
REMARKS: The studied specimens are of medium- to large-sized, rhombohedral shell, with a distinct umbo-posterior carina forming a small crenule; ornamented with 18-21 radial 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 Vistula Valley.

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

1850. Arca granulatoradiata ALTH, p. 235, Pl. 12, Fig. 20.
1909. Arca granulatoradiata ALTH; ROGAL, p. 505.
1905. Arca granulatoradiata ALTH; HÄGG, p. 21, Pl. 2, Fig. 2.
1978. Arca (Arca) eriae n. sp., HEINBERG, p. 104, Fig. 2.
1982. Arca granulatoradiata ALTH; SOBIEWSKI, p. 78, Pl. 6, Fig. 22.

MATERIAL: 2 from Nasliów (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 crenule, and ornamented with granular radial ribs. The studied specimens agree with Arca granulatoradiata ALTH. HEINBERG (1978) introduced A. (Arca) eriae 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; GOLDFUS, p. 142, Pl. 13b, Fig. 1.
1946. Arca tenuistriata MÜNSTER; REUSS, p. 11.
1893. Arca tenuistriata MÜNSTER; FAVRE, p. 136, Pl. 13, Fig. 14.
1909. Arca tenuistriata v. MÜNSTER; GRIEPENKERL, p. 54.
1911. Arca tenuistriata MÜNSTER; ROGAL, p. 492.
1911. Arca tenuistriata MÜNSTER; FRIECH, p. 34, Text-Fig. 154.
1927. Arca tenuistriata MÜNSTER; HÄGG, p. 22, Pl. 3, Fig. 5.
1938. Arca tenuistriata MÜNSTER; POZARYNSKI, p. 22.
1964. Arca tenuistriata MÜNSTER; HÄGG, p. 50.
1969. Arca tenuistriata MÜNSTER; CIESIELSKI, p. 36.
1975. Arca tenuistriata MÜNSTER; SAVČENKOVA, p. 78, Pl. 11, Fig. 8.
1977. Arca tenuistriata MÜNSTER; SOBIEWSKI, p. 20, Pl. 3, Fig. 5.
1982. Arca tenuistriata MÜNSTER; SOBIEWSKI, p. 78, Pl. 6, Fig. 11; Pl. 30, Fig. 8.

MATERIAL: 19 from Kasimir, 30 from Nasliów (23 opoka, 7 hardground).
REMARKS: The species is common in the uppermost Maastrichtian deposits of the study area, particularly in the Nasłów quarry. The studied specimens are of large-sized shell, elongately ovate in outline, with a well distinct ventral sinus and radial ornamentation.

CIEŚLINSKI (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, Donbas basin; and the per-Caspian basin; Upper Maastrichtian of the Lvov region and of the Middle Vistula Valley.

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

1865. Arca geinitzi REUSS, p. 11, Pl. 34, Fig. 11.
1866. Arca Geinitzi ? REUSS; KNER, p. 22, Pl. 3, Fig. 27.
1869. Arca Geinitzi REUSS; FAUVRE, p. 122, Pl. 12, Figs 15–16.
1872. Arca Geinitzi REUSS; GEINITZ, p. 55, Pl. 16, Figs 7–8.
1890. Arca Geinitzi REUSS; FRIC, p. 79, Text-Fig. 53.
1924. Arca (Barbatia) Geinitzi REUSS; ANDERT, p. 229, Pl. 11, Fig. 17.
1925. Arca Geinitzi REUSS; HÖGG, p. 21, Pl. 3, Fig. 1.
1929. Arca geinitzi REUSS; POZARSKI, p. 22.
1929. Arca geinitzi REUSS; PUTZESEN, p. 231.
1974. Arca geinitzi REUSS; SAVCZINSKAJA, p. 73, Pl. 11, Figs 7–9.
1988. Arca geinitzi REUSS; SOBETSKY, p. 79, Pl. 8, Figs 8–10, Pl. 20, Fig. 7.

MATERIAL: 4 from upper Campanian (3 from Cisyca Kolonia, 1 from Piotrawin), 3 from Mećmierz, 3 from Kasemierz, 23 from Nasłów (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 straight 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 tenistiata (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 Donbas basin, the per-Caspian basin, Crimea, and the Middle Vistula Valley.

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

1878. Barbatia (Barbatia) forchhammeri (LUNDGREN); HEINBERG, p. 187, Fig. 2.

MATERIAL: 3 from Kasemierz, 1 from Nasłów (opoka).

REMARKS: The studied specimens are identified with those of B. (B.) forchhammeri (LUNDGREN) which were precisely described by HEINBERG (1878) 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 Vistula Valley.

Subgenus Acar GRAY, 1857

Type species: Arca gradata BRODERIP & SOWERBY; 1829; SD WOODRING, 1925
**Barbatis (Acar) hennigi** HEINBERG, 1978

*(Pl. 26, Fig. 4)*

*1978. Barbatis (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 posterior-ventral carina, and ornamented with discontinuous 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.

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**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. 2b); 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.

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**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.*

*1853. Arca leopoliensis ALTH; FLAŠTEKO, p. 18.*

*1859. Arca leopoliensis ALTH; FAVRE, p. 128, Pl. 12, Fig. 17.*

*1869. Cucullaea leopoliensis ALTH; GRIEPENKEL, p. 38.*

*1891. Arca leopoliensis ALTH; BOHLM, p. 90, Pl. 3, Fig. 25.*

*(1900) Cucullaea (Arca) leopoliensis ALTH; ROGALA, p. 82.*

*(1911) Arca leopoliensis ALTH; ROGALA, p. 492.*

*1938. Arca leopoliensis ALTH; HEGER, p. 22, Pl. 3, Fig. 3.*

*1963. Arca leopoliensis ALTH; PASTERNAK, p. 102, Pl. 10, Figs 12–15.*

*1971. Arca leopoliensis ALTH; SORENSEN, p. 29, Pl. 2, Fig. 4.*

**MATERIAL:** 5 from Dobrze, 3 from Podgörz, 3 from Męcznerz, 19 from Kazimierz, 13 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 theumbo-ventral sulcus, and absent or less distinct on the dorsal flanks). The studied specimens agree with those figured by ALTH (1850), FAVRE (1889), and PASTERNAK (1889) from the Upper Senonian deposits of the Lvov region.

Based on the hinge features the genus Cuculacea LAMERCK is herein accepted for this species, as previously regarded by GRIEPENKERL (1889) and ROGA-LA (1898).

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 Limopsaceae DALL, 1885
Family Limopsidae DALL, 1885
Genus Limopsis SASSI, 1827
Type species: Arca aurita BROCHI, 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.
1851. Limopsis rhomboidalis ALTH; PLACETIKO, p. 17.
1850. Limopsis rhomboidalis ALTH; FAVRE, p. 121, Pl. 12, Figs 11–12.
1851. Limopsis rhomboidalis ALTH; VOGEL, p. 37.
1850. Limopsis rhomboidalis ALTH; ROGA-LA, p. 492.
1862. Limopsis rhomboidalis ALTH; PASTERNAK, p. 113, Pl. 15, Figs 9–9.

MATERIAL: 1 from Cimyca Góra (Upper Campanian), 1 from Dukrki; 3 from Dobrow, 20 from Kazimierz, 1 from Bochnica, 11 from Nasilow (2 opeka, 1 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 Krumrude (the Netherlands).

Limopsis (Limopsis) sacheri ALTH, 1850
(Pl. 26, Fig. 11)

1850. Limopsis Sacheri M., ALTH, p. 134, Pl. 12, Fig. 8.
1851. Limopsis Sacheri ALTH; FAVRE, p. 133.
1850. Limopsis sacheri ALTH; PASTERNAK, p. 124, Pl. 15, Figs 10–12.
1915. Limopsis sacheri sp., HEINBERG, p. 57, Figs 15–16.

MATERIAL: 96 from Kazimierz, 2 from Bochnica hardground, 63 from Nasilow (6 opeka, 32 hardground).

REMARKS: The species is very common in the uppermost Maastrichtian deposits of the study area, particularly in the Nasilow hardground. It is characterized by a compressed, obliquely oblong to subtriangular shell, with its postero-ventral part acute, and with a slightly curved hinge. The species L. sacheri 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.
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

\textit{Limopsis} (\textit{Limopsis}) aff. \textit{helenae} HEINBERG, 1976
(Pl. 26, Fig. 12)

\textit{aff. 1976. \textit{Limopsis} (\textit{Limopsis}) helenae n. sp.}, HEINBERG, p. 89, Fig. 17.

\textbf{MATERIAL:} 2 from Kazimierz, 11 Nastlów (opoka).

\textbf{REMARKS:} The species is closely similar to \textit{L. helenae} HEINBERG in its elongated lenticular shape, and a shorter hinge as well as in its dentition, but \textit{L. helenae} differs in having radial striae, particularly near the margins. The species \textit{L. kunraadiensis} VOGEL, from the Maastrichtian deposits of Lâmburg 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.

\textit{Limopsis (\textit{Limopsis}) radiata} ALTH, 1850
(Pl. 26, Fig. 14)

1850. \textit{Limopsis radiata} m., ALTH. p. 334, Pl. 12, Fig. 18a.
1859. \textit{Limopsis radiata} ALTH; FAVRE, p. 226, Pl. 12, Fig. 13.
(1911) \textit{Limopsis radiata} ALTH; ROGALA, p. 492.

\textbf{MATERIAL:} 3 from Dobro, 3 from Męcmlierz, 30 from Kazimierz, 11 from Nastlów (10 opoka, 1 hardground).

\textbf{REMARKS:} The species is of medium- to moderately large-sized shell, sub-trigonal 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 \textit{L. avildae} and \textit{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 \textit{L. avildae} differs in having numerous less distinct posterior ribs and closely spaced inner crenulations, and \textit{L. magdae} differs in having less distinct posterior ribs and inner crenulations, extended along the margins.

\textbf{AGE and DISTRIBUTION:} Maastrichtian of the Lwów region and Upper Maastrichtian of the Middle Vistula Valley.

\textbf{Order Mytiloida FÉRUSSAC, 1822}
\textbf{Superfamily Mytilacea RAFINESQUE, 1815}
\textbf{Family Mytilidae RAFINESQUE, 1815}
\textbf{Subfamily Mytilinacea RAFINESQUE, 1815}
\textbf{Genus Septifer RACLUV, 1848}
\textbf{Type species: Mytilus bilocularis LINNAEUS, 1758; SD STOLICZKA, 1871}
\textbf{Subgenus Septifer RACLUV, 1848}
\textbf{Septifer (Septifer) scalaris (J. MÜLLER, 1847)}
(Pl. 27, Fig. 6 and Pl. 28, Fig. 2)

1847. \textit{Mytilus scalaris} MÜLLER, p. 25, Pl. 2, Fig. 11.
1858. \textit{Mytilus lineatus} SOWERBY; HOLZAPFEL, p. 216, Pl. 23, Figs 19–23 (non SOWERBY).
1854. \textit{Mytilus scalaris} J. MÜLLER sp.; ANDERT, p. 156, Pl. 26, Figs 23–24 (cum syn.).

\textbf{MATERIAL:} 8 from Kazimierz, 10 from Nastlów (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 PETHÖ and Mytilus regiolutteranus GRIEPENKERL from the Upper Senonian of Fruska 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)

1800. **Septifer lineatus** (SOWERBY); WOODS, p. 106, Pl. 18, Figs 1–2 (cum syn.).
1833. **Septifer lineatus** (SOW. sp.); SYNEWSKA, p. 287, Fig. 8.
1884. **Septifer lineatus** (SOW. sp.); ANDERT, p. 196, Pl. 10, Fig. 25.
1884. **Septifer lineatus** (SOW. sp.); BLANCKENBORN, p. 207, Pl. 19, Fig. 81.
1980b. **Septifer lineatus** (SOWERBY); CIESLIŃSKI, p. 22.
1974. **Septifer lineatus** (SOWERBY); SAVCZINSKAJA, p. 185, Pl. 37, Figs 9–10.
1981. **Septifer lineatus** (SOWERBY); TZANKOV, p. 77, Pl. 19, Figs 2–3.

MATERIAL: 4 from Nasłów (opoka).

REMARKS: The species is characterized by a large, regular mytiliform thin shell, ornamented with numerous very fine radial ribs cancelled by concentric growth lines. The studied specimens agree with those figured by WOODS (1900). CIESLIŃSKI (1985b) 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 Leov region, Maastrichtian of Bulgaria, uppermost Maastrichtian of the Middle Vistula Valley.

**Subfamily Lithophaginæ** H. ADAMS & A. ADAMS, 1857

**Genus Inoperna CONRAD in KERR, 1875**

**Type species:** *Modiolus* (*Inoperna*) carolinensis CONRAD, 1875;

**SD STEPHENSON, 1923**

**Inoperna flagelljfera** (FORBES, 1846)

(Pl. 27, Fig. 4)

1800. **Modiola flagelljfera** FORBES; WOODS, p. 96, Pl. 27, Figs 1–2 (cum syn.).
1848. **Modiola flagelljfera** FORBES; PETHÖ, p. 236, Pl. 16, Figs 17–33.
1848. **Modiola flagelljfera** FORBES; SCUPIN, p. 108.
1884. **Modiola flagelljfera** FORBES; ANDERT, p. 203, Pl. 10, Fig. 21.
1947. **Modiola flagelljfera** FORBES; HAGG, p. 61.
1981. **Modiola flagelljfera** FORBES; TZANKOV, p. 75, Pl. 19, Fig. 3.

MATERIAL: 2 from Kazimiera, 7 from Nasłów (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 gilieroni* (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:** Albain 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)

1838. *Cypricardia elongata m.* PUSCH, p. 68; Pl. 7, Fig. 6.

1842. *Cypricardia elongata PUSCH; GEINITZ, p. 12, Pl. 3, Fig. 7.

1846. *Cypricardia elongata PUSCH; GEINITZ, p. 189.

1863. *Modiola capitatula ZITTEL; GEINITZ, p. 89, Pl. 13, Fig. 1.

1878. *Modiola capitatula ZITTEL; GEINITZ, p. 217, Pl. 45, Fig. 10; Pl. 18, Fig. 9.

1877. *Modiola capitatula ZITTEL; FRIC, p. 113, Text-fig. 97.

1889. *Modiola capitatula ZITTEL; Siemens & ROGALA, p. 60, Pl. 3, Fig. 4.

1889. *Modiola capitatula ZITTEL; HOLZAPFEL, p. 22, Pl. 25, Fig. 14.

1892. *Modiola capitatula ZITTEL; FRIC, p. 95.

(1911) *Modiola capitatula ZITTEL; ROGALA, p. 48.

1933. *Modiola capitatula ZITTEL; FRIC, p. 86, Text-fig. 165.

(1938) *Modiola capitatula ZITTEL; POZARYSKI, p. 61.

(1945) *Modiola capitatula ZITTEL; PUTZER, p. 70.


**MATERIAL:** 2 from Kazimierz, 1 from Bochońce, 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 (1849) 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)
**Modiolus (Modiolus) siliquus (MATHERON, 1842)**

*(Pl. 27, Fig. 5)*


(1850) *Modiolus siliquus MATHERON; GEINITZ, p. 168, Pl. 16, Fig. 14.*

1906. *Modiolus siliquus MATH.; ZITTEL, p. 21, PI. 11, Fig. 3.*

1973. *Mytilus (Modiolus) siliquus MATH.; GEINITZ, p. 213, Pl. 15, Fig. 4; Pl. 47, Fig. 3.*

1981. *Modiolus siliquus MATH.; BOSSM, p. 51, PI. 5, Fig. 19.*

**MATERIAL:** 1 from Kazimierz and 1 from Nasilow (opoka).

**REMARKS:** Two incomplete specimens possess 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.

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**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)*


v. 1837. *Pinna decussata nobis, GOLDFUSS, p. 185, Pl. 136, Fig. 2.*

1882. *Hippurites quadrilaterals PACHETRO, p. 29, Pl. 2, Fig. 7.*

1889. *Pinna cretacea SCHLOTHEIM; ZITTEL, p. 87, Pl. 12, Fig. 4.*

1879. *Pinna cretacea SCHLOTHEIM; GEINITZ, p. 86, Pl. 14, Figs 2–5.*

1888. *Pinna cretacea v. SCHLOTHEIM; GRIEPENKERL, p. 84.*

1906. *Pinna cretacea SCHLOTHEIM; VOGEL, p. 54.*

1906. *Pinna decussata GOLDFUSS; WOODS, p. 89, Pl. 78, Figs 1–2 (cum sim.).*

(1838) *Pinna decussata GOLD.; POZARYSKI, p. 21.*

(1912) *Pinna decussata GOLD.; PUTZER, p. 271.*

1933. *Pinna cretacea (SCHLOTHEIHM); VAN DER WELDEN, p. 21, Pl. 7, Figs 1–3.*


MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

p. p. 1951. Pinna decussata GOLDFUSS; TZANKOV, p. 38, Pl. 20, Fig. 1.
1961. Pinna cretacea (SCHLÖTHERM); TZANKOV, p. 90, Pl. 21, Fig. 1.
1963. Pinna decussata GOLDFUSS; NESTLER, p. 49, Fig. 62.
1963. Pinna decussata GOLDFUSS; DEHONDT, p. 27, Pl. 4, Fig. 4.
1961. Pinna decussata GOLDFUSS; SOBEJTSKI, p. 61, Pl. 6, Fig. 10.

MATERIAL: 1 from Czarna Kolonia (Upper Campanian), 1 from Podgorz, 4 from Kazimierz, 2 from Bochnica; 1 from Nasilow (Spekk).

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 strength 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. DEHONDT, pers. comm.). The species quadrilateralis from the Upper Senonian deposits of the Lvov region, established by PLACHETKO (1963) 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. calamosacoides 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 Campanian — Upper Maastrichtian of Europe and Southern India.

