

HALINA PUGACZEWSKA

THE UPPER CRETACEOUS OSTREIDAE FROM THE MIDDLE  
VISTULA REGION (POLAND)

*Abstract.*— Twelve species of pelecypods representing the subfamilies: Pycnodontinae, Exogyrinae and Ostreinae are described. The growth changes in *Pycnodonte (Phygraea) vesicularis* and in *Gryphaeostrea vomer* are reported. The “fingerprint shell structure” has been found on the shell of *P. (Phygraea) vesicularis*, and it is interpreted as the remain of conchioline membrane in the subnacreous layer. In earlier stages of the Upper Cretaceous in the Middle Vistula region the ostreids dominate, while in the later ones brachiopods and belemnites are more abundant.

## INTRODUCTION

The Upper Cretaceous oysters are numerous and well preserved in the several quarries and outcrops of the Middle Vistula region, Poland, among others in the vicinity of Bochoznica, Nasiłów, Kazimierz, Solec and Piotrawin (fig. 1 and Popiel-Barczyk 1968: fig. 1). The oysters were so far but quoted in some papers dealing with the geology of the region (Cieśliński & Pożaryski 1970). The collection described here amounts to more than 1300 specimens which I gathered during the 1964—1965 field works. I was also able to use the materials kindly provided by the Museum of Earth in Warszawa. Besides, the Museum of Earth made available for comparisons its collections of the pelecypods coming from Belgium, France, Switzerland, Federal Republic of Germany and the USSR. During my two months stay in the German Democratic Republic I was able to compare the Polish material with those from other regions of the world being stored mainly in the Palaeontological Museum of the Humboldt University (Berlin) and in the Geologic-Paleontological Institute of the Moritz Arndt University (Greifswald).

The most abundant species of oysters in the region under investigation come from the Campanian of Nasiłów. They are mostly *Pycnodonte (Phygraea) vesicularis* (Lamarck, 1806) and *Gryphaeostrea vomer* Stephenson, 1941. They form 80% of the entire assemblage of the fauna in this locality.

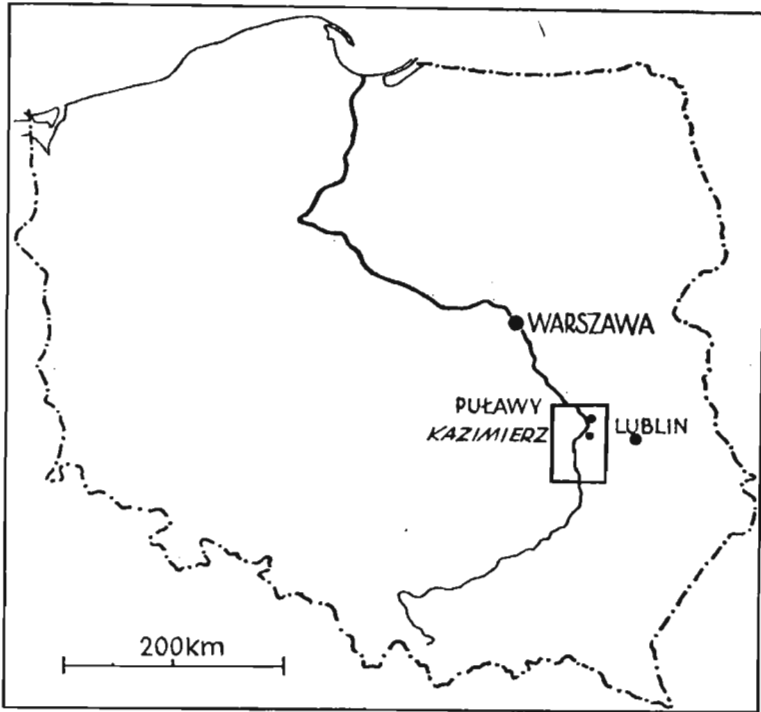


Fig. 1. Schematic map of Poland showing the Middle Vistula region where the oysters described were collected.