Subgenus Plesiopinna AMANO, 1956
Type species: Plesiopinna atritiformis 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 (Belocamella kasimirensis 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 lam-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: 1 from Kazimierz.

MEASUREMENTS:

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<th>E.L.</th>
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<tr>
<td>Holotype (Pl. 28, Fig. 1)</td>
<td>136.8</td>
<td>147.8</td>
<td>59p</td>
</tr>
<tr>
<td>Paratype (Pl. 28, Fig. 1)</td>
<td>128.0</td>
<td>133.8</td>
<td>59p</td>
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DESCRIPTION: The shell is large, wedge-shaped, equilateral 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 late 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 Pina 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) atriformis AMANO (1985), the type species, as figured by HAYMI (1979) from the Albian — Cenomanian of the Goyonoura Group in Shishijima Island, Japan.

The specimens described as P. decussata by Tzankov (1983, 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 Pteroida NEWELL, 1965
Suborder Pterina 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 solenoidea DEFR.; GOLDFUS, p. 124, Pl. 115, Fig. 10.
1886. Gervillia solenoidea DEFR.; ZITTEL, p. 91, Pl. 15, Fig. 2.
1888. Gervillia solenoidea DEFR.; G. MÜLLER, p. 41, Pl. 5, Fig. 6.
1891. Gervillia solenoidea DEFR.; KRACH, pp. 384—385, Pl. 8, Fig. 3.
(1830) (Gervillia solenoidea DEFR.; POZARSKÝ, p. 21.
(1842) Gervillia solenoidea DEFR.; PUTZER, p. 71.
1845. Gervillia solenoidea DEFRANCE; HÄGG, p. 35.

MATERIAL: 2 from Piotrawin (uppermost Campanian), 3 from Solac, 1 from Mechmierz, 1 from Dobro, 80 from Kastmierez, 30 from Nasłów (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). POZARSKÝ (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. 19, pi. 3, fig. 18.
1855. Pteria (Pseudoptera) coerulescens (NILSSON); WOODS, p. 67, pi. 9, figs. 12–18. (syn. syn.).
1899. Avicula coerulescens NILSSON; ROGALA, p. 897.
1911. Avicula coerulescens NILSS.; ROGALA, p. 453.
1915. Avicula coerulescens NILSS.; SCUPIN, p. 217, pi. 12, fig. 5.
1932. Avicula (Pseudoptera) coerulescens NILSSON; WOLANSKY, p. 29, pi. 3, fig. 14.
MATERIAL: 2 from Kazimierz, 1 from Noszów (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 (1895).

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 Pheloptoria STEPHENSON, 1952
Type species: Pteria? dali STEPHENSON, 1936; OD
Pheloptoria pectinoides (REUSS, 1846)
(Pl. 28, Figs. 4–5)

1846. Avicula pectinoides REUSS, p. 23, pi. 32, figs. 8–9.
1867. Avicula (Melaearina) pectinoides REUSS; FRECH, p. 120, pi. 14, figs. 6–8.
1893. Avicula pectinoides REUSS; FRIC, p. 89, text-fig. 121.
1895. Avicula pectinoides REUSS; VOGEL, p. 28.
1900. Avicula pectinoides REUSS; G. MOLLER, p. 38, pi. 5, fig. 13.
1902. Avicula pectinoides REUSS; RAVN, p. 90, pi. 11, fig. 5.
1905. Avicula pectinoides REUSS; ROGALA, p. 497.
(1811). Avicula pectinoides RISS.; ROGALA, p. 493.
1913. Avicula pectinoides REUSS; SCUPIN, p. 216, pi. 12, fig. 6.
1934. Avicula pectinoides REUSS; ANDERT, p. 95, pi. 1, fig. 1.
MATERIAL: 4 from Meśmierz, 4 from Kazimierz, 1 from Noszów (opoka).

REMARKS: All the studied specimens are left valves, small-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 Pheloptoria geinitzi (REUSS), P. neagreta (REUSS) and P. caudigera (ZITTEL) by its smaller anterior auricles and by the value of proscoclinality.

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.

Pheloptoria cincta (ALTH, 1850)
(Pl. 29, Figs. 2–3)

1850. Avicula cincta m., ALTH, p. 239, pi. 12, fig. 24.
1859. Avicula cincta ALTH; FAVRE, pp. 130–131.
MATERIAL: 3 from Cisyca Kolonia (Upper Campanian), 1 from Kazimierz, 1 from Noszów (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 DHOND'T 1983b). This gradual decrease in inoceramids is clearly noticeable 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 POZARYSKI (1938) and BŁASZKIEWICZ & CIEŚLIŃSKI (1978), 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 equivaive Spyridoceramus tegulatus (v. HAGENOW) and the inequivaive Tenuipteria argentea (CONRAD).

The identification of equi- and inequivaive 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 inequivaive species, and pelomorphic (DHOND'T 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 equivaive species Tenuipteria argentea (CONRAD) with Inoceramus dobrovi JELETZKY; and inequivaive 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.

DHOND'T (1979) discovered the inequivaive species Tenuipteria geminatus (VOGEL) in the Maastrichtian stratotype (the Netherlands); she also recorded (DHOND'T 1982) both equivaive and inequivaive tegulated species in the Upper Maastrichtian (Belemnitella junior Zone) of Hemmoor Chalk, West Germany. However, the figured specimens from Hemmoor are incomplete and most probably belong to equivaive not inequivaive species if carefully compared with the material from Maastricht and Isle of Rügen. Recently, DHOND'T (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:

— equivalent *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);
— inequivalent *T. argentea*, *T. geulemensis*, and *I. dobromi*.

DHONDT (1983a) accepted *Tenuipteria* STEPHENSON as a generic name for inequivalent species and *Spyridoceramus* HEINZ for equivalent ones. In this work the author follows DHONDT (1983a), regardless her Text-fig. 3 (lower part) which presents the species not belonging to the equivalent genus *Spyridoceramus*. (1960),

All the Polish investigators (see Text-fig. 7), viz. POZARYSKI (1938, 1960), POZARYSKA & POZARYSKI (1951), CIEŚLIŃSKI (1960), BŁASZKIEWICZ & CIEŚLIŃSKI (1976), and CIEŚLIŃSKI & BŁASZKIEWICZ (1984) considered both equivalent and inequivalent species as *I. tegulatus* v. HAGENOW, following ODUM (1922), DOBROV (1951), DOBROV & PAVLOVA (1959), and JELEŻECKI (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 equivalent species *Spyridoceramus tegulatus* is only recorded (see Text-fig. 15) in the Lower Maastrichtian and low–Upper Maastrichtian (Bellemnitella junior Zone), while the inequivalent *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).](image-url)
two species are not overlapping, and there is a small gap of few meters in the uppermost part of the Belemnella junior Zone (see Text-fig. 15). Hence, all the specimens collected from the uppermost Maastrichtian (Kazimierz, Bochotnica and Nasilów 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 POZARYSKI (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 Hommooor 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: Inoceramus tegulatus v. HAGENOW, 1842; non ÖDUM, 1922.

Spyridoceramus tegulatus (v. HAGENOW, 1842)
(Pl. 31, Figs 1—2)

1842. Inoceramus tegulatus n., v. HAGENOW, p. 359 (90).
1925. Inoceramus sp. (cf. tuberculatus WOODS); SYNIEWSKA, p. 283, Fig. 3.
1932. Inoceramus (Spyridoceramus) tegulatus v. HAGENOW; WOLANSKY, p. 22, Pl. 4, Fig. 8; Pl. 5, Figs 5—6.
1932. Inoceramus tegulatus HAG.; POZARYSKI, p. 21.
1933. Inoceramus caucasicus n. sp. DOBROV, p. 198, Pl. 1, Fig. 2.
1939. Inoceramus caucasicus DOBROV; DOBROV & PAVLOVA, p. 190, Pl. 15, Fig. 40, b.
1961. Inoceramus fibrosus (MEEK & HAYDEN); JELETZKY, p. 141, Pl. 141, Figs 4—7.
1965. Inoceramus fibrosus a synonym of L tegulatus HAGENOW; JELETZKY & CLEMENS, p. 957.
1965. Inoceramus tegulatus HAGENOW; KOTSYUBINSKII, p. 148, Pl. 29, Fig. 3; Pl. 29, Fig. 9.
1970a. Tenuipteria tegulata (HAGENOW); SPEDEN, p. 6, Pl. 2, Figs 1—3.
1970a. Tenuipteria fibrosa (MEEK & HAYDEN); SPEDEN, p. 34, Text-fig. 3a and Pl. 1, Figs 1—6.
1970b. Tenuipteria fibrosa (MEEK & HAYDEN); SPEDEN, p. 82, Pl. 8, Figs 11—16; Pl. 9, Figs 1—16.
1962. Inoceramus tegulatus v. HAGENOW; NESTLER, p. 45, Fig. 72.
1962. ? Tenuipteria tegulata (VON HAGENOW); DHONDT, p. 79, Pl. 1, Figs 1—2.
1963a. Spyridoceramus tegulatus (VON HAGENOW); DHONDT, p. 49, (non Text-fig. 3).
1963b. Spyridoceramus tegulatus (VON HAGENOW); DHONDT, p. 697.

Material: 1 from Dzurków, 6 from Kudzie, 2 from Podgorze (own collection); 1 from Solow (POZARYSKI'S Collection); I.G., No. 12 II. 27); 7 from Mięchów—Michów Upland (MAZUREK'S Collection); I.G., No. 1481 II. 106, 302, 265, 225, 111, 65; specimens from borehole Garwolin, Polish Lowland (I.G. No. 690, II. 85, 88, 90); 300 specimens from the Chelm chalk (Lublin Upland).
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

MEASUREMENTS: All the studied specimens from the Middle Vistula Valley, and others are fragmented, except of 3 specimens from Chełm which are almost complete.

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REMARKS: The species is characterized by an equivaleval shell, inequilateral and subovoidal (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), NESTILORET (1962), SPEDEN (1970a), and KOTSUBINSKII (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 — Lower-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: Drzurków, Sołeć, Kłudzie (Lower Maastrichtian); Podgórz (Belemnitella junior Zone), — Lublin Upland: Chełm chalk (Belemnitella junior Zone), — Miechów Upland: Miechów and Pęczków (Lower Maastrichtian), — Encountered in boreholes penetrating the Lower Maastrichtian deposits, such as Puławy, and Garwolin (Polish Lowland).

Genus Tenuiptera STEPHENSON, 1955; emend. SPEDEN (1970a, b)

Type species: Inoceramus argenteus CONRAD, 1858; OD

Tenuiptera argentea (CONRAD, 1858)

(PI. 31, Figs 3—4)

1858. Inoceramus argenteus CONRAD, p. 294, PI. 34, Fig. 18.
1902. Avicula spec.; BAVN, p. 81, PI. 1, Figs 4—6.
1922. Inoceramus agnatus v. HAGENOW; ODUM, pp. 1—33, Figs 1—3, 7.
1928. Inoceramus tegulatus HAG.; POZARYSKI, p. 21.
1932. Inoceramus tegulatus HAG.; PUTZER, p. 370.
1931. Inoceramus tegulatus HAG.; POZARYSKA & POZARYSKI, p. 21.
1956. Inoceramus tegulatus HAG.; CIEŚLINSKI, p. 484.
1859. Tenuiptera argentea (CONRAD); COX, p. N30, Figs C63—5a, b.
1970a. Tenuiptera dobroi (JELTEZKY); SPEDEN, p. 34, PI. 2, Figs 4—6.
1970b. Tenuiptera argentea (CONRAD); SPEDEN, p. 33, PI. 2, Fig. 7; PI. 3, Figs 1—6.
1970c. Tenuiptera gentilemensis (F. VOGEL); DHONDT, p. 126, PI. 1, Figs 3—5, 7—8 (non PI. 4).
1952. Tenuiptera gentilemensis (F. VOGEL); DHONDT, p. 77, PI. 1, Figs 8, 10, 11 (non PI. 3, 4, 5, 7, 8).
1963a. Tenuiptera argentea (CONRAD); DHONDT, p. 47, Text-Fig. 3.
1963b. Tenuiptera argentea (CONRAD); DHONDT, p. 697.
1984. Inoceramus tegulatus HAGENOW; CIEŚLINSKI & BŁASZKIEWICZ, p. 357, PI. 151, Fig. 4.

MATERIAL: 3 from Kazimierz, 2 from Buczotnie, 53 from Nasłów (25 opoka, 3 hardground); Samples from boreholes Garwolin (I.G. — No. 252 II. 14, 16, 26), and Łowicz (I.G. — No. 432 II. 35) in the Polish Lowland.
MEASUREMENTS: All the measured specimens are from Nasiłów.

L  varies from 18.3 to 48.5; av. 32.0, n = 36
HL 15.0
HE 16.85
H/L 0.77
HRL 0.53

where HL — height of LV, HE — 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, Aviculo-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, 1970), Denmark (RAVN, 1902, ØDUM, 1923), North Caucasus (DOBROV & PAVLOVA, 1958) 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 RAFINESQUE, 1815
Family Oxytomidae ICHIKAWA, 1958
Genus Oxytoma MEEK, 1864.

Type species: Aviculo muensteri BRONN, 1830; OD

Subgenus Hypoxytoma ICHIKAWA, 1958

Type species: Aviculo danica RAVN, 1902; OD
Oxytoma (Hypoxytoma) danica (RAVN, 1902)
(Pl. 32, Figs 7—8)

1803. Aviculo danica n. sp. RAVN, p. 79, Pl. 1, Figs 1—3.
1841. Aviculo danica RAVN; STOLL, p. 89, Pl. 1, Fig. 31.
1964. Persia (Oxytoma) danica RAVN; VONGET, pp. 631—632, Pl. 17, Figs 1—7; Pl. 19, Fig. 1—11.
1984. Oxytoma danica danica (RAVN); PARMONOVÁ, 119.
(1972a) Persia danica RAVN; CIESLINSKI, p. 130.
1988. Oxytoma (Hypoxytoma) danica (RAVN); DHONDT, p. 80, Pl. 4, Fig. 2.

MATERIAL: 45 from Męciniarz, 2 from Dobro, 2 from Podgórz, 75 from Kazimierz, 1 from Janowice, 3 from Nasiłów (opoka).

REMARKS: The majority of the collected specimens are sea valves, which were accumulated in patches along the bedding plane, particularly in the Męciniarz marly chalk and in the Kazimierz marly opoka. Right valves are rare.

The species can be easily distinguished from O. (H.) pectinata (SÖWERBY) from the Lower Cretaceous, O. (H.) tenuecostata (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 (20-22).

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 Amusidae 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.

1866. Pecten membranaceus Nilss.; Siemiradzki, p. 59, Pl. 4, Fig. 5.


1866. Entolium membranaceum (Nilsson); Pasternak, p. 131, Text-Fig. 18 and Pl. 30, Figs 11-12.

1871. Entolium membranaceum (Nilsson); Dhondt, p. 27, Pl. 1, Fig. 3 (cum syn.).

1877. Entolium membranaceum (Nilsson); Sobetski, p. 57, Pl. 2, Figs 16-17.

1882. Entolium membranaceum (Nilsson); Sobetski, p. 69, Pl. 8, Fig. 22; Pl. 31, Figs 3-4.

1882. Entolium membranaceum (Nilsson); Dhondt, p. 89.

MATERIAL: 1 from Męciszew, 19 from Kazimierz, 1 from Bochotnica, 8 from Nasilów (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 (1972), 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 (Pozarski 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 auodecimlanellatus Bronn, 1831; OD

Propeamussium (Parvamussium) inversum (Nilsson, 1827)

(Pl. 32, Figs 5-8)

1827. Pecten inversus Nilsson, p. 24, Pl. 9, Fig. 12a-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 Cretaceous opoka (1 from Cisłeye Kolonia, 2 from Cisłeye Góra, 1 from Piotrowin), 2 from Sołec, 3 from Dzulków, 1 from Janowiec. 8 from Kazimierz, 1 from Nasilów (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) ignotus 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 (Paramussium) bisculptum (VON KOENEN) as figured by GILBERT & VAN DE POEL (1973) resembles the studied species, but it differs in having numerous external radial ribslets 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, 1884
Type species: Pecten rigidus HALL & MEEK, 1856; OD
(non SOWERBY, 1818)

Syncyclonema haeggi DHONDT, 1971
(Pl. 32, Figs 11—12)

1887. Pecten lasius NILSSON, p. 34, Pl. 9, Fig. 17.
1971. Syncyclonema haeggi nom. nov., DHONDT, p. 65, Pl. 2 (cum syn.).
1982. Syncyclonema lasius (NILSSON); SOBETSKI, p. 101, Pl. 6, Fig. 25.

MATERIAL: 2 from Działków, 1 from Podgórze, 12 from Kazimierz, 4 from Nasilów (3 opoka, 1 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 greater 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)

1896. Pecten exilis REUSS; ZITTEL, p. 100, Pl. 17, Fig. 5a—c.
1896. Pecten (Pseudamussium) spatulatus VOGEL, p. 20, Pl. 1, Figs 14—16.
1971. Syncyclonema gamsensis nov.; DHONDT, p. 63, Pl. 1, Fig. 3.

MATERIAL: 1 from Podgórze, 1 from Mačmierz, 2 from Kazimierz, 1 from Nasilów (opoka).