The remaining species occur in much smaller quantities, sometimes being represented by several or singular specimens only. The fauna successively decreasing in abundance has been collected from the quarries in: Piotrawin, Kazimierz and Bochońnica.

The brachiopods from the same Upper Cretaceous localities in this region were described by Popiel-Barczyk (1968). They were most abundant in the Upper Maestrichtian (phosphorite horizon) in Nasiłów and Bochońnica. Ninety percent of brachiopods comes from the Upper Maestrichtian, as well as the majority of belemnites (Kongiel 1962).

The good state of preservation of the oysters, and the presence of the shells of different growth stages, evidence the autochthonic character of this fauna. The shells do not bear any trace of transportation and they had good conditions for development in their natural environment. The latter concerns especially the oysters from Campanian of Nasiłów. The autochthonic character of brachiopods was also assumed by Popiel-Barczyk (*l.c.*). This author (*l.c.*) has presented a detailed stratigraphy of the profile in question, based on the geological investigations of earlier authors (Pożaryski 1938, Kongiel 1958, Pożaryski & Pożaryska 1960).

The extensive individual variability of the oysters (different growth forms and shell dimensions), especially of those from the Campanian and

Maestrichtian in Nasiłów, is in my opinion, a consequence of the sedentary life (see also Pugaczewska 1971, 1975).

The stratigraphic range of the most species described agrees with that in other geographic regions; however, two of the species: *Pycnodonte* (*Pycnodonte*) *biauriculata* (Lamarck 1819) and *Hyotissa armata* (Goldfuss 1840) known so far from the Cenomanian to/or Santonian, occur in the Middle Vistula region in the Campanian. The same range was reported for the cosmopolitic *Rhynchostreon suborbiculatum* (Lamarck 1801), while the most probably conspecific form *Rh. cf. suborbiculatum* occurs in the Campanian deposits in the region under study.

The Upper Cretaceous oysters from the Middle Vistula region (12) and those from the mesozoic margin of the Holy Cross Mts (14) are similar in number of species but differ in the species composition: only half of the species are common to both regions (Cieśliński & Pożaryski 1970).

The systematics accepted in this paper is that advanced by Stenzel (1971).

Sincere gratitude is due to the authorities of the Museum of Earth, Polish Academy of Sciences in Warszawa, for supplying the material for investigation, as well as to the authorities of the Palaeontological Museum of the Humboldt University in Berlin and of the Geologic-Palaeontological Institute of the Moritz Arndt University in Greifswald for making their collections available for comparison. The collections described in this paper are housed in the Institute of Paleobiology of the Polish Academy of Sciences (abbr. ZPAL) and in the Museum of Earth of the Polish Academy of Sciences (abbr. MZ) in Warszawa.

## DESCRIPTIONS

### Family **Gryphaeidae** Vyalov, 1936

#### Subfamily **Pycnodonteinae** Stenzel, 1959

#### Genus *Pycnodonte* Fischer de Waldheim, 1835

#### Subgenus *Pycnodonte* (*Pycnodonte*) Sacco, 1897

#### *Pycnodonte* (*Pycnodonte*) *biauriculata* (Lamarck, 1819)

(pl. 11:3)

1964. *Biauris biauriculata* (Lamarck); Rengarten:27, pl. 3:2-3, (non *Ostrea lesueurii* d'Orbigny, 1850).

*Material.* — One ventrally damaged valve of adult individual (MZ VIII/M1-124/12).

*Supplementary description.* — The valve thick-walled; its maximum thickness in the subhinge part of valve amounts to 5 mm; the greatest length of valve measured along the dorsal margin equals about 50 mm, the greatest convexity placed just below the centre amounts to 18 mm, incomplete height of the valve — about 47 mm. A faint posterior sulcus visible on the outer surface of valve. The attachment area narrow, occupying the dorsal margin. The hinge typical of the oysters, triangular

in shape, broad at the base, 5 mm high, 18 mm long; resilifer spoon-like deepened, bourrelets flat, about half the width of resilifer; the commissural shelf smooth, its width near the posterodorsal margin attains up to 12 mm; the surface of auricles concave, covered with about 12 chomata, some of which are discontinuous and dichotomous. The submedially placed adductor muscle scar rounded, 15 mm in diameter; it is flat, only somewhat deepened along the dorsal margin. The Quenstedt muscle scar faintly deepened, rounded, about 2 mm in diameter. Ornamentation consists of fine growth lines and depressed lamellae, which are more developed under the anterior auricle; inner surface smooth.

*Remarks.* — The specimen from Poland is close in its dimensions to the specimens described and illustrated by Rengarten (1964) from the Caucasus. It has similar thick walls, large auricles and a straight hinge margin. The same characters make the Polish specimen similar to those quoted and illustrated by Coquand (1869:114, pl. 42:1-7) and d'Orbigny (1847:719, pl. 476); it differs from them in the smaller deepness of the adductor scar and its submedial position. These differences fit within the range of the individual variability. More significant is the difference concerning the stratigraphic range. Our specimen comes from the Campanian, while those quoted in the above papers come from the Cenomanian to Santonian. Thus, the stratigraphic range of *Pycnodonte (P.) biauriculata* has to be enlarged.

Rengarten (1964) has included *Ostrea lesueuri* d'Orbigny into *P. (P.) auriculata*. In my opinion, *O. lesueuri* cannot be assigned here, because it is distinct in many characters such as: the lack of auricles and chomata, the circular outline of shell, the pointed umbo, the attachment area occupying the entire left valve, the thinness of the wall of valves, with reflexed margins along its periphery.

*Occurrence.* — Poland: Campanian (Nasiłów). Caucasus, Western Europe, Palestine: Cenomanian-Santonian.

#### Subgenus *Pycnodonte (Costeina)* Vyalov, 1965

#### *Pycnodonte (Costeina)* cf. *akkaptschigensis* (Bobkova, 1961)

(pl. 12:3)

*Material.* — One somewhat damaged left valve (ZPAL Mo. XI/31).

*Description.* — The valve broad, convex, thin-walled and translucent, 27 mm in height. The length about equals the height. Halfway the height, the valve attains its greatest convexity, being here 7 mm. The dorsal margin long, straight, occupied by the attachment area. Ornamentation consists of the growth lines, concentric folds and riblets which are, sometimes developed, as well as of radial riblets. The latter extend from the dorsal margin almost to half of valve. The inner surface is smooth except for a concentric spot of roughened and destroyed valve wall, where the vesicular microstructure is visible. This spot corresponds probably to the junction area between the valves. The hinge destroyed. The adductor muscle scar rounded, flat, 4 mm in diameter; it is submedially placed, very close to the dorsal margin.

*Remarks.* — The specimen from Poland is similar to that from the Campanian of the Tadjik SSR (Bobkova 1961:80, pl. 15:2a, b) in its size, outline, convexity and ornamentation. Both specimens expose the small posterodorsal and anterior lobes. Other Tadjik specimens (Bobkova l.c. pl. 15:1, 3) are larger, their umbos projected and the hinge triangular. The submedial position of the adductor muscle scar distinguishes the Polish specimen from those from the Tadjik SSR. However, this position shifts with growth and is related to the place of greatest convexity of the valve. Thus, it seems reasonable to accept that this difference may be due to the younger

growth stage of the Polish specimen. One of the Tadjik specimens (Bobkova l.c.: pl. 15:1) is 70 mm high and has thickened, irregularly arranged radial ribs as well as thickened, squamate shell, all these being gerontic features.

*Occurrence.* — Poland: Campanian (Nasiłów).

Subgenus *Pycnodonte* (*Phygraea*) Vyalov, 1936  
*Pycnodonte* (*Phygraea*) *vesicularis* (Lamarck, 1806)  
 (pl. 13:1-13)

1898. *Gryphaea vesicularis* Lam.; Müller:14, pl. 3:10-15.