REMARKS: The studied specimens agree with those figured by VOGEL (1896) 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 from 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.
Syncyclonema nilsoni (GOLDFUSS, 1835)  
(Pl. 32, Figs 9—10)

v. 1833. Pecten Nilsoni nobis, GOLDFUSS; p. 76, Pl. 38, Fig. 8a—b.
1912. Pecten (Syncyclonema) nilsoni GOLDF.; LOPUSKI, p. 194, Pl. 2, Fig. 15.
1922. Pecten (Syncyclonema) nilsoni GOLDFUSS; WOLANSKY; p. 17, Pl. 1, Figs 9—11.
(1938) Pecten Nilsoni GOLDF.; POZARYSKI, p. 23.
(1951) Pecten nilsoni GOLDF.; POZARYSKA & POZARYSKI, p. 24, Pl. 7, Fig. 13.
(1953c) Pecten (Syncyclonema) nilsoni GOLDF.; CIEŚLIŃSKI, p. 129.
(1953b) Pecten (Syncyclonema) nilsoni GOLDF.; CIEŚLIŃSKI, p. 12.
(1958) Chlamys (Camptonectes?) nilsoni (GOLDFUSS); PASTERNAK, p. 197, Text-fig. 31 and Pl. 36, Figs 1—2.
1971. Syncyclonema nilsoni (GOLDFUSS); DHOND'T, p. 54, Pl. 4 (cum. syn.)
1981. Syncyclonema nilsoni (GOLDFUSS); TZANKOV, p. 106, Pl. 44, Fig. 4.
1982. Syncyclonema nilsoni (GOLDFUSS); SOBEKSI, p. 102, Pl. 6, Fig. 26.
1986. Syncyclonema nilsoni (GOLDFUSS); NESTLER, o. 46, Fig. 14.

MATERIAL: 2 from Dobre, 25 from Kazimierz, 1 from Bocotnica, 14 from Nasłów (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 totophyses from Maastricht in the almost straight apical margins, the higher H/L ratio, and the smaller size. These differences have been noticed by DHOND'T (1971) between the totophyses and the Rügen specimens, and she concluded that this difference might be due to environmental factors. On the other hand, PASTERNAK (1988) also noticed this difference and erroneously identified WOLANSKY’s figures and “Pecten” membranaceus Roemer, 1870 (= Syncyclonema haeggi DHOND’T) 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. 23, Pl. 9, Fig. 18.
(1838) Pecten virgatus NILSS.; POZARYSKI, p. 22.
1958. Chlamys (Camptonectes) virgata (NILSSON); PASTERNAK, p. 197, Pl. 35, Figs 8—2.
1972a. Camptonectes (Camptonectes) virgatus (S. NILSSON); DHOND'T, p. 13, Pl. 2, Fig. 1  
(cum. syn.).
1977. Camptonectes virgatus (NILSSON); SOBEKSI, p. 46, Pl. 4, Fig. 14.
1981. Camptonectes virgatus (NILSSON); TZANKOV, p. 101, Pl. 45, Fig. 1.
1983. Camptonectes virgatus (NILSSON); DHOND'T, p. 82.

MATERIAL: 4 from Kazimierz, 4 from Nasłów (opoka).

REMARKS: The studied specimens are identical with those from the Upper Cretaceous of Europe revised by DHOND’T. (1972a), who precisely discussed the generic status, stratigraphic range and geographic distribution of this species. POZARYSKI (1988) 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)

1857. *Pecten asper* var. *polonica* FUSCH, p. 41, Pl. 5, Fig. 7a—b (nomen oblitum).
1858. *Pecten acuteplicatus* m., ALTH, p. 246, Pl. 12, Fig. 34.
(1858) *Pecten acuteplicatus* ALTH; POZARYSKI, p. 22.
(1843) Aequipecten acuteplicatus ALTH; PUTZER, p. 31.
(1863) *Pecten acuteplicatus* ALTH; POZARYSKA & POZARYSKI, p. 22, Figs 5—7, Fig. 11.
(1866a) *Pecten (Aequipecten) acuteplicatus* ALTH; CICERLINSKI, p. 120.
1866. *Chlamys (Aequipecten)*? *acuteplicata* (ALTH; PASTERNAK, p. 165, Pl. 34, Figs 10—12.
1972b. *Lyropecten (Aequipecten) acuteplicatus* (ALTH; DHONDOT, p. 23, Pl. 1, Figs 3a—b; Pl. 3, Figs 1a—b (cum syn.).
1977. *Chlamys (Microchlamys) acuteplicata* (ALTH; SOBETSKI, p. 84, Pl. 4, Figs 14—15.

MATERIAL: More than 600 separate valves from Kazimierz and Janowice, and the majority from Nasław and Bochotna.

REMARKS: The studied specimens are identical with those from the Lvov region figured by ALTH (1850) and others, and with those revised by DHONDOT (1972b) from the Upper Maastrichtian of Northern European Province. In the studied material, especially in the best preserved valves, the Campionectes-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).

DHONDOT (1972b) fully discussed the synonymy and geographic distribution of this species, and she indicated that *Pecten obtusus* CONRAD and *P. farcensis* ZITTEL from the Maastrichtian of Jordan and Egypt, respectively, are undoubtedly synonyms of the studied species (see also ŁOFUSKI 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. 5, Fig. 12.
1853. *Pecten (Aequipecten) pulchellus* NILSSON; WOODS, p. 194, Pl. 37, Figs 3—15.
1912. *Pecten (Aequipecten) pulchellus* NILSSON; ŁOFUSKI, p. 101, Pl. 2, Fig. 14.
1863. *Chlamys (Aequipecten) pulchellus* (NILSSON); PASTERNAK, p. 166, Pl. 34, Figs 12—15.
y. 1972b. *Lyropecten (Aequipecten) pulchellus* (NILSSON); DHONDOT, p. 15, Pl. 1, Fig. 2 (cum syn.).
1974. *Chlamys pulchellus* (NILSSON); SAVCZINSKAJA, p. 81, Pl. 28, Figs 14—15.
1977. *Chlamys (Microchlamys) pulchella* (NILSSON); SOBETSKI, p. 84, Pl. 4, Fig. 8.
1982. *Lyropecten (Aequipecten) pulchellus* (NILSSON); DHONDOT, 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 Mečmlers, 8 from Kazimierz, 5 from Nasław (3 opo-ka, 2 green sand).

REMARKS: The measurements and orientation of the studied specimens agree with those revised by DHONDOT (1972b) from the Upper Cretaceous of Europe. DHONDOT (1982) mentioned that this species occurs more frequently in the Maastrichtian calcarenites 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 DHOND'T'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)

(1936) *Pecten campaniensis* d'ORB.; POZARYSKI, p. 23.
1969. *Chlamys (Aequipecten) campaniensis* (ORBIGNY); PASTERNAK, p. 161, Pl. 34, Fig. 2.
1972b. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); DHOND'T, p. 9, Pl. 1, Figs 1a—c (cum syn.).
1982. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); DHOND'T, p. 81, Pl. 5, Figs 4—7.
1983. *Lyropecten (Aequipecten) campaniensis* (d'ORBIGNY); NESTLER, p. 45, Fig. 78.

**MATERIAL:** 7 from Piotrawin (uppermost Campanian), 1 from Dżarków, 2 from Kudziele, 4 from Męcźmierzyce, 1 from Kaszmierz, 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 macrostructure. DHOND'T (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. POZARYSKI (1936) 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) wisniowski* (PASTERNAK, 1962)
(Pl. 32, Figs 1—2)

1969. *Chlamys (Aequipecten) wisniowski* PASTERNAK; PASTERNAK, p. 163, Pl. 34, Figs 9—11.

**MATERIAL:** 1 from Piotrawin (uppermost Campanian), 3 from Kudziele.

**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 Lyriocephalchlamys SOBETSKI, 1977**
**Type species:** *Pecten fissicosta ETHERIDGE, 1881**
Chlamys (Lyriochlamyx) septemplicata (NILSSON, 1827)
(Pl. 33, Figs 4—5)*

1827. Pecten septemplicatus NILSSON, p. 29, Pl. 18, Fig. 8.
1860. Pecten dujardini REUSSE; IMMIERADZKI, pp. 56—60, Pl. 5, Fig. 1.
1912. Pecten (Aequipecten) Dujardinii ROMER var. vesiculosa; ŁOPUSKI, p. 191, Pl. 2, Fig. 5.
7 (1936) Pecten dujardini ROEM.; POZARYSKI, p. 22.
7 (1942) Aequipecten dujardini ROEM.; PUTZER, p. 371.
7 (1954) Pecten dujardini ROEM.; POZARYNSKA & POZARYSKI, p. 2.
1963. Chlamys (Chlamys) septemplicata (NILSSON); PASTERNAK, p. 197, Pl. 33, Fig. 6.
1972b. Lyropecten? septemplicatus (NILSSON); DHOND'T, p. 59, Pl. 3, Fig. 3.
1977. Chlamys (Lyriochlamyx) septemplicata (NILSSON); SOBETWSKI, p. 33, Pl. 4, Fig. 3.
1981. Chlamys (Chlamys) septemplicata (NILSSON); TZANKOV, p. 162, Pl. 45, Figs 3—4.

MATERIAL: 8 from Bochotnicia, 50 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 DHOND'T (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 asperimus LAMARCK, 1819; OD
Mimachlamys cretosa cretosa (DEFRANCE in A. BRONGNIART, 1822)
(Pl. 34, Figs 1—2)

1992. Pecten (Chlamys) cretusus DEFRANCE; WOODS, p. 174, Pl. 53, Figs 4—9; Pl. 54, Figs 1—12.
1912. Pecten (Chlamys) cretusus DEF.; ŁOPUSKI, p. 192, Pl. 2, Figs 5—6.
1930. Pecten cretusus DEF.; POZARYSKI, p. 22.
1973a. Mimachlamys cretosa (DEFRANCE); DHOND'T, p. 77, Pl. 5, Fig. 1; Pl. 7, Fig. 1 (cum syn.).
1977. Chlamys (Chlamys) cretosa (DEFRANCE); SOBETWSKI, p. 44, Pl. 3, Fig. 6.
1981. Chlamys (Chlamys) cretosa (DEFRANCE); TZANKOV, p. 103, Pl. 45, Fig. 6.
1982. Chlamys (Chlamys) cretosa (DEFRANCE); SOBETWSKI, p. 104, Pl. 21, Figs 1—5; Pl. 31, Fig. 6.

MATERIALS: 5 from Piotrawin (uppermost Campanian), 3 from Działek, 2 from Klucze, 1 from Dobera, 1 from Podgórzy, 1 from Męcinerz, 5 from Kazimierz, 1 from Bochotnicia, 5 from Nasiłów (opoka).

REMARKS: Most of the studied specimens are fragments. However, they agree with those given by DHOND'T (1973a) from different European localities. DHOND'T (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* nov., v. HAGENOW, p. 519 (22).
1973a. *Mimachlamys cretosa* subspecies denticulata (VON HAGENOW); DHOND'T, p. 89, Pl. 1, Figs 1a—c.

**MATERIAL:** 10 from Kazimierz, 2 from Bochotnica, 7 from Naśów (6 opoka, 1 greensand).

**REMARKS:** The studied specimens are identified with those described by WOLANSKY (1932) and DHOND'T (1973a, 1982). DHOND'T (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* 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)

1862. *Pecten (Chlamys) trilucus* v. HAGENOW; ŁOPUSKI, p. 194, Pl. 2, Figs 10—11.
1862. *Pecten (Chlamys) trilucus* HAG.; POŻARYSKI & POŻARYSKI, p. 11.
1862. *Pecten (Chlamys) trilucus* HAG.; CIŚLINSKI, p. 120.
1973a. *Merklinia variabilis* (VON HAGENOW); DHOND'T, pp. 18—27, Pl. 1, Fig. 2; Pl. 2, Figs 1a—b (cum syn.).
1972. *Merklinia variabilis* (VON HAGENOW); DHOND'T, p. 84, Pl. 2, Fig. 12.

**MATERIAL:** 4 from Męcmierz, 13 from Kazimierz, 72 from Naśów (70 opoka, 2 hard-ground).

**REMARKS:** The studied specimens are identical with those revised by DHOND'T (1975) from the Upper Cretaceous of the North European Province. DHOND'T (1975) fully discussed the synonymy of this species and concluded that *Pecten leonhardi*, *P. variabilis*, and *P. trilucus* v. HAGENOW (1842) are conspecific, and *P. variabilis* has priority over the formerly used name of *P. trilucus*.

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 Neithhea* DROUET, 1824

*Type species:* *Pecten aequicostatus* LAMARCK, 1819;

*SD CHENU, 1882*
Subgenus Neitha DROUET, 1824
Neitha (Neithia) sexcostata (WOODWARD, 1833)
(Pl. 32, Figs 3—4)


(1838) *Vola sexcostata* WOOD.; POZARYSKI, p. 22.
1853. Neithia sexcostata (WOODWARD); ABBA, p. 58, Pl. 4, Figs 12—13, 14.
1873b. Neithia (Neithia) sexcostata (WOODWARD); DHONDT, p. 44, Pl. 5, Figs 2a—b (cum syn.).
1977. Neithia (Neithieope) sexcostata (WOODWARD); SOBETSKI, p. 71, Pl. 5, Figs 4—5.
1981. Neithia (Neithia) sexcostata (WOODWARD); TZANKOV, p. 100, Pl. 46, Figs 1, 1a.
1983. Neithia sexcostata (WOODWARD); NESTLER, p. 49, Figs 9a—c.
1982. Neithia sexcostata (WOODWARD); DHONDT, p. 88, Pl. 2, Figs 7—11.

MATERIAL: 1 from Dzierkó w, 1 from Maćmierz, 2 from Kazimierz, 43 from Nasilów (49 opoka, 2 hardground).

REMARKS: The studied specimens coincide with those revised by DHONDT (1973b). The species *Neithia 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 POZARYSKI (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 dutempleanus* d'ORBIGNY, p. 672, Pl. 460, Figs 6—11.
1861. *Spondylus dutempleanus* d'ORBIGNY; WOODS, p. 129, Pl. 23, Figs 11—14; Pl. 24, Figs 1—5.
1912. *Spondylus dutempleanus* d'ORBIGNY; ŁOPUSKI, p. 263, Pl. 2, Fig. 16; Pl. 3, Figs 1—3.
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1977. Diaphora dutempleana (ORBIGNY); SOBIESKI, p. 34, Pl. 5, Fig. 13.
1981. Spondylus (Spondylus) dutempleanus D’ORBIGNY; TSKOV, p. 112, Pl. 50, Fig. 5.
1982. Spondylus dutempleanus D’ORBIGNY; BHONDY, p. 85, Pl. 3, Figs 1–4; Pl. 4, Fig. 5.
1982. Diaphora dutempleana (ORBIGNY); SOBIESKI, p. 121, Pl. 13, Fig. 4; Pl. 31, Fig. 7.

MATERIAL: 6 from Plotrowin (uppermost Campanian), 1 from Kudzie, 1 from Dżurków,
4 from Maćmierz, 64 from Kazimierz, 1 from Rochotnica, 28 from Nasliw (22 opoka,
6 hardground); and 8 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 (1933) from the Upper Cam-
panian — 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)

1837. Podopleis truncata LAM.; NILSSON, p. 37, Pl. 2, Fig. 77.
1839. Spondylus truncatus nova, GOLDFUSS, p. 97, Pl. 198, Fig. 4.
1840. Spondylus truncatus LAMARCK; G. MÜLLER, p. 19, Text-fig. 5.
1911. Spondylus truncatus d’ORB.; ROGALA, p. 863.
1912. Spondylus truncatus LAM. sp.; ŁOPUSKI, p. 201, Pl. 4, Fig. 12.
1977. Diaphora truncata (LAMARCK); SOBIESKI, p. 85, Pl. 8, Figs 1–3.
1982. Diaphora truncata (LAMARCK); SOBIESKI, p. 121, Pl. 13, Fig. 5; Pl. 31, Fig. 8.

MATERIAL: 3 from Dżurków, 1 from Dobro, 2 from Maćmierz, 33 from Kazimierz, 29 from
Nasliw (opoka).

REMARKS: The studied specimens coincide with those described by GOL-
DFUSS (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 Bulgar
ia 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 5–7.
1982. Diaphora serrata (WOODS); SOBIESKI, p. 120, Pl. 12, Fig. 3.

MATERIAL: 1 from Kazimierz, 14 from Nasliw (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 Terqueemiidae 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.
1868. Placunopsis undulatus MÜLLER; RAVN, p. 111, Pl. 5, Fig. 26.
1872. Placunopsis granulosa A. ROEMER; WOLANSKY, p. 34, Pl. 3, Figs 10—12.
(1869) Placunopsis undulata MÜLL.; POZARYSKI, p. 21.

MATERIAL: 1 from Kudzie, 1 from Dobre, 21 from Kazimierz, 1 from Janowiec, 13 from Nasłów (opoka).

REMARKS: This species is common in marly opoka of the Belemnella kazimirovensis 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 Atrella ÉTALLON, 1862
Type species: Ostrea blandina d'ORBIGNY, 1850;
SD COX, 1964
Atrella nilssonii (v. HAGENOW, 1842)
(Pl. 36, Figs 1—3)

1861. Dimyodon Nilssonii v. HAGENOW sp.; J. ROEM, p. 85, Pl. 4, Fig. 7.
1902. Dimyodon Nilssonii HAGENOW sp.; WOLLEMBRANN, p. 83.
1911) Dimyodon Nilssonii HAG.; ROGALIA, p. 662.
1932. Dimyodon nilssonii v. HAGENOW; WOLANSKY, p. 24, Pl. 3, Fig. 22.
1955. Dimyodon nilssonii v. HAGENOW; FUGACZEWSKA, p. 55, Pl. 13, Figs 2—3 (note Fig. 4).
1955a. Dimyodon nilssonii (v. HAGENOW); NESTLER, pp. 87—89, Pl. 1, Fig. 7; Pl. 3, Figs 1—
1972. Atrella nilssonii (HAGENOW); CARTER, p. 332, Pl. 1, Fig. 11.
1972. Dimyodon nilssonii (v. HAGENOW); NESTLER, p. 45, Fig. 67.
1982. Dimyodon nilssonii (v. HAGENOW); DHONDT, p. 67, Pl. 2, Fig. 10.
1985. Atrella nilssonii (v. HAGENOW); SKELTON, p. 31, Pl. 6, 4. 33.