1969. *Pycnodonta vesicularis* (Lamarck); Tschelzova:59, pl. 9:3-4.

*Material.* — Numerous well preserved valves, representing different growth stages, several shells (ZPAL Mo. XI/1-30; MZ VIII/ML-124/1-7).

*Supplementary description and growth changes.* — The prodissoconch almost globular, about 0.33 mm in diameter, with small umbo. Valves of the young individuals flat, thin-walled and rounded; their adductor muscle scar as long as high, flat and medially placed; the hinge weakly differentiated, with faintly depressed resilifer and unprotruded burrelets; chomata developed as few thickened riblets separated by grooves. During successive development stages, the valves enlarge quickly, the edges standing outside the substratum upturned; deepness of the left valves increases (pl. 13:1a); the hinge is strongly differentiated: resilifer becomes deeper and burrelets more convex; chomata are long, numerous, often dichotomous. The adductor muscle scar deepens at the dorsal margin and shifts more backwards (pl. 13:9). In the younger valves the posterior sulcus shows as a bending of the growth lines; a deepening typical of the species, appears later on, separating the elongated, posteroventral lobe (pl. 13:13). The valves of adult and gerontic individuals are strongly convex (more than 60 mm), thick-walled, above 100 mm in height; at the end of growth, the number of chomata decreases to a few deep grooves and tubercular thickenings; the Quenstedt muscle scar elongates up to 1.5 mm. Sometimes delicate brown spots are visible on the internal surface of the adult valves, which resemble the papillary lines of the finger tip (pl. 13:12). This structure shows through the successive layers of the valve, and the surface is quite smooth in this place.

The individual variability is very extensive in *Pycnodonte* (*Ph.*) *vesicularis* and it concerns, among others, the outline of valves, their convexity, the thickness of the walls, the dimensions, the deepness, shape and position of the adductor muscle scar, as well as the characters of chomata. This variability depends on the local environmental conditions, especially on the character and size of the substratum. Especially extensive variability is manifested in the shape and convexity of the valves in young individuals. The strongly convex, narrow valves attached to the substratum with a small or very small surface (pl. 13:1, 7), while the broad, faintly convex valves adhered to it with a very large surface, which occupies sometimes the whole surface of the left valve (pl. 13:2).

*Remarks.* — The above differences in the attachment surface between the narrow and broad valves was considered by von Hagenov (1842) to be of specific value and he described these forms accordingly as two separate species: *Ostrea ungula-equina* and *O. hippopodium*. The later authors (see Nestler 1965) regarded them as different growth forms of *Pycnodonte* (*Ph.*) *vesicularis*. The thickwalled, large valves with high hinge and a well developed vesicular layer were the objects of quite a few investigations. Among others, the age of an individual was calculated by the number

of growth lines of the ligament (Müller 1970) or the number of layers in the complex of lamellar and vesicular layers (Nestler 1965). The disturbances in the ligament (i.e. discontinuities, thickness and length) were taken into account as the indices of the environmental conditions and their influence on the functions of the organism and morphology of its valves (Müller 1970).

The brown spots resembling the papillary lines on the internal surface of the valve (mentioned in the above description) have been observed for the first time on fossil valves. This structure was reported by Dunker (1846) in the Recent species *Ostrea cumingiana* (fide Stenzel 1971), which was later included into the synonymy of *Alectryonella plicatula* (Gmelin 1971). Thin "fingerprint shell structure" in the species mentioned was illustrated by Stenzel (l.c.: figs J 29). According to this author, the etiology of such a structure is not clear, but in his opinion the translucent material of the thin threads is probably conchioline. This structure fully corresponds with those described and illustrated by Ranson (1966:22, pl. 15) in *Ostrea cumingiana*. Ranson (l.c.) suggests that the brown membrane may be formed when a foreign particle penetrates between the shell and the mantle. It envelopes locally the foreign body colouring the subnacreous layer brown. This membrane is secreted by the mantle in the continuation of the conchioline membrane, though it differs from the latter in structure.