MATERIAL: 1 from Piotrawin (uppermost Campanian), 1 from Dziurków, 7 from Kazimierz, 2 from Nasłów (2 opoka, 3 greensand).

REMARKS: The studied specimens coincide in shape and size with those from the Maastrichtian stratotype, the Isle of Rügen, Hemmnoor; English Chalk, as figured by VOGEL (1865), WOLANSKY (1932), DHONDT (1852), and WOODS (1905), respectively. All the collected specimens are right valves attached to the belemnite guards, oysters, echinoids, becullites, pectinids and other shells.
The confusion in identification of this species with small juvenile oysters was discussed by Woods (1865) and Nestler (1965a).

The genus *Aetra* ÉTALLON resembles *Dimyodon* MUNIER-CHALMAS in having crenulated rim and the hinge structure, but the latter has two adductor scars whilst *Aetra* has one obscure scar (Cox 1964). Tashiro (1978) described *Aetra imitlaevus* 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 *Aetra* under the Placatulidae.

AGE and DISTRIBUTION: Albain — 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 **Limaecae** RAINÉSQUE, 1815
Family **Limaecidae** RAINÉSQUE, 1815
Genus **Limaecula** WOODS, 1839
Type species: *Pecten subauriculatus* MONTAGU, 1808;
*SD GRAY, 1847*
**Limaecula kunradensis** MARQUET, 1982
(Pl. 35, Fig. 10)

1982. *Limaecula kunradensis* n. sp., MARQUET, pp. 19–22, pl. 1, figs 1a–d.

**MATERIAL:** 9 from Plotznia (uppermost Campanian), 1 from Dolurków, 2 from Klučné,
11 from Kazimierz, 40 from Nasidów (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.

**Limaecula ovata** (NILSSON, 1827)
(Pl. 35, Fig. 11)

1827. *Placostoma ovatum* NILSSON, p. 25, pl. 2, fig. 2.
1827. *Lima ovata* NILSSON; HENNING, p. 47, pl. 2, fig. 12.

**MATERIAL:** 3 from Kazimierz, 9 from Nasidów (6 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 identical with that of *Limaecula ovata* (NILSSON).

AGE and DISTRIBUTION: Upper Campanian of Sweden, and uppermost Maastrichtian of the Middle Vistula Valley.

Genus **Limaecula** BRONN, 1831
Type species: *Ostrea striigilata* BROCHI, 1814; *M*
Subgenus **Limaecula** BRONN, 1831
**Limaecula geinitzi** (v. HAGENOW, 1842)
(Pl. 35, Figs 8–9)
REMARKS: The species was reported from the Upper Campanian of the study area by ŁOPUSKI (1912).

The generic assignment of this species is a matter of discussion by the previous investigators, who assigned it either to Lima, Lina, Limatula, or to Pseudolimea. However, Lima BRONN is accepted herein for "Lima" getintzi 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 Lycov 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)

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 CIESLIŃSKI (1955b) considered Lima pseudocardium REUSS as a synonym of this species, although these two species, similar in shape, are different 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 form 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*) acutepicatus (ALTH); Nasilów opoka (1a, 1b external and internal views of RV; 2 and 3 external view of LV), ×1

4-5 — *Chlamys* (*Lyriochlamys*) *septemplicata* (NILSSON); Nasilów 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*) putchellus (NILSSON); 8 from Nasilów 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 Kaximierz; 2 shell fragment from Nasilów opoka

3-6 — *Mimachlamys cretosa denticulata* (v. HAGENOW); 3–4 from Nasilów opoka (3 incomplete LV, 4 internal view of RV), 5 from Kaximierz (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 Chelem 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 nilssonii* (v. HAGENOW); 1–2 from Nasilów opoka (*ta*, *tb* internal and *1b*, *2b* external views of RV), *3* juvenile RV attached to oyster shell from Nasilów greensand, × 1
4–7 — *Placunopsis granulosa* (ROEMER); 4–5 from Kazimierz, 6–7 from Nasilów opoka, RV, × 1
8–9 — *Lithoceras genitsi* (v. HAGENOW); Nasilów opoka (*8* external, *9* internal views of LV), *8* is × 3, *9* is × 2
10 — *Limatula kunradensis* MARQUET; steinkern from Nasilów opoka, × 1
11a–11b — *Limatula ovata* (NILSSON); Nasilów opoka (*11a* fragment of shell, × 1; *11b* sculpture, × 4)
1–3 — *Pseudolittorina* (?) *granulata* (NILSSON), 1 steinkern from Kazimierz, × 1; 2 fragment of shell showing sculpture from Nasilów opoka, × 2; 3 from Kazimierz (internal view), × 2

4–7 — *Ctenoidea* *dunkeri* (v. HAGENOW); 4 from Nasilów opoka (incomplete), × 2; 5 steinkern from Nasilów opoka (RV), × 1; 6–7 shell fragments (sculpture) from opoka, × 4

8 — *Plagiostoma hopeni* MANTELL; Nasilów opoka (LV), × 1; note color bands

9 — *Plagiostoma* *cretaeae* (WOODS); Nasilów opoka (incomplete), × 1

10a–10b — *Hyottia* *semiplanum* (SOWERBY); Bochnianka (10a external 10b internal views of LV), × 1
1-3 — Gryphaeostrea canaliculata (SOWERBY); Nasilow 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 — Fycnodonte (Phygraeae) vesicular (LAMARCK); Nasilow 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 — Pyemodonte (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 Bocholina hardground, 2 from Cisyka Kolonia, ×2

3-4 — *Granocardium (Granocardium) glutacium* (v. MÜNSTER); 4 steinkern from Nasilów hardground, ×1; 3 from Kazimierz (fragment of external mold, showing sculpture), ×2

5 — *Venericardia santonensis* G. MÜLLER; steinkern from Nasilów opoka, ×1

6-7 — *Granocardium (Criocardium) productum* (SOWERBY); Kazimierz (6 sculpture, 7 external mold)

8a-8b — *Granocardium (Granocardium) aff. pustulosum* (v. MÜNSTER); Nasilów opoka (anterior and LV views)

9a-9b — *Nemocardium (Nemocardium) fenestratum* (KNER); Kazimierz (anterior and LV views), ×1

10 — *Pleuriocardia (Pleuriocardia) noeggerathi* (J. MÜLLER); Nasilów 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)

1832. Plagiostoma Hoperi MANTELL, pp. 284—286; Pl. 26, Figs 3, 8, 15.
1889. Lima Hoperi F. ROEMER; SKIMIRADZKI, pp. 89—89, Pl. 5, Fig. 7.
1894. Lima (Plagiostoma) Hoperi MANTELL; WOODS, pp. 17—22, Pl. 4, Figs 1—12 (cum syn.).
1912. Lima (Plagiostoma) Hoperi MANTELL; LOPUSKI, p. 197, Pl. 1, Fig. 26.
1922. Lima (Plagiostoma) Hoperi MANTELL; WOLANSKI, p. 29, Pl. 3, Fig. 2.
1923. Lima hoperi MANTELL; POZARYSKI, p. 21.
1951. Lima hoperi MANTELL; POZARYSKA & POZARYSKI, p. 21, Pl. 7, Fig. 8.
1968. Lima (Plagiostoma) hoperi hoperi (MANTELL); PASTERNAK, pp. 179—180, Pl. 17, Figs 2—3.
1974. Lima hoperi MANTELL; SAVCZINSKAJA, p. 33, Pl. 25, Fig. 11.
1977. Plagiostoma hoperi MANTELL; SOBETSKI, p. 101, Pl. 6, Fig. 13.
1981. Plagiostoma hoperi MANTELL; TZANKOV, p. 118, Pl. 51, Fig. 5.
1985. Lima (Plagiostoma) hoperi MANTELL; NESTLER, p. 86, Fig. 50.
1985. Plagiostoma hoperi MANTELL; DEJONG, p. 89, Pl. 4, Fig. 1.
1985. Plagiostoma hoperi MANTELL; BOBETSKI, p. 124, Pl. 12, Fig. 8; Pl. 52, Figs 1—3.

MATERIAL: 1 from Sošec, 1 from Dobrc, 2 from Podgora, 4 from Męcinierz, 3 from Kazimierz, 1 from Janowiec, 1 from Bochotnica, 9 from Naśliw (49 opoka, 3 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 Belemneena kazimiroviensis Zone. ŁOJUSKI (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 (POZARYSKI 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. 23—23, Pl. 4, Figs 13—15; Pl. 5, Figs 1—4.
1905. Lima (Lima?) cretacea WOODS; PASTERNAK, p. 179, Pl. 25, Fig. 17.
1974. Lima cretacea WOODS; SAVCZINSKAJA, p. 95, Pl. 51, Figs 6—8.
1977. Plagiostoma cretaceum WOODS; SOBETSKI, p. 102, Pl. 6, Fig. 19.
1981. Lima cretacea WOODS; TZANKOV, p. 113, Pl. 51, Fig. 3—4.

MATERIAL: 3 from Kazimierz, 37 from Naśliw (38 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. 250 (39).
1868. Lima (Radula) Dunkeri HAG., VOGEL, p. 17, Pl. 1, Fig. 8.
1892. Lima Dunkeri v. HAGENOW; RAYN, p. 140, Pl. 2, Fig. 14.
1892. Lima (Pliagnostoma) Dunkeri v. HAGENOW; ŁOPUSKI, p. 190, Pl. 1, Fig. 11.
1892. Lima (Radula) dunkeri v. HAGENOW; WOLANSKY, p. 20, Pl. 3, Fig. 8.
(1893) Lima dunkeri HAG.; POŻARSKA, p. 21.
(1893) Lima dunkeri HAG.; PUTZER, p. 371.
(1893) Lima dunkeri HAG.; POŻARSKA & POŻARSKY, p. 31.
1898. Lima (Limæ) dunkeri HAGENOW; PASTERNAK, p. 178, Pl. 97, Figs 1—2.
1977. Pliagnostoma dunkeri (HAGENOW); SOBIESKI, p. 194, Pl. 6, Fig. 20.

MATERIAL: 1 from Sołeć, 1 from Podgórze, 27 from Kazimierz, 6 from Nasłówek (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 spaced 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 Ostreaea RAFINÉSQUE, 1815
Family Gryphaeidae VYALOV, 1936
Subfamily Pycnodontaæ des WALDHEIM, 1835
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 vesiculare LAM.; NILSSON, p. 28, Pl. 7, Figs 3—5; Pl. 8, Figs 5—6.
1837. Gryphaea dilatata SOW.; PUSCH, p. 54 (non SOWERBY).
1913. Ostrea vesiculare LAMARCK; WOODS, pp. 354—974, Text-figs 143—142 and Pl. 55,
Figs 4—6 (eum sym.).
1921. Ostrea vesiculare LAM.; KRACH, p. 367, Pl. 5, Fig. 2.
(1835) Ostrea vesiculare LAM.; POŻARSKA, p. 21.
(1842) Gryphaea dilatata SOW.; PUTZER, p. 372.
1931. Ostrea vesiculare LAM.; POŻARSKA & POŻARSKY, p. 21, Pl. 8, Fig. 16.
1959. Gryphaea vesicularea (LAMARCK; IVANOVA, p. 232, Pl. 11, Figs 1—2.
1969. Pycnodonta vesiculare (LAMARCK); NEISTERL, pp. 45—86, Pl. 1, Figs 1—6; Pl. 2, Figs 1—5.
1974. Gryphaea vesicularea (LAMARCK); SAVCZENKOWA, p. 103, Pl. 25, Fig. 3.
1977. Pycnodonte (Phygraea) vesiculare (LAMARCK); PUGACZEWSKA, p. 194, Pl. 13, Figs 3—43 (non Fig. 7).
1977. Pycnodonte (Phygraea) bifurcata (LAMARCK); PUGACZEWSKA, p. 195, Pl. 11, Figs 3—9 (non LAMARCK).
1977. Pycnodonte vesiculare (LAMARCK); SOBIESKI, p. 145, Pl. 11, Figs 7—9.
MATERIAL: 70 from Upper Campanian opoka (26 from Clamysa Kolonia, 19 from Clamysa Górná, 25 from Plotrawn), 2 from Męśmiers, 40 from Kazimierz, 10 from Bochota, 10 from Naślów (60 opoka, 10 hardground, 50 greensand); (65 specimens taken from the KONIEZ'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 attachment surface. Some shells have elongate xenomorphic area parallel to the hinge line and acquire their anterior auricle-like. Such shell were erroneously attributed to Pycnodonte bivauriculatum (LAMARCK) by PUGACZEWSKA (1977) and TZANKOV (1981) from the Maastrichtian deposits of the study area and Bulgaria, respectively. Moreover, DHOND'T (1984) concluded that P. (Pycnodonte) bivauriculatum (LAMARCK) is widely distributed mainly along the northern Tethys, stratigraphically restricted to the low-Late Cenomanian, displaying no attachment surface an which presumably lived unattached all its life, being floated on fine substrate (recliner). DHOND'T added that this species suddenly disappeared and was replaced by Rhynchostrea suborbiculatum (LAMARCK).

WOLANSKY (1982) and NESTLER (1985a) considered Ostrea 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 Gryphae left valve, a more curved elevated umbro, 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 POZARSKA & POZARSKI 1951) in the overlying younger Paleocene strata (Swak). Therefore, the stratotype of Gryphaea similis PUSCH is the Lower Paleocene (Swak) not "Kreidemargel" (opoka) as stated by PUSCH (1837).

AGE and DISTRIBUTION: Cosmopolitan 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. 97, Pl. 496, Figs 1–8.

1877. Ostrea semiplana SOW.; HENNIG, p. 5, Pl. 1, Figs 1–14, 15, 16, 19.


1931. Ostrea semiplana SOW.; KRACH, p. 368, Pl. 7, Figs 9, 9a

(1933) Ostrea semiplana SOW.; POZARSKI, p. 21.

1931. Ostrea semiplana SOW.; POZARSKA & POZARSKI, p. 21, Pl. 8, Fig. 13.

1982. Lophia semiplana (SOWERBY); IVANOVA, p. 326, Pl. 13, Figs 1–6.


1977. Hyotissa semiplana (SOWERBY); PUGACZEWSKA, p. 184, Pl. 12, Figs 4–5.

1981. Lophia semiplana (SOWERBY); TZANKOV, p. 124, Pl. 68, Figs 1–2.
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1981. Ostrea semiplana SOWERBY; KRACH, p. 34, Pl. 3, Fig. 1.
1982. Hyottisa semiplana (SOWERBY); NESTLER, p. 44, Fig. 86.
1983. Lopha semiplana (SOWERBY); SOBETSKI, p. 177, Pl. 14, Fig. 1; Pl. 22, Fig. 7.

MATERIAL: 1 from Dukrów, 3 from Krudzie, 1 from Kaszmirz, 1 from Bochnimica, 15 from Nasłów (5 opoka, 1 hardground, 8 greensand).

REMARKS: PUGACZEWSKA (1977) described Hyottisa armata (GOLDFUSS) from the Nasłów quarry, as 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) fail 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 Hyottisa 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 Gryphaeoestrea CONRAD, 1865
Type species: Gryphaea eversa MELLEVILLE, 1843; M Gryphaeoestrea canaliculata (SOWERBY, 1813)
(Pl. 38, Figs 1–3)

1913. Chama canaliculata SOWERBY, Vol. 1, p. 23, Pl. 20, Fig. 1.
1927. Ostrea lateralis n., NILSSON; FUSCH, p. 25.
1915. Ostrea canalicleata (SOWERBY); WOODS, p. 275, Pl. 55, Figs 2–10 (cum syn.).
1931. Ostrea canalicleata SOW.; KRACH, p. 366, Pl. 7, Figs 6–8.
1934. Ostrea canalicleata SOW.; ANDERT, p. 183, Pl. 10, Figs 7–8.
1935. Ostrea canalicleata SOW.; POZARYNSKI, p. 21.
1951. Ostrea canalicleata SOW.; POZARYNSKI & POZARYNSKI, p. 21, Pl. 8, Fig. 15.
1964. Ostrea canalicleata (SOWERBY); HÄGG, p. 43.
1966. Amphidonta (Gryphaeoestrea) lateralis (NILSSON); SYANOVA, p. 344, Pl. 19, Fig. 5.
1981. Gryphaeoestrea canalicleata (SOWERBY); TZANKOV, p. 132, Pl. 60, Figs 1–4.
1982. Gryphaeoestrea canalicleata (SOWERBY); SOBETSKI, p. 138, Pl. 13, Fig. 16; Pl. 22, Fig. 4.
1983. Gryphaeoestrea canalicleata (SOWERBY); SOBETSKI, p. 140, Pl. 14, Fig. 2; Pl. 15, Fig. 5.

MATERIAL: 8 from Kaszmirz, 74 from Nasłów (43 opoka, 30 greensand); 39 from the PUGACZEWSKA's Collection, 20 from the KONIGEL's Collection.

REMARKS: The species was described by KRACH (1931) and PUGACZEWSKA (1977) from the studied sections. The former authors correctly attributed their material from Nasłów to the North America species Gryphaeoestrea vomer STEPHEHISON, 1941, and she neglected the famous European species Gryphaeoestrea canalicleata (SOWERBY, 1813), and G. lateralis (NILSSON, 1827). Indeed, there is
no distinct morphological difference between these three species, and the European species *G. canaliculata* has the priority. POZARYSKI (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 Actoostrea VYALOV, 1936**

**Type species**: *Ostrea acutirostris NILSSON, 1827; OD* *Actoostrea incurva* (NILSSON, 1827)

(Pl. 38, Fig. 4 and Pl. 39, Fig. 8)

1827. *Ostrea incurva* NILSSON; p. 38, Pl. 7, Figs 6a, b.
1902. *Ostrea incurva* NILSSON; RAVN, p. 113, Pl. 3, Fig. 4.
1908. *Ostrea incurva* NILSSON; ROGALA, p. 691.
(1911) *Ostrea incurva* NILSSON; ROGALA, p. 494.
1913. *Ostrea incurva* NILSSON; WOODS, p. 395, Pl. 50, Figs 10—13, Pl. 50.
(1936) *Ostrea incurva* NILSSON; POZARYSKI, p. 22.
1939. *Lanostrea incurva* (NILSSON); IVANOVA, p. 356, Pl. 10, Fig. 4.

**MATERIAL**: 4 from Płotrawin (uppermost Campanian), 3 from Dźwirżów, 3 from Kłodzie, 1 from Dobrze, 3 from Kazimierz.

**REMARKS**: The studied specimens are medium- to large-sized, have elongate — spatulate shells with acute and curved umbones. The shell is more thicker in the umbonal part and gradually thinner toward the ventral commissural shelf.

POZARYSKI (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. *Agerostrea lunata* NILSSON; WOODS, pp. 395—396, Pl. 60, Figs 16—18; Pl. 61, Figs 1—4.
1982. *Agerostrea lunata* (NILSSON); SOBETSKI, p. 127, Pl. 15, Fig. 7.

**MATERIAL**: 3 from Płotrawin (uppermost Campanian), 1 from Sołeć, 3 from Naśliw (greensand; the PUGACZEWSKA's Collectlon).

**REMARKS**: The studied specimens from the ophoka and greensand of the study area (see PUGACZEWSKA 1977) agree with those figured by WOODS (1913), ZAVCZINSKAJA (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 NILSSON (1827) and GOLDFUSS (1833) from the arenaceous facies of Åhus sandstone (Scania, Sweden) and St. Petersburg (Maastricht, the Netherlands) in having a distinct posterior auricle as well as small and numerous commissural plications. Moreover, the specimens figured by NILSSON (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.
1861. Lucina subnumismalis D’ORB.; BÖHM, p. 73, Pl. 2, Fig. 8.
1886. Lucina subnumismalis D’ORB.; G. MÜLLER, p. 29, Text-fig. 17.
1920. Lucina subnumismalis d’ORBIGNY; RAVN, p. 129, Pl. 4, Fig. 31.
1939. Lucina subnumismalis d’ORB.; ROGALA, p. 398.
1941. Lucina subnumismalis d’ORB.; ROGALA, p. 492.
1951. Lucina subnumismalis d’ORB.; KRACH, p. 388, Pl. 7, Fig. 3.
1955. Lucina subnumismalis (d’ORBIGNY); HÄGG, p. 46, Pl. 6, Figs 12–15.
1964. Lucina subnumismalis (d’ORBIGNY); HÄGG, p. 45.
1977. Lucina subnumismalis ORBIGNY; SOBETSKI, p. 111, Pl. 15, Fig. 17.

MATERIAL: 5 from Kasimierz, 5 from Naślówek (opoka).

REMARKS: The studied specimens agree with those described by J. MÜLLER (1851), HOLZAPFEL (1859), BÖHM (1891). KRACH (1931) described one specimen of this species from the opoka exposed at Plotrawin (uppermost Campanian) of the study area.

AGE and DISTRIBUTION: Senonian of West Germany; Upper Senonian of the Netherlands, Sweden and the Low 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 5, 15.
1850. Venus laminosa d’ORBIGNY, p. 287.
1853. Venus laminosa REUSS; FRIC, p. 97, Text-figs 17–17a.
1856a Lucina laminosa REUSS; CIEŚLIŃSKI, p. 123.
1837. Lucina laminosa (REUSS); SOBETSKI, p. 172, Pl. 15, Fig. 12.

MATERIAL: 2 from Dziurków, 3 from Kasimierz, 6 from Naślówek (opoka).

REMARKS: The species can be easily distinguished from Lucina subnumismalis d’ORBIGNY by its higher posterodorsal part and the finer concentric ornamentation. The species is closely similar to L. tenera (SOWERBY), described by WOODS (1904) from the Albion of England, in its general form and ornamentation.
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

AGE and DISTRIBUTION: Upper Turonian — Lower Senonian of Bohemia, Maas-
trichian of Crimea and the Middle Vistula Valley; recorded also (CIEŚLINSKI
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)

1885. Fimbria coarctata ZITTEL, p. 44, Pl. 7, Fig. 5.
1890. Mutiella coarctata ZITTT.; G. MÜLLER, p. 66, Pl. 8, Fig. 6; Pl. 11, Figs 1—3.
1909. Mutiella coarctata ZITTT. sp.; ROGALA, p. 785, Pl. 29, Fig. 4.
(1911) Mutiella coarctata ZITTT.; ROGALA, p. 492.
1934. Mutiella coarctata ZITTT.; ANDERT, p. 232, Pl. 12, Figs 4—5.
(1936) Mutiella coarctata ZITTT.; POZARYSKZ, p. 22.
(1940) Mutiella coarctata ZITTT.; PUTZER, p. 371.
1941. Mutiella coarctata (ZITTEL); TZANKOV, p. 125, Pl. 68, Fig. 11; Pl. 67, Fig. 1.

MATERIAL: 1 from Mećmierz, 27 from Kazmlerz, 65 from Nasłów (30 opoka, 15 hard-
ground).

REMARKS: The species is closely allied to Mutiella rotundata (d'ORBIGNY)
from the Cenomanian — Lower Turonian of France, but the latter differs in hav-
ing a higher shell and fine reticulate ornamentation.

In the study area, the species is predominant in the uppermost part of the Belemnella kasimiroviensis Zone, particularly in the Nasłów section.

AGE and DISTRIBUTION: Middle Turonian — Lower Senonian of Bohemia, Lo-
wier Senonian of West Germany, Santonian — Maastrichtian of Bulgaria, Upper
Senonian of Austria and the Lvov region, Upper Maastrichtian of the Middle Vis-
tula 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. 123, Pl. 124, Fig. 22.
1852. Astarte similis v. MÜNSTER; PLACHETKO, p. 17, Pl. 1, Fig. 14.
1853. Astarte similis v. MÜNSTER; ZITTEL, p. 25, Pl. 9, Fig. 6.
1856. Astarte similis MÜNSTER; FAYRE, p. 116, Pl. 12, Fig. 7.
1864. Astarte similis MÜNSTER; ANDERT, p. 243, Pl. 11, Fig. 44.
1865. Astarte similis MÜNSTER; HÜG, p. 44, Pl. 6, Fig. 5.
(1830) Astarte similis MAN.; POZARYSKZ, p. 22.
1845. Astarte similis MÜNSTER; VAN DER WEIJDEN, p. 43, Pl. 2, Figs 12—13.
1877. Astarte similis MÜNSTER; SOBIESKI, p. 186, Pl. 18, Fig. 7.
1891. Astarte (Astarte) similis MÜNSTER; TZANKOV, p. 134, Pl. 67, Fig. 2.

MATERIAL: 1 from Czycya Kolonia (Upper Campanian), 2 from Kazmlerz, 1 from Bo-
chotnica (hardground), 1 from Nasłów (1 opoka, 1 hardground).
REMARKS: The studied specimens are small, with triangle shells, ornamented with 4-8 rounded concentric undulations which are covered by fine growth lines. They agree with those figured by the previous investigators. POZARSKY (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. 65, Pl. 7, Figs 8a—b.
(1842) Isocardia ventricosa PUSCH; PUTZER, p. 372.

MATERIAL: 12 from Kazimierz, 4 from Bochotnica, 33 from Nasilów (15 opoka, 18 hard-ground).

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 GRIEPEKNERL, 1889, from the Lower Campanian of Königsruh, 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)

1909. Venericardia santonensis G. MÜLLER; ROGALA, p. 690, Pl. 26, Fig. 16.
(1911) Venericardia santonensis G. MULL.; ROGALA, p. 492.
1917. Venericardia santonensis MÜLLER; SOBETSKI, p. 193, Pl. 15, Figs 15—16.

MATERIAL: 8 from Ciżycia Góra (Upper Campanian), 2 from Dżurków, 1 from Kazimierz, 9 from Nasilów (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 Lyov region, respectively.

The species is closely allied to Venericardia bohemia (GRIEPEKNERL) 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 Albion of England in general form and numerous radial ribs.

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

Superfamily Cardiacea LAMARCK, 1809
Family Cardiidae LAMARCK, 1809
Subfamily Cardinaceae 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.
1888. Cardium alutacium MÜNSTER; FRIČ, p. 77, Text-fig. 55.
1890. Cardium alutacium v. MÜNSTER; GRIEPENKERL, p. 63.
1897. Cardium alutacium MÜNST.; FRIČ, p. 82.
1913. Cardium alutacium MÜNSTER; FRIČ, p. 21, Text-fig. 133.
(1838) Cardium alutacium GOLDF.; POZARYSKI, p. 22.
(1942) Cardium alutacium GOLDF.; PUTZER, p. 371.

MATERIAL: 9 from Kaszimierz, 12 from Nasilów (5 opoka, 7 hardground).

REMARKS: The studied specimens are identified with that figured by GOLDFUSS (1838) 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 cardids 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 Kaszimierz, 5 from Nasilów (opoka).

REMARKS: The studied specimens are closely similar in general features to "Cardium" pustulosum v. MÜNSTER (see GOLDFUSS 1838, p. 221, Pl. 144, Fig. 6a-b) from the Coniacian deposits of Postelberg (Czechoslovakia), but the latter possesses distinctly 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 5—7)

1844. Cardium productum SOWERBY; d’ORBIGNY, p. 31, Pl. 247.

MATERIAL: 1 from Podgórze, 11 from Kaszimierz, 3 from Nasilów (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 (1886). The latter specimens are ornamented with single rows of small and equal spines alternated with smooth radial ribs. This difference 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 (1976), 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" costalatinum d'ORBIGNY (Neocomian) undoubtedly belong to 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.
1877. Cardium Noeggerathi JOS. MULL.; FRECH, p. 183.
1896. Cardium Noeggerathi J. MULL.; G. MÜLLER, p. 61, Pl. 9, Figs 5—6.
1894. Cardium nöggerathi J. MULL.; ANDERT, p. 381, Pl. 11, Fig. 19.
(1893) Cardium noeggerathi MULL.; POŻARSKI, p. 22.
(1943) Cardium noeggerathi MULL.; PUTZER, p. 11.
1943. Cardium nöggerathi J. MÜLLER; VAN DER WELDEN, p. 82, Pl. 2, Fig. 22.

MATERIAL: 7 from Nasłów (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 Pleurocaridaca costalatinum (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.
1860. Cardium poloniolum ALTH, p. 327, Pl. 12, Fig. 3.
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1899. Cardium fenestratum M., KNER, p. 30, Pl. 2, Fig. 22.
1899. Cardium fenestratum KNER; FAVRE, p. 114, Pl. 2, Fig. 6.
1899. Cardium (Protocardium) fenestratum KNER; GRIEPENKERL, p. 61.
(1811) Proto cardium fenestratum KNER; ROGALA, p. 494.
(1838) Cardium fenestratum KNER; POZARYSKI, p. 21.
(1851) Cardium fenestratum KNER; POZARYSKA & POZARYSKI, p. 28.
1917. Granocardium fenestratum (KNER); SOBETSKI, p. 185, Pl. 16, Fig. 4.

MATERIAL: 5 from Piotrowin (uppermost Campanian), 1 from Dobre, 3 from Miętłiers, 31 from Kadmierz, 1 from Janowiec, 40 from Nasilów (opoka, 8 hardground).

REMARKS: The genus Nemocardium MEIK is accepted herein for the studied species, which carries the main diagnosis of the genus, particularly the ornamentation (numerous radial ribs less distinct on the posterior part and crossed by fine concentric growth lines).

The species “Cardium” subalutatum 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. POZARYSKI (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 (?) kulczyński ROGALA, 1911
(Pl. 41, Figs 1—2)

1911. Cultellus (?) kulczyński nov. sp.; ROGALA, p. 496, Fig. 4.
MATERIAL: 1 from Podgórz, 23 from Kadmierz, 8 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 bipplicata CONRAD, 1858; M
Leptosolen concentristriatus (G. MÜLLER, 1888)
(Pl. 41, Figs 3—4)

1888. Siliquaria concentristriata G. MÜLLER, p. 431, Pl. 18, Fig. 5.
1892. Siliquaria concentristriata G. MÜLLER; G. MÜLLER, p. 76, Pl. 13, Fig. 5.
1911. Leptosolen concentristriatus G. MÜLLER; ROGALA, p. 495, Fig. 5.
† 1851. Leptosolen Peteri KRUS; KRUSCH, p. 205, Pl. 7, Fig. 4.
MATERIAL: † from Kadmierz, 1 from Janowiec, 2 from Nasilów (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 (1889) 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 peteri (REUSS) and most probably related.

AGE and DISTRIBUTION: Lower Senonian of West Germany, Upper Senonian of the Lvov region, and uppermost Maastrichtian 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 Lithothyris CONRAD in KEER, 1875
Type species: Linearia (Lithothyris) carolinensis CONRAD, 1875; M
Linearia (Lithothyris) gorbatschae SOBETSKI, 1977
(Pl. 41, Fig. 10)

1977. Linearia (Lithothyris) gorbatschae SOBETSKI, p. 178, Pl. 15, Figs 23–34.
MATERIAL: One specimen from Bochotnica (hardground).

REMARKS: The studied specimen is stained by limonitic material, but its general features as well as concentric ornamentation coincide with those of Linearia (Lithothyris) 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 parialis CONRAD, 1860; M
Tenea cf. ovalis SOBETSKI, 1977
(Pl. 41, Figs 5–6)

cf. 1977. Tenea ovalis n. sp., SOBETSKI, p. 292, Pl. 17, Fig. 6.
MATERIAL: 1 from Dobre, 81 from Kazimierz, 20 from Nasilów (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 Nasilów (opoka).
REMARKS: The studied specimen closely resembles *Venulocardia ventriculi* BOSQUET) from the Campanian greensand of Aachen, as figured by HOLZAPFEL (1898, Pl. 16, Figs. 1–5), but it differs in having the gently curved posterior and subrounded posterior margin. The studied specimen shows also many similarities 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. *Crassestella trapezoidalis* N. ROEMER, p. 74, Pl. 9, Fig. 22.
1904. *Trapezium trapezoidale* (ROEMER); WOODS, pp. 169–180, Pl. 23, Figs. 17–19 (c.f. syn.).
1913. *Cypricardia trapezoidalis* A. ROEM.; SCUFIN, p. 164, Pl. 7, Fig. 5.
1913. *Trapezium trapezoidale* ROEM.; WOLDIRSCH, p. 294, Pl. 8, Fig. 6.
1933. *Cypricardia trapezoidalis* A. ROEMER; WOLANSK, p. 21, Pl. 3, Figs. 18–32a.
1895. *Cypricardia trapezoidalis* ROEM.; POZARYSKI, p. 32.
1939. *Cypricardia trapezoides* ROEM.; PUTZER, p. 271.
1951. *Trapezium trapezoides* ROEM.; POZARYSKA & POZARYSKI, p. 21, Pl. 7, Fig. 7.
1960. *Cypricardia* (Trapezium) *trapezoidalis* (ROEMER); CIEŚLINSKI, p. 25, Pl. 2, Fig. 3.

MATERIAL: 1 from Podgora, 2 from Mączniers, 31 from Kashmir, 15 from Nastów (13 opoka, 2 hardground).

REMARKS: Most of the studied specimens were affected by the plastic deformation. POZARYSKI (1939) recorded this species in the Upper Campanian — Upper Maastrichtian, and CIEŚLINSKI (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 RAFINESQUE, 1815
Family Veneridae RAFINESQUE, 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)

1915. Venus *fragilis* d'ORBIGNY, p. 446, Pl. 368, Figs 11–12.
1939. *Tapes fragilis* d'ORBIGNY; ZETTEL, p. 16, Pl. 8, Fig. 3.
1939. *Tapes fragilis* d'ORBIGNY; HOLZAPFEL, p. 154, Pl. 15, Fig. 6.
1911. *Venus (Tapes) fragilis* d'ORB.; STUREN, p. 13, Pl. 7, Fig. 8.
1915. *Tapes (Baroda) fragilis* d'ORBIGNY; PERVINQUIERE, p. 277, Pl. 20, Fig. 10.
1934. *Tapes fragilis* d'ORB.; BLANCKENHORN, p. 266.
1941. *Legumen fragilis* (d'ORBIGNY); TZNANKOV, p. 143, Pl. 70, Fig. 4.

MATERIAL: 2 from Kazimierz, 9 from Nasów (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 Nasilów (opoka). They are of small, rostrostrated 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 Hiatellesca 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)

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 RAFINÉSQUE, 1815
Teredinid tubes
(Pl. 43, Fig. 4)

1841. Succinodon putzeri: v. HUENE, pp. 65—61, Fig. 1.
(1842) Succinodon putzeri v. HUENE; PUTZER, p. 370.
1881. Kuphus sp.: POZARYScka & PUGACZEWSKA, pp. 30—31, Pl. 2, Figs 1—7 and Pl. 4, Figs 1—3.

MATERIAL: 1 from Dęblinów, 1 from Kazmierz.