*Occurrence.* — Poland: Campanian-Maestrichtian (Nasiłów, Bochoznica, Piotrowin). Species cosmopolitan, known from the Upper Cretaceous deposits.

*Pycnodonte (Phygraea) bechkochensis* (Weber, 1934)  
(pl. 11:1-2)

1969. *Gryphaella bechkochensis* (Weber); Tschelzova: 64, pl. 5:6-8.

*Material.* — Three well preserved left valves (MZ VIII/ML-124/8-10).

*Supplementary description.* — The valves obliquely oval, thick-walled (4 mm), with arched, often overhanging umbo (pl. 11:1a). Valves 30-35 mm high, 22-31 mm long; the maximum convexity at half their height equals 16-19 mm. The height index calculated for the narrow and high valves equals 1.5, while that for broad and low valves is 1.13 — 1.2. The growth lines and lamellae are irregular, bent at the posterior sulcus and posterodorsal lobe. The maximum depth of valves at halfway the height amounts to 10 mm. The hinge triangular, 5-6 mm in height and twice as long. Resilifer relatively deep, bourrelets narrow, convex. The elongated grooves, deep at the hinge and shallowing towards the ventral margin, are present on the surface of the commissural shelves (pl. 11:1a, 2a). They contain chomata, developed as simple or dichotomous riblets. These grooves fade away at the middle part of the valves. The proximal margin of commissural shelves, pronounced in the form of convex ridge at the hinge region, flattens away. The adductor muscle scar rounded 7-8 mm in diameter, deepened only along the dorsal margin. The Quenstedt muscle scar rounded about 1 mm in diameter.

*Remarks.* — The described specimens are most similar to those from the Crimea (Tschelzova 1969: pl. 5:6, 7) in having equally narrow, high, arcuate and overhanging umbo of the left valve. The minor differences concern the deeper sulcus and more elongate posteroventral lobe of the Crimea specimens. According to Tschelzova (l.c.: 64), the strongly arched umbo of the left valve devoid of the attachment area is indicative of the lying mode of life.

*Occurrence.* — Poland: Maestrichtian (Bochoznica region). West Europe: Upper Cretaceous. The Crimea: Upper Maestrichtian.

Genus *Hyotissa* Stenzel, 1971*Hyotissa semiplana* (Sowerby, 1825)

(pl. 14:1-3)

1898. *Ostrea semiplana* Sow.; Müller: 8, pl. 1:1-4, pl. 3:3.1961. *Lopha* (*Lopha?*) *semiplana* (Sowerby); Bobkova: 86, pl. 16:4.*Material*. — Ten valves in different growth stages (MZ VIII/ML-126/1-10).

*Supplementary description*. — The valves thick-walled, wide, almost as long as high. The largest specimen in the described collection measures 50 mm in height. The outer surface of valves rough, nodose, folded by few high and broad ribs. The growth lines undulated on the ribs passing into the spine-like lamellae (pl. 14:3b). The hinge relatively low, 7 mm high and 13 mm long on the largest specimen. The Quenstedt muscle scar rounded, about 1 mm in diameter. The commissural shelves geniculately reflexed, covered at the hinge with long, vermiculate chomata. The proximal margin of commissural shelves visible along almost entire periphery of the valves. Prodissoconch large, 0.75 mm in diameter. The vesicular microstructure well developed, with large vesicles.

*Remarks*. — The representatives of the genus *Hyotissa* Stenzel, 1971 are recently the characteristic elements of coral biocenoses. Thus the presence of *H. semiplana* in the Upper Cretaceous deposits in Poland may speak for the similar environmental conditions (stenohaline and stenothermal) prevailing in the Campanian and Maestrichtian seas.

*Occurrence*. — Poland: Campanian-Maestrichtian (Nasiłów, Solec region, the Mesozoic margin of the Holy Cross Mts, the Pieniny Mts). Europe, North Africa: Santonian