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 (1841) as remains teeth a titanosaurid dinosaur (sic!), called by him as "Succinodon putzeri HUENE" (see also PUTZER 1942). POZARYSCKA & PUGACZEWSKA (1981) described these tubes with preserved pallets (which they called "the septa") from Bochotnica and Nasłów greensands, and attributed them to the bivalve genus Kuphus.

It is to note that TURNER (1869) 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 RADWANSKI (1977).

AGE and DISTRIBUTION: Maastrichtian of the Middle Vistula Valley (not Montian as given by POZARYSKA & PUGACZEWSKA 1981).

Order Hippuritoida NEWELL, 1965
Superfamily Hippuritacea GRAY, 1848
Family Monopleuridae MUNIER-CHALMAS, 1873
Genus Gyropleura DOUVILLE, 1887
Type species: Requienia cenomanensis d'ORBIGNY 1850; OD Gyropleura inequirostrata (WOODWARD, 1833)
(Pl. 42, Figs 5—7)

1838. Caprothina rufinaensis d'ORB.; STEMIRADZKI, pp. 63—63, Pl. 4, Fig. 1.
1838. Gyropleura inequirostrata (WOODWARD); WOODS, p. 209, Pl. 33, Figs 8—12.
1838. Gyropleura inequirostrata WOODWARD; KRACH, p. 327, Pl. 7, Figs 2, 1a—b.
(1848) Gyropleura inequirostrata WOODW.; POZARYSKI, p. 21.
(1848) Gyropleura inequirostrata WOODW.; PUTZER, p. 37a.
1838. Gyropleura inequirostrata WOODW.; POZARYScka & POZARYSck, p. 23, Pl. 7, Fig. 5.
1865. Pycnochorda sp. PUGACZEWSKA, pp. 89—90, Pl. 12, Fig. 1.
1874. Gyropleura inequirostrata (WOODWARD); SAVČENSKAJA, p. 110, Pl. 46, Figs 6—17.

MATERIAL: 1 from Męcisław, 85 from Kazmierz, 3 from Janowice, 1 from Bochotnica, 34 from Nasłów (60 cępka, 8 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 Nasilów and Bochotnica opoka) to Gyroplicaeus 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. munsteri (v. HAGENOW) from the Isle of Rügen and Denmark, G. ciplyana (de RYCKHOLT) from France and Limburg, G. costulata (J. MÜLLER) from Aschen and Maastricht, G. moritzi (STROMBECK) from Königsultr, West Germany, G. russenstis (d'ORBIGNY) from the Russian Platform, G. laevis HOLZAPFEL from Aschen, and G. lomtciikii RUGALA from the Lvoiv region. The species munsteri, costulata, moritzi were considered as synonyms of G. ciplyana by HOLZAPFEL (1889), WOLLEMMANN (1902), and WOŁANSKY (1832). MORRIS (1854; vide WOODS 1906) listed G. russenstis as a synonym of G. inequirostrata.

The species G. laevis HOLZAPFEL and G. lomtciikii RUGALA 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 Pholadoma G. B. SOWERBY, 1823
Type species: Pholadoma candia SOWERBY, 1823;
SD GRAY, 1847
Subgenus Pholadoma G. B. SOWERBY, 1823
Pholadoma (Pholadoma) kastmiri PUSCH, 1837
(Pl. 45, Figs 3—4 and Pl. 46, Figs 4—5)
1887. Pholadoma Kastmiri m., PUSCH, p. 88, Pl. 8, Fig. 12.
1888. Pholadoma Esmarkii PUSCH; GOLDFUSS, p. 226, Pl. 197, Fig. 10a—d.
1892. Pholadoma Casimirii PUSCH ?; ALTH, p. 277.
1893. Pholadoma Casimirii PUSCH; PLACHEYKO, p. 19, Pl. 1, Fig. 17.
1899. Pholadoma Esmarkii NILSSON sp.; FAVRE, p. 100, Pl. 4, Fig. 10.
1915. Pholadoma Esmarkii NILSSON sp.; MOESCH, p. 101, Pl. 38, Fig. 7 and Pl. 34, Fig. 5.
1916. Pholadoma Kastmiri PUSCH; MOESCH, p. 111.
1928. Pholadoma Casimirii PUSCH; SIEPIRANZKI, p. 65.
1-2 — Cultellus(?) kulczynski ROGALA; Kazimierz (1, 2 LV, two valves views)
3-4 — Leptosolex concentri striatus (G. MÜLLER); 3 from Kazimierz, 4 from Janowice (steinkerns of RV)
5-6 — Tenea cf. ovalis SOBESKI; Kazimierz (steinkerns of RV)
7-8 — Opis (Opis) ventricosa (PUSCH); 7 steinkern from Nasilow opoka (7a, 7b anterior and posterior views), 8 steinkern of LV
9 — Venilocardia aff. venrayi (BOSQUET); Nasilow opoka (LV view; MACHALSKI’S Coll)
10 — Linearia (Liathyris) gorbatschae SOBESKI; Bochotnica opoka (external mold of RV; MZ-M, 2363)

All figures in natural size
1 — Corbula sp.; Nasiłów opoka (external mold of RV), X2
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); Razimierz (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 X2
1-2 — *Liopistha (Liopistha) aequivalvis* (GOLDFUSS); Nasilów opoka (1, 2 LV and RV views)

3a-3b — *Panopea (Panopea) mandibula* (SOWERBY); steinkern from Nasilów 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 Nasilow 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 — Pholadomya (Bucardiomya) esmarki (NILSSON); Nasilów opoka (LV and dorsal views)

2 — Pholadomya (Procardia) decussata (MANTELL); Kazimierz (anterior view)

3-4 — Pholadomya (Pholadomya) kasimiri PUSCH; 3 from Nasilów opoka, 4 from Nasilów 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 Nasilów opoka, 5 from Nasilów handground (4, 5a LV views; 5b dorsal view)

6 — *Cercomya* (Cercomya) harpa (KNER); Nasilów 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) maileana (d'ORBIGNY); Nasiłów opoka (LV and dorsal views)
3-5 — Liopista (?Psilomya) sp.; 3—4 from Nasiłów opoka, 5 from Kazimierz (LV)

All figures in natural size
1-2 — Thracia (Thracia) carinifera (SOWERBY); Nasilów opoka (1a, 2a LV and RV views; 1b, 2b dorsal views)

3-4 — Cercomya (Cercomya) harpa (KNER); 3 from Nasilów hardground (3a, 3b LV and dorsal views), 4 from Kazimierz (RV view; IGP II.377)

5 — Cercomya (Cercomya) aff. harpa (KNER); Nasilów opoka (incomplete RV)

All figures in natural size
DESCRIPTION: The shell is large, variable in shape, subtrigonal to suboval, elongated, equi-ovate, and strongly inequilateral. Umbones are turbid, subrounded, and prosogyrous. Maximum inflation lies on the anterodorsal part, and it decreases gradually toward the ventral and posterior margins. Posterior dorsal 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 16–20 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 Kázmark 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 FLACHETKO (1883) when he described the Maastrichtian fauna of the Lvov region, as well as by MOESCH (1875), HOLZ-APFEL (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. LABSSON (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 varieties 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 kasimir PUSCH and Pholadomya salzbergensis ANDERT.

Fig. 17. Height and H/L ratio (in percent) against length in Pholadomya kasimir PUSCH.
(see Text-figs 16—17). This variability can be defined in three forms, as follows:

1) Short (Pl. 46, Fig. 4): This form is similar to those figured by Pusch (1837) and Krach (1881). It is characterized by higher shells trigonal in shape. It is relatively less common, and about 15 specimens were collected at Naślow 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 Naślow 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 subcylindrotrigonal shape, and its ribs are more spaced, restricted to the middle part, and in the absence of the umbonal ridges. The species P. ellipecta v. Münscher differs in having a larger anterior part; however, it seems to be related. The species P. nodulifera v. Münscher 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 (Waite 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. 1934, Pholadomya nodulifera Münscher var. elliptica (SCUFEN); Krach, pp. 309—311, Pl. 7, Fig. 11.


MATERIAL: 16 from Kazimierz, 1 from Bochotnica, 13 from Naślow (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 (1862).

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, Nilsson, p. 17, Pl. 5, Figs 3a—c.

1877, Pholadomya esmarkii M., Pusch, p. 87, Pl. 6, Fig. 14.

v. 1896. Cardita esmarkii NILSSON; Goldfuss, p. 187, Pl. 123, Fig. 14.
DESCRIPTION: The shell is large, subtrigonal, equivale, 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 end 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 esmarkti NILSSON”; (3) original specimen of VOGEI (1885) from the Kunrude Maastrichtian, deposited in the Rijksmuseum voor Geologie en Mineralogie, Leiden, the Netherlands; (4) two specimens from the EWALDS 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 (1897), PEACHETKO (1963) and HENNIG (1987) are quite similar to studied specimens. The species Pholadomya umbonata ROEMER is most probably related to P. esmarkti (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. uschi GOLDFUSS from the Oligocene of Europe and P. marginataceae (SOWERBY) from the Upper Eocene of Italy in their general form and the absence of the umbonal ridges.

AGE and DISTRIBUTION: Turonian of France, Cambrian of Western Gotland, Maastrichtian of the Netherlands, Sweden and the Lvov region; uppermost Maastrichtian of the peri-Caspian basin(t) and of the Middle Vistula Valley.
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Subgenus *Procardia* MEEK, 1871

Type species: *Isocardia? hodgeti* MEEK, 1871; *M Pholadomya (Procardia) decussata* (MANTELL, 1822) (Pl. 44, Fig. 6 and Pl. 45, Fig. 2)

1822. *Cardium? decussatum* MANTELL, p. 129, Pl. 25, Fig. 3.
1837. *Pholadomya decussata* PHILLIPS; PUSCH, p. 87.
71877. *Cardita obliqua* m., PUSCH, p. 67, Pl. 7, Fig. 5e–f.
v. 1837. *Cardium decussatum* MANTELL; GOLDFUSS, p. 223, Pl. 145, Fig. 2.
1875. *Pholadomya decussata* MANTELL; MOECH, p. 197, Pl. 32, Figs 5–6 and Pl. 34, Figs 5–6.
1883. *Pholadomya decussata* MANT.; SIEMIRADZKI, p. 64, Pl. 4, Fig. 3.
1909. *Pholadomya decussata* (MANTELL); WOODS, pp. 266–267, Pl. 41, Figs 7–9; Pl. 43, Fig. 1 (cæm. sym.).
(1811) *Pholadomya decussata* MANT.; ROGALA, p. 492.
(1829) *Pholadomya decussata* MANT.; POZARYSKI p. 21.
(1832) *Pholadomya decussata* PHILL.; PUTZER, p. 359.
(1835) *Cardita obliqua* PUSCH; PUTZER, p. 372.
(1851) *Pholadomya decussata* MANT.; POZARYSKA & POZARYSKI, p. 21.
1977. *Pholadomya decussata* (MANTELL); SOBETSKY, p. 211, Pl. 18, Figs 8–9.
1981. *Pholadomya decussata* (MANTELL); TZANKOV, p. 165, Pl. 71, Fig. 1–2.

**MATERIAL:** 26 from Upper Cenomanian opoka (6 from Ciszyca Kolonia, 1 from Ciszyca Górna, 13 from Plotrawin), 1 from Sojce, 1 from Dobro, 2 from Maślumia, 1 from Kazimierz, 1 from Bochotnica (opoka).

**REMARKS:** The studied specimens agree with those described by WOODS (1899). The species "Cardita obliqua" established by PUSCH (1837) from the opoka exposed at Kazimierz, most probably concerns badly preserved specimens of the studied species. POZARYSKI (1938) reported this species from the upper Cenomanian—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* nova, GOLDFUSS, p. 251, Pl. 154, Fig. 13.
1841. *Goniomya consignata* ROEMER, p. 78, Pl. 10, Fig. 3.
1853. *Goniomya designata* GOLDF.; GRÜPPE, p. 58.
1869. *Goniomya designata* GOLDF.; VOIGEL, p. 46.
1881. *Goniomya consignata* ROEMER; G. MÜLLER, p. 71, Pl. 10, Fig. 7.
1892. *Goniomya consignata* ROEMER; POZARYSKI, p. 44.
1891. *Goniomya consignata* ROEMER; PUTZER, p. 271.
1891. *Goniomya designata* (GOLDFUSS); HÄGG, p. 54, Pl. 7, Fig. 55.

**MATERIAL:** 2 from Bochotnica, 40 from Nasłów (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 (FRIC), and G. americana MEERK & 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. _Goniomya mailleana_ (d'ORBIGNY), p. 235, Pl. 354, Fig. 1—2.
1906. _Goniomya Mailleana_ (d'ORBIGNY); WOODS, pp. 236—236, Pl. 43, Fig. 6—7.
1906. _Goniomya Mailleana_ d'ORB.; ROGALA, pp. 761—763, Pl. 38, Fig. 6.
1935. _Goniomya mailleana_ d'ORB.; POZĄRSKI, p. 32.
1943. _Goniomya mailleana_ d'ORB.; PUTZER, p. 571.
1934. _Goniomya mailleana_ (d'ORBIGNY); HÄGG, p. 53, Pl. 9, Fig. 81.

MATERIAL: 1 from Kazimierz, 1 from Janowice, 14 from Masiłów (14 ovoid, 3 hardground).

REMARKS: The studied specimen agrees with those figured by WOODS (1906) from the Upper Albion 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_ MEERK & 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.


_Superfamily Pandoraeae_ RAFINÉSQUE, 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. 34, Pl. 4, Fig. 11.
1850. _Anatina harpa_ KNER; GEINITZ, p. 148.
1869. _Anatina harpa_ KNER; FAVRE, pp. 107—108, Pl. 12, Fig. 1.
1869. _Anatina millepunctata_ spec. nov., VOGEL, p. 47, Pl. 3, Fig. 19.
1869. _Cercomya harpa_ KNER; ROGALA, p. 753, Pl. 38, Fig. 8.
1870. _Cercomya harpa_ KNER; ROGALA, p. 392.
1872. _Cercomya harpa_ KNER; KRACH, p. 364.
1872. _Anatina harpa_ KNER; POZĄRSKI, p. 32.
1872. _Anatina harpa_ KNER; PUTZER, p. 571.

MATERIAL: 21 from Kazimierz, 2 from Bochnicka (hardground), 8 from Masiłów (8 ovoid, 2 hardground).

REMARKS: KNER (1850) and FAVRE (1869) illustrated incomplete specimens of _Cercomya harpa_ from the Upper Senonian of the Lvov region; however, ROGALA (1869) 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
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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 Nasilów 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 inequalateral 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 subtragicue (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. ambiguua TASHIRO, 1978, from the Maastrichtian (Upper Heterian), 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)

1982. Lutaria? carinifera J. de C. SOWERBY, Vol. 6, p. 68, Pl. 534, Fig. 2.
1999. Lutaria carinifera d'ORB.; BIC, p. 97, Text-fig. 115.
1905. Thracia cardiifera (SOWERBY); WOODS, p. 244, Pl. 49, Figs 10–13 (cum syn.).
1909. ?Cypriocardiella parallela ALTHE; ROGALA, p. 781, Pl. 25, Fig. 7.
1923. Thracia cardiifera SOW.; SYNEWSKA, p. 294.

MATERIAL: 1 from Podgórz, 1 from Męcinsky, 8 from Kazimierz, 2 from Janowiec, 2 from Nasilów (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. Ornamenation is composed mainly of numerous fine radial striae crossed by concentric growth striae.


Superfamily Peromyacea DALL, 1886
Family Poromyidae DALL, 1886
Genus Liopistha MEEK, 1884
Typotype species: Cardium elegantulum ROEMER, 1852; OD
Subgenus Liopistha MEEK, 1884
Liopistha (Liopistha) aequivalvis (GOLDFUSS, 1834)
(Pl. 43, Figs 1–2)

1834. Corbula aequivalvis nobilis, GOLDFUSS, p. 369, Pl. 151, Fig. 15.
1841. Pholadomya caudata A. ROEMER, p. 75 Pl. 10, Fig. 5.
1889. Liopistha aequivalvis GOLDF.; HOLZAPFEL, p. 159, Pl. 9, Figs 4–5.
1898. Liopistha aequivalvis GOLDF. sp.; G. MÜLLER, p. 76, Pl. 10, Fig. 9.
1924. Liopistha aequivalvis GOLDF. sp.; ANDERT, p. 35, Text-fig. 36, Pl. 15, Fig. 9 (cum syn.).
1927. Liopistha aequivalvis GOLDF.; LEHNER, p. 165, Pl. 25, Fig. 30.
1937. Liopistha aequivalvis GOLDF.; POZARZYK, p. 29.
(1945) Liopistha aequivalvis GOLDF.; PUTZER, p. 371.
1943. Liopistha aequivalvis (GOLDFUSS); VAN DER WEIDEN, p. 75, Pl. 8, Figs 7–8.
1954. Liopistha aequivalvis (GOLDFUSS); HÄGG p. 55.
1977. Liopistha aequivalvis (GOLDFUSS); SOBIESKI, p. 218, Pl. 17, Fig. 13 and Pl. 18, Fig. 1.

MATERIAL: 1 from Bohotynia, 8 from Nasilów (1 opoka, 7 hardground).

REMARKS: The studied specimens agree with those described by GOLDFUSS (1834), VOGEL (1886), and others. The species Pholadomya caudata ROEMER is undoubtedly a junior synonym of the studied species, as recognized by HOLZAPFEL (1889). The species Liopistha inilata 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 Dobrze, 1 from Podgórz, 2 from Męcinsky, 10 from Kazimierz, 9 from Nasilów (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 scaly radial ribs. 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: *Cuspidaria 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. 12.
1834. *Corbula caudata* NILSSON; GOLDFUSS, p. 251, Pl. 151, Fig. 17.
1836. *Corbula caudata* NILSSON; REUS, p. 30, Pl. 35, Fig. 23.
1838. *Corbula caudata* NILSSON; KNER, p. 26, Pl. 6, Fig. 3.
1850. *Corbula caudata* NILSSON; ALTH, p. 231, Pl. 11, Fig. 22.
1859. *Naniera caudata* NILSSON; FAVRE, p. 102, Pl. 11, Fig. 19.
1867. *Cuspidaria caudata* NILSS.; HENNIG, p. 62, Pl. 3, Fig. 20.
1902. *Naniera caudata* NILSS.; RAVN, p. 133, Pl. 4, Fig. 34.
1935. *Cuspidaria caudata* (NILSSON); RÜGG, p. 51, Pl. 7, Fig. 6.
1935. *Naniera caudata* NILSS.; POZARYSKI, p. 22.
1977. *Cuspidaria caudata* (NILSSON); SOBETSKI, pp. 219—220, Pl. 10, Fig. 11.
1893. *Cuspidaria caudata* (NILSSON); SOBETSKI, p. 105, Pl. 19, Fig. 19.

MATERIAL: 6 from Upper Campanian opoka (2 from **Ciszyca Kolonia**, 3 from **Ciszyca Górna**, 1 from **Piotrówna**, 1 from **Dobre**, 4 from **Męcniarz**, 3 from **Kazimierz**, 19 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 ribs.

The specimens described as "**Cuspidaria caudata**" by HEINBERG (1979) 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 (1979) 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. grigoriijevae* 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

<table>
<thead>
<tr>
<th>World-wide genera</th>
<th>Euramerican genera</th>
<th>North European genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emarginula</td>
<td>Acmaea</td>
<td>'Conotomaria</td>
</tr>
<tr>
<td>Architectonica (Solarisax)</td>
<td>Calliomphalus s.s.</td>
<td>Leptomaria</td>
</tr>
<tr>
<td>Turririta s.s.</td>
<td>Calliomphalus (Planolateralus)</td>
<td>+Loxotoma</td>
</tr>
<tr>
<td>Turririta (Hautstator)</td>
<td>Atria</td>
<td>Chiodonta</td>
</tr>
<tr>
<td>Cerithium</td>
<td>Laxispira</td>
<td>Margarites ?</td>
</tr>
<tr>
<td>Xenophora</td>
<td>Bittium</td>
<td>Gibbula</td>
</tr>
<tr>
<td>Aporchais</td>
<td>Anthoglossus (Latiola)</td>
<td>+Trochocanthus</td>
</tr>
<tr>
<td>Drepanochellus</td>
<td>Chronia (Sassia)</td>
<td>Lemintina</td>
</tr>
<tr>
<td>+Helicaulax</td>
<td>Bellifusus</td>
<td>+Confusiscala</td>
</tr>
<tr>
<td>Natica</td>
<td>Euthriafusus</td>
<td>+Kauhowniens</td>
</tr>
<tr>
<td>+Gyrodus</td>
<td>+Graphidula</td>
<td>+Perissoptera</td>
</tr>
<tr>
<td>Volutilithes</td>
<td>Cancellaria</td>
<td>+Cultrigera</td>
</tr>
<tr>
<td>Turricula</td>
<td></td>
<td>+Columbellaria</td>
</tr>
<tr>
<td>Tornatellaceae</td>
<td></td>
<td>+Tibia</td>
</tr>
<tr>
<td>Avellana</td>
<td></td>
<td>+Cassidaria</td>
</tr>
<tr>
<td>Cylichna</td>
<td></td>
<td>+Bilplex</td>
</tr>
</tbody>
</table>

Note:
+Extinct genera
+First recorded genera

Volutismpina
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, Confusiscula, Perissoptera, Cultrigera, Columbellaria, Tudicla, Volutilispina, 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, Dombass and Crimea areas.

OPOKA-MARL FACIES. The Upper Senonian gastropods of the Lvov region, as well as of the Dombass and peri-Caspian basins have been described by KNER (1850, 1852), ALTH (1850), PŁÄCHETKO (1863), FAVRE (1869), ROGALA (1911), BLANK (1974), and PLAMADIALA (1982). The Mesogastropods comprise a large number of species and genera (see Text-fig. 18C—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 costatostrata, Calliomphalus (Calliomphalus) dichotomus, Architectonica (Solariaxis) granulatocostata, Cerithium pu-cicostatum, C. polystropha, Aporrhais pyriformis, A.(?) najdini, Tibia laevis, Charonia multicostata, Bellifusus septemcostatus, Graphidula pro-cera, Tudicla althi, Rostellana aequescostata, Volutilithes kneri, and Vo-lutilispina 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 apparently 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, KAUF-FMAN 1979, JABLONSKY & BOTTGER 1983).

CALCARENITE FACIES. The gastropods of the Maastrichtian stratotype and the Kumrđe Limestone were described by BINKHORST (1861) and KAUNHOWEN (1897). They are characterized by the predominance of rock-clinging 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. 18A). 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-
MAASTRICHTIAN NON-CEPHALOPOD MOLLUSKS

ly restricted to these two areas, viz. Calliomphalus (Calliomphalus) rimosus granulatus, Chilodonta rudis, Lemintina uciosa, Cerithium teg- 
tiforme, Bittium tripychum, Arrhoges (Latiala) pelecyphora, Kaunho-venia carinifera, and Charonia tuberculosa.

Generally, the two areas are sharing in the important endemic gene-
ra characterizing the North European Province, but the Limburg fauna
possesses a higher number of endemic species of such genera as Astral-
ium, Nerita, Hipponix, Littorina, Nerinea, Cypraea, Clavella, Fascio-
ria, and Turbinella. This means that this area is considered as an end-
emic center, which continued since the Campanian (the Aachen Green-
sand), 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 for-
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 in-
dicated by SOHL (1960, 1964), who described and revised about 150 gas-
troped genera and subgenera. These assemblages possess a high percent-
age of endemic genera, 42 of which are restricted to the Gulf and Atlantic
Coastal Plains. These gastropod faunas are characterized by the predomi-
nance 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 Neogastropo-
da; 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 gastro-
pod 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 Ameri-
can Province are sharing in the Euramerican genera (see Table 3) and the
wide spread genera as Turritella, Cerithium, Xenophora, Gyrodes, Nati-
ca(?), Aporhais, Drepanocheilus, Heliculae, Volutilithes, Tornatellaea,
and Cylichna. The large volutids are also common both in the North Eu-
ropean and the North American Provinces.
TETHYAN REALM

The Tethyan Realm is characterized by the predominance 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 Yugoslavia, 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, Aporhais, 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 is clear (see Table 4) that there are no endemic genera characterizing the Maastrichtian of the Middle Vistula Valley, and that cosmopolitan and trans-tempe-
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)

<table>
<thead>
<tr>
<th>Cosmopolitan genera</th>
<th>Widespread and trans-temperate genera</th>
<th>Euramerican genera</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nucula s.s.</td>
<td>Phelopteria</td>
<td>+Tenuipteria</td>
</tr>
<tr>
<td>Nuculana s.s.</td>
<td>+Syncyclonema</td>
<td>Acutosorea</td>
</tr>
<tr>
<td>Barbatia s.s.</td>
<td>Lyropecten (Aequipecten)</td>
<td>+Granocardioid (Cricardioid)</td>
</tr>
<tr>
<td>Cuculaea</td>
<td>Agreostra</td>
<td>Pleurocardia s.s.</td>
</tr>
<tr>
<td>Limopsis</td>
<td>Gryphaeostrea</td>
<td>Lineolaria (Liothyris)</td>
</tr>
<tr>
<td>Septifer</td>
<td>Hyotissa</td>
<td>Cuspidaria</td>
</tr>
<tr>
<td><em>Insperna</em></td>
<td><em>Mutilia</em></td>
<td></td>
</tr>
<tr>
<td>Mediolus</td>
<td><em>Opis</em></td>
<td></td>
</tr>
<tr>
<td>Pinna s.s.</td>
<td>Venericardioid</td>
<td></td>
</tr>
<tr>
<td>Gavrinia</td>
<td>Leptosolen</td>
<td></td>
</tr>
<tr>
<td><em>Inceramus</em></td>
<td>Cordula</td>
<td></td>
</tr>
<tr>
<td><em>Oxytoma</em> (Hypoxyloma)</td>
<td>Venelicardioid</td>
<td></td>
</tr>
<tr>
<td><em>Entolium</em></td>
<td>Panopea</td>
<td></td>
</tr>
<tr>
<td>Propeamussium (Purva.)</td>
<td>+Gyropleura</td>
<td></td>
</tr>
<tr>
<td>+Comptonectes</td>
<td>+Periplana</td>
<td></td>
</tr>
<tr>
<td>Mimichlamys ?</td>
<td>+Lipistha s.s.</td>
<td></td>
</tr>
<tr>
<td><em>Neitheo</em> s.s.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Spondylus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Limatula</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Piagostoma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pycnodonte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Piacunopsis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Astarte</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lucina</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Granocardioid s.s.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>-Nemocardioid</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pholadomya s.s.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>+Pholadomya (Procardia)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cerasyma</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Genomya s.s.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| North temperate genera       |                                                                 |                                                         |
| Pinna (Plesiopinna)          | +Atrela                                                               |                                                         |
| Pseudoptera                 | +Legumenh                                                            |                                                         |
| +Spiridacercamus             | +Tanea                                                                |                                                         |
| +Thracia                    | Lioptista (Psilomya)                                                 |                                                         |

| North European genera        |                                                                 |                                                         |
| Arca (Eonavicula)            |                                                         |                                                         |
| Barbatica (Acoc)             | Chlamys (Lirochiomys)                                                |                                                         |
| +Merklnia                   | Pseudolimnea                                                         |                                                         |
| Limesa                      | Ctenoidea                                                            |                                                         |
| +Trapezium                  | Cultellus                                                            |                                                         |
| Pholadomya (Bucardiomya)     |                                                         |                                                         |

Note: +Extinct genera

European 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 (Eonavicularia), Lyrropecten (Aequipecten), Mimachlamys, Chlamys (Lyriochlamys), Merkina, 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), PŁAČHEΤKO (1863), FAVRE (1869), ROGLA (1909, 1911), PASTERNAK (1968), SAVCZIN-SKAJA (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 Lyrropecten (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. 19C, 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 pteriomorphs. However, the Limburg Maastrichtian differs in having a smaller number of 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 Vwilicardia are absent in Limburg, but they are present in the Middle Vistula area. The species Lyrropecten (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.
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

SPEEDEN (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. 20B) instead of the Pteriomorpha in the Middle Vistula area. The pectinid, chlamid 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* (*Jupitra*), *Yoldia*, *Malletia*, *Solemya*, *Parallelodon*, *Corbicula*, *Spaniorinus*, *Souriims*, *Spicula*, *Nymphalucina*. The two areas are sharing only in the cosmopolitan genera and other common genera of the European 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 chlamidid, pectinid and limid genera, whilst the Pteriomorpha and Heterodonts are nearly equal (see Text-fig. 20A). Such genera as *Inoperna*, *Pycnodonte*, *Leptosolen*, *Legumen*, *Panopea*, *Pholadomya* and *Liopistra* occur in both the Ripley Formation and the Middle Vistula area, whilst the important genera of the Ripley Formation (*Yoldia*, *Nemodon*, *Protocardia*, *Idaionia*, *Aenona*, *Corbulamella*, *Martesia*, *Eteoa*, *Sembula*, *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. 20C) due to the predominance of the Heterodonts and a lack of pectinid, chlamidid 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*, *Apotrigonia*, *Microtrigonia*, *Steinmanella*, *Agnomyax*, *Flelastexte*, 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 *Liopistra* 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, POPENO 1937, ANDERSON 1958) are similar to that of the Himenoura Group in the abundant occurrence of *Aquila*, *Glycymera*, *Nanovenis*, *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, Synecyclonema, 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 Noetiidae, although, such cosmopolitan species as Camptonectes virgatus, Neithea sexcostata, Pycnodonte vesicularis, Hyotissa semiplana, Gryphaeoestrea 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 STO-LICZKA (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 flagelliformis, Pinna cretacea, Gervillia solenoidea, Camptonectes virgatus, Pycnodonte vesicularis, Gryphaeoestrea 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.
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 POZARYSKA & PERYT (1979), neither benthic nor planktic foraminifers, 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

<table>
<thead>
<tr>
<th>Family</th>
<th>Trophic groups</th>
<th>No. of genera</th>
<th>No. of species</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aporrhaidae</td>
<td>D</td>
<td>7</td>
<td>13</td>
<td>380</td>
</tr>
<tr>
<td>Turritellidae</td>
<td>S</td>
<td>1</td>
<td>3</td>
<td>222</td>
</tr>
<tr>
<td>Nodiophinulidae</td>
<td>H?</td>
<td>1</td>
<td>3</td>
<td>205</td>
</tr>
<tr>
<td>Trochidae</td>
<td>H</td>
<td>5</td>
<td>15</td>
<td>114</td>
</tr>
<tr>
<td>Volutidae</td>
<td>P</td>
<td>4</td>
<td>5</td>
<td>104</td>
</tr>
<tr>
<td>Naticidae</td>
<td>P</td>
<td>2</td>
<td>3</td>
<td>56</td>
</tr>
<tr>
<td>Cerithiidae</td>
<td>H</td>
<td>2</td>
<td>9</td>
<td>44</td>
</tr>
<tr>
<td>Pleurotomariidae</td>
<td>H?</td>
<td>2</td>
<td>4</td>
<td>43</td>
</tr>
<tr>
<td>Vasicidae</td>
<td>P</td>
<td>1</td>
<td>5</td>
<td>26</td>
</tr>
<tr>
<td>Vermetidae</td>
<td>S</td>
<td>2</td>
<td>2</td>
<td>23</td>
</tr>
<tr>
<td>Ringulidae</td>
<td>P</td>
<td>1</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td>Fasciolaridae</td>
<td>P</td>
<td>3</td>
<td>6</td>
<td>21</td>
</tr>
<tr>
<td>Acteonidae</td>
<td>P</td>
<td>1</td>
<td>1</td>
<td>14</td>
</tr>
<tr>
<td>Strombidae</td>
<td>P?</td>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Cymatidae</td>
<td>P</td>
<td>2</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>Columbellaridae</td>
<td>?</td>
<td>1</td>
<td>3</td>
<td>10</td>
</tr>
<tr>
<td>Buchinidae</td>
<td>P</td>
<td>1</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td>Scalidae</td>
<td>?</td>
<td>1</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Fissurellidae</td>
<td>H</td>
<td>2</td>
<td>2</td>
<td>7</td>
</tr>
<tr>
<td>Cancellariae</td>
<td>P</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
<td>Turridae</td>
<td>P</td>
<td>1</td>
<td>2</td>
<td>3</td>
</tr>
<tr>
<td>Xenophoridae</td>
<td>?</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
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<td>Acteonidae</td>
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<td>2</td>
</tr>
<tr>
<td>Solaridae</td>
<td>?</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Acmaidae</td>
<td>H</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Cassididae</td>
<td>P</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

\(^1\) 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

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aporrhais pyriformis</td>
<td>247</td>
</tr>
<tr>
<td>Trochaconthus tricanatus tricanatus</td>
<td>171</td>
</tr>
<tr>
<td>Turritella (Turritella) hagenoviana</td>
<td>119</td>
</tr>
<tr>
<td>Turritella (Haustator) plana</td>
<td>102</td>
</tr>
<tr>
<td>Volutispina kasimiri</td>
<td>48</td>
</tr>
<tr>
<td>Perissospera emarginulata</td>
<td>38</td>
</tr>
<tr>
<td>Rostellana aequosttata</td>
<td>37</td>
</tr>
<tr>
<td>Arrhages (Latiala) pelecyphora</td>
<td>31</td>
</tr>
<tr>
<td>Natica (?) cretacea</td>
<td>27</td>
</tr>
<tr>
<td>Calliomphalus fructi</td>
<td>28</td>
</tr>
<tr>
<td>Conotomaria linearis</td>
<td>23</td>
</tr>
</tbody>
</table>

Table 7

Ranked abundance of the studied bivalves by superfamilies

<table>
<thead>
<tr>
<th>Superfamily</th>
<th>No. of families</th>
<th>No. of genera</th>
<th>No. of species</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pectinacea</td>
<td>6</td>
<td>13</td>
<td>20</td>
<td>1287 v</td>
</tr>
<tr>
<td>L iniacea</td>
<td>1</td>
<td>5</td>
<td>7</td>
<td>345 v</td>
</tr>
<tr>
<td>Pholadomyacea</td>
<td>1</td>
<td>2</td>
<td>6</td>
<td>276</td>
</tr>
<tr>
<td>Ostreaea</td>
<td>2</td>
<td>5</td>
<td>5</td>
<td>263 v</td>
</tr>
<tr>
<td>Limopsacea</td>
<td>1</td>
<td>1</td>
<td>4</td>
<td>210</td>
</tr>
<tr>
<td>Pteriacea</td>
<td>2</td>
<td>5</td>
<td>6</td>
<td>203 v</td>
</tr>
<tr>
<td>Mytilacea</td>
<td>1</td>
<td>3</td>
<td>6</td>
<td>180</td>
</tr>
<tr>
<td>Hippuralceae</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>128</td>
</tr>
<tr>
<td>Arcacea</td>
<td>3</td>
<td>4</td>
<td>8</td>
<td>123</td>
</tr>
<tr>
<td>Articidae</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>119</td>
</tr>
<tr>
<td>Cardiacea</td>
<td>1</td>
<td>3</td>
<td>5</td>
<td>116</td>
</tr>
<tr>
<td>Nuculanacea</td>
<td>1</td>
<td>1</td>
<td>6</td>
<td>116</td>
</tr>
<tr>
<td>Lucinacea</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>114</td>
</tr>
<tr>
<td>Hiatiellacea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>71</td>
</tr>
<tr>
<td>Grossatellacea</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>55</td>
</tr>
<tr>
<td>Poromyacea</td>
<td>2</td>
<td>2</td>
<td>3</td>
<td>54</td>
</tr>
<tr>
<td>Panderacea</td>
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<td>3</td>
<td>4</td>
<td>51</td>
</tr>
<tr>
<td>Nuculacea</td>
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<td>1</td>
<td>5</td>
<td>48</td>
</tr>
<tr>
<td>Solenacea</td>
<td>1</td>
<td>2</td>
<td>2</td>
<td>41</td>
</tr>
<tr>
<td>Pinnacea</td>
<td>1</td>
<td>1</td>
<td>2</td>
<td>15</td>
</tr>
<tr>
<td>Carditacea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>12</td>
</tr>
<tr>
<td>Veneracea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>11</td>
</tr>
<tr>
<td>Myacea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Pholadacea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>2</td>
</tr>
<tr>
<td>Tellinacea</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>

v - separate valves
### Table 8

<table>
<thead>
<tr>
<th>Species</th>
<th>No. of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lyropecten (Aequipecten) acuteplicatus</td>
<td>660 (valves)</td>
</tr>
<tr>
<td>Pycnodonte (Phygrea) vesiculare</td>
<td>160 (valves)</td>
</tr>
<tr>
<td>Pholadomya kasimirii</td>
<td>158</td>
</tr>
<tr>
<td>Gyropleura inequirostrata</td>
<td>128</td>
</tr>
<tr>
<td>Gervillia solenoidea</td>
<td>115 (valves)</td>
</tr>
<tr>
<td>Limopsis sacheri</td>
<td>114</td>
</tr>
<tr>
<td>Oxytoma (Hypoxytoma) danica</td>
<td>109 (valves)</td>
</tr>
<tr>
<td>Plagiostoma hopeni</td>
<td>108 (valves)</td>
</tr>
<tr>
<td>Spondylus dutempleanus</td>
<td>100</td>
</tr>
<tr>
<td>Mutiella coarctata</td>
<td>95</td>
</tr>
<tr>
<td>Merklinia variabilis</td>
<td>92 (valves)</td>
</tr>
<tr>
<td>Gryphaeoestrea canaliculata</td>
<td>79 (valves)</td>
</tr>
<tr>
<td>Modiolus elongatus</td>
<td>75</td>
</tr>
<tr>
<td>Nuculana producta</td>
<td>74</td>
</tr>
<tr>
<td>Panopea mandibula</td>
<td>73</td>
</tr>
<tr>
<td>Nemocardium fenestratum</td>
<td>66</td>
</tr>
<tr>
<td>Tenuipteria argentea</td>
<td>65</td>
</tr>
<tr>
<td>Limatula kunradensis</td>
<td>63 (valves)</td>
</tr>
<tr>
<td>Spondylus truncatus</td>
<td>61</td>
</tr>
<tr>
<td>Chlamys (Lyriochlamys) septemplicata</td>
<td>60 (valves)</td>
</tr>
</tbody>
</table>

### 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, Cucullata, Limopsis, Mutiella, Venericardia, Astarte, Opis ?, Granocardium ?, Pleurocardia ?, Nemocardium ? |
| III | Infaunal siphonate suspension feeders: Cultellus, Leptosolen, Linearia, Tenea, Ventilicardia, 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: Neithia |
| VII | Epifaunal byssally attached suspension feeders: Arca, Barbatia, Septifer, Pseudopteria, Phalaeopteria, Spiridoceras, Tenuipteria, Oxytoma, Syncyclonema, Canpontecetes, Chlamys (Lyriochlamys), Mimachlamys, Merklinia, Limatula, Limea, Pseudalmea, Plagiostoma, Ctenoides |
| VIII | Epifaunal cemented suspension feeders: Spondylus, Placunopsis, Atreta, Pycnodonte, Hyotissa, Gryphaeoestrea, Acutostrea, Agerostrea, Gyropleura |
| IX | Free - living suspension feeders: Entolium, Propomussium, Lyropecten (Aequipecten) |

The lithofacies, to which the investigated assemblages 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 versiculare, 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

![Image of assemblage]

**Fig. 21.** Schematic sketch of the benthic assemblage of uppermost Campanian opoka, as exposed at Piotrawin

In — Inoceramus sp., Py — Pycnodonte versiculare, 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 versiculare 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 Tudicia 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 MASTRICHTIAN 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 (Parvaamussium) inversum*, *Pseudolinea*? *granulata*, *Acutoostrea incurva*, *Hyotissa semiplana*, and *Neithia sexcostata*.

![Fig. 22. Schematic sketch of the benthic assemblage of Lower Maastrichtian opoka, as exposed at Dziurków](image)

**In** — *Inoceramus* sp., **Py** — *Pygiodonta vesiculare*, **Ne** — *Neithia 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 *Neithia 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 & BOTTGER 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: *Phelopecteria 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* (epibysseate) and *Phelopecteria pectinoidea* (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 assemblage of Upper Maastrichtian marly chalk, as exposed at Męcinerz](image)

**GASTROPODS:** *Ap* — *Aporrhais pyriformis,* *Tu* — *Turritella plana*

**BIVALVES:** *Ox* — *Oxytoma danica,* *Pe* — *Phelopecteria pectinoidea,* *Py* — *Pyconodonte 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 allows to prolongate into a narrow auricle, which may have had a stabilizing function (see SEILACHER 1984). The species *Phelopecteria 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 ASSOCIATION AT KAZIMIERZ TOWN QUARRY SECTION**

Dominant taxa: *Gyropleura inequirostrata*, *Gervillia solenoidea*, *Oxytoma (Hypoxytoma) danica*, *Spondylus dutempleanus*, *Plagiostoma hopeni*, *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 limpets (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 *Merkina* (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 *Turritella hagenoviana* which certainly were mucus-net suspension feeders in soft substrates (see JABLONSKI & BOTJER 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 aporhaid and turritellid 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%), Ca — Calliomphalus fruchtii (4.7%), Ce — Cerithium nerei (4.5%), Lp — Leptomaria subgigantea, V — Voluitespinosa kasimiri

**BIVALVES:** Gy — Gyropleura inaequirostrata (8.8%), Gr — Gerrilla solenoidea (6.4%), Ox — Oxystoma danica (6%), Sp — Spondylus duemplennus (5%), Pt — 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 nilssonii, En — Entolium membranaceum, Pa — Panopea mandibula, Ph — Pholadomya kasimiri, Cr — Cercomya harpa, P — Pinna (Pleistopina) kasimirenensis

**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 (Aegulpecten) acuteplicatus, Pholadomya kasimiri, Merklinia variabilis, Trochacanthus tricarinatus tricarinatus, Turritella hagenoviana, T. plana, and Aporrhaias pyriformis; besides the dominance of sponges, brachiopods and bryozoans.

Common taxa: Modiolus radiatus, M. elongatus, Pycnodonte vesiculare, Mutiella coarctata, Volutispina kasimiri, Rostellana aequescostata, and Presuloptera 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-

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**Fig. 25.** Schematic sketch of the benthic assemblage of uppermost Maastrichtian marly ooka, as exposed at Nasilow

**GASTROPODS:** Tr — *Trachacanthus tricarinatus tricarinatus* (33%), Tu — *Turritella hagenoviana* and *T. plana* (30%), Ap — *Aporrhais pyriformis* (9%), R — *Rostellana aequescostata* (7.7%), V — *Volutispina kasimiri* (7.7%), Pr — *Perissoptera emarginulata* (7%), Ar — *Arrhagoges plecephora* (8.5%), Na — *Natica(?)* cretacea and *N. exaltata* (9%), Ca — *Calliomphalus fruchti*, Cs — *Conenomaria linears*

**BIVALVES:** Ly — *Lyropecten (A.) acuteplicatus* (13%), Ph — *Pholadomya kasimiri* (7.2%), Me — *Merklinia variabilis* (4.6%), Mo — *Modiolus elongatus* and *M. radiatus* (8.5%), Py — *Pycnodonte vesiculare* (4%), Gy — *Gyropleurana inequirostrata*, B — *Barbatia tenuistrata*, Sy — *Synecholomina nilsoni*, Pr — *Plagiostoma hoperi*, Ne — *Netheica sexcostata*, A1 — *Atreia nilsoni*, P — *Penna cretacea*, Sp — *Spougytius dutempleanus*, G — *Goniomya designata*

**OTHERS:** S — sponges; Se — serpulids; T — brachiopods; bu — burrows, in general
tililds along with aprorrhaisds. 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 cardids 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 *Aprorhais* 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:* *Aprorhais pyriformis*, *Lyrpecten (Aequitecten) acuteplicatus*, *Limopsis sacheri*, *Turritella hagenoviana*, and *T. planta*; besides sponges and brachiopods.

*Common taxa:* *Opis ventricosa*, *Natica(?) cretacea*, *Pycnodonte vesiculare*, and *Mutella crocata*.

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 Nasilów

**GASTROPODS:** Ap — Aporrhais pyriformis (56%), Tu — Turritella hagenoviana and T. plana (9%), Na — Natica(?) cretacea (4.3%), Ar — Arrhodes pelocyphora (4%), Tr — Trochacanthus tricarinatus tricarinatus (2%), Ca — Calliomphalus nasilowensis (2%), V — Volutispina kasimir

**BIVALVES:** Ly — Lyropecten (A.) acuteplicatus (50%), L — Limopsis sacheri (8%), Py — Pycnodonte vesiculare (2.5%), Mo — Modiolus elongatus (1.8%), Sp — Spondylus dutempleanus, Fa — Panopea mandibula, Cr — Cercomya harpa, G — Gonimyia designata, B — Barbatia tenuistrata

**OTHERS:** S — sponges; Sr — serpulids; T — brachiopods; bu — burrows, in general; Th — Thalassinoides-type burrows; Oc — Ocyopode-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 kazimirovienis, 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

<table>
<thead>
<tr>
<th>Age/L. Maastr.</th>
<th>Local</th>
<th>Zone</th>
<th>Temperature (°C)</th>
<th>Distance to shore</th>
<th>Water depth (m)</th>
<th>Substrate</th>
<th>Environment</th>
</tr>
</thead>
<tbody>
<tr>
<td>z Belemnella kazimirovienis</td>
<td>&gt; 10</td>
<td>near</td>
<td>20 - 50</td>
<td>? firm</td>
<td>inner shelf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>y = Tenuipertonia argentea</td>
<td>&gt; 10</td>
<td>near</td>
<td>0 - 10</td>
<td>firm</td>
<td>tidal flat</td>
<td></td>
<td></td>
</tr>
<tr>
<td>x Belemnella junior</td>
<td>warm</td>
<td>off</td>
<td>100 - 150</td>
<td>soft</td>
<td>mid to outer shelf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>w Belemnella occidentalis</td>
<td>&gt; 10</td>
<td>off</td>
<td>100 - 150</td>
<td>firm</td>
<td>mid to outer shelf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>v Belemnella lancelata</td>
<td>&gt; 10</td>
<td>off</td>
<td>100 - 150</td>
<td>firm</td>
<td>mid to outer shelf</td>
<td></td>
<td></td>
</tr>
<tr>
<td>t Nostoceras pozaryskii</td>
<td>warm</td>
<td>off</td>
<td>100 - 150</td>
<td>firm</td>
<td>mid to outer shelf</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: all terms are relative; temperature based mainly on the previous works on belemnites (BOWEN 1961, 1966; KONIGEL 1965), ostracodes (CLARKE 1962), flora (CIESLIŃSKI 1964, GAZDZICKA 1979); environments of the hardground and greensand are taken from RÄD-WAŃSKI (1985)
fera which indicate warm and normal marine water (see GAŻDZICKA 1978, POŻARYSKA & PERYT 1979), and also from the data on paleo-
temperature (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 *Cytherollobi-
dea*.

On the other hand, the studied gastropod and bivalve faunal assem-
blages, 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

<table>
<thead>
<tr>
<th>Age</th>
<th>Zone</th>
<th>Assemblage</th>
<th>Diversity</th>
<th>Density</th>
<th>Trophic groups in percent of specimens</th>
<th>Trophic groups in number of specimens</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>no. of species</td>
<td>total of specimens</td>
<td>Gastropods</td>
<td>Bivalves</td>
</tr>
<tr>
<td>Belemnella</td>
<td>Greensand</td>
<td></td>
<td>11</td>
<td>—</td>
<td>—</td>
<td>238</td>
</tr>
<tr>
<td>Kazimierz</td>
<td>Hardground</td>
<td></td>
<td>40</td>
<td>44</td>
<td>233</td>
<td>304</td>
</tr>
<tr>
<td>(Tenuipturia</td>
<td>Nasitew</td>
<td></td>
<td>63</td>
<td>88</td>
<td>653</td>
<td>1590</td>
</tr>
<tr>
<td>argentea)</td>
<td>Kazimierz</td>
<td></td>
<td>67</td>
<td>98</td>
<td>389</td>
<td>1302</td>
</tr>
<tr>
<td>Lat.</td>
<td>Marly opoka</td>
<td></td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Maaschricht</td>
<td>G. junior</td>
<td></td>
<td>—</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
<tr>
<td>Belemnitella</td>
<td>Kudzie</td>
<td></td>
<td>1</td>
<td>12</td>
<td>23</td>
<td>—</td>
</tr>
<tr>
<td>occidentalis</td>
<td>Dzirklów</td>
<td></td>
<td>—</td>
<td>—</td>
<td>15</td>
<td>—</td>
</tr>
<tr>
<td>Lancellata</td>
<td>Solec</td>
<td></td>
<td>—</td>
<td>11</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>Belemnella</td>
<td>Piotrowin</td>
<td></td>
<td>16</td>
<td>20</td>
<td>49</td>
<td>239</td>
</tr>
</tbody>
</table>

* 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 KONGIUL 1962, p. 131; and CHRISTENSEN 1976). Even the isotopic temperatures obtained from belemnite guards 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 transgression.

The predominance of the infaunal suspension feeders, including the bivalves (see Table 11) and turritellids and aporrhaid (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 bivalves 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 palaeontological and palaeoecological 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 palaeoecological 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 palaeoecological conditions prevailing during the deposition of the Maastrichtian opokas, a quantitative investigation of their full faunal content, rather than the traditional macrofaunal and microfaunal sampling 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 DHONDIT (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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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 mastychtu odsłaniających się wzdłuż przełomu Wisły przez Pas Wyżyn Polski Środkowej, od Piotrowina aż po okolice Kazimierza nad Wisłą (patrz fig. 1—10 oraz tab. 1—2). Utwory najświętszego mastychtu kończą tutaj jedynie w Europie ciągi profiļ osadów środkowej i górnej kredy (por. POZARSKI 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, rozmiaru grup ekologicznych, obecności elementów typowych dla innych prowincji, pojawienia się szeregu form karakterystycznych dla kenozoku), 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—49). Wśród ślimaków ustanowiono 13 gatunków dla nauki nowych, a mianowicie: Loxotoma multiradiata sp. n., Callimorphus (Planolateralis) nasilovenis sp. n., Cerithium mazurecki sp. n., Heliacaulax pozaryskii sp. n., Cultrigea turritiformis sp. n., Columbellaria laevicostata sp. n., Cassidaria truncata sp. n., Bilex cretaceus sp. n., Buccinum giganteum sp. n., Graphidula radwanski sp. n., Graphidula vistulensis sp. n., Tudicia (Tudicia) globosa sp. n., oraz Tornatella konigii sp. n. Ustanowiono także nowy rodzaj, Kaunhowenia gen. n., który obejmuje jeden gatunek z rodziny Aporrhaidae, C. carinifera (KAUNHOWEN, 1897), o bardzo specyficznym urzeźbieniu, a opisywany dotychczas tylko z osad stratotypu mastychtu w Holandii. Wśród małży ustanowiono jako nowy jeden gatunek, Pinna (Plestopinna) kasimirense sp. n.

Zważywszy, że dotychczasowa znajomość nie-głowonogowej fauny mięczaków z osad mastrychtu przełomu Wisły była bardzo słaba (patrz PUSCH 1937, ŁO-PUSKI 1913, POZARSKI 1938, PUTZER 1942), a tylko stosunkowo niewielkie formy były przedmiotem monograficznego ujęcia (KRACH 1931), opracowanie niniejsze stanowi pendant do istniejących już opracowań faun głowonogowych —
lodzików (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 *Volutospina kasimiri* (KRACH, 1931), oraz małe *Pholadomya* (Pholadomya) *kasimiri* PUSCH, 1837, i *Pholadomya* (Bucardomyia) *esmarki* (NILSSON, 1827), przedstawiające rewię ich taksonomii, która była poprzednio przedmiotem rozbieżnych ujęć. Podobną uwagę zwrócono na dwa gatunki inceramidów, *Spyridoceras 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 kazimirovienis* (SKOŁOZDRÓWNIA, 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-uniormowanej.

Analiza ekologiczna bentonicznych zespołów faunistycznych w obrębie całego mastrychtu, od jego granicy z kampanem aż po najwyższy mastrycht (*patrz* fig. 21–28 oraz tab. 5–9), wskazuje na wyraźny wzrost ilościowy oraz jakościowy poszczególnych zespołów, połączony z pojawianiem się stopniowo coraz bardziej różnicowanych grup troficznych, m.in. licznych form roślinonowych. Zmiany tych zespołów odpowiadają stopniowemu zmniejszaniu się głębokości basenu, połączonym 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 najwyższy mastrychtie, zespołów faunistycznych odmiennych od znanych dotychczas z innych obszarów występowania osadów kręgowych w Europie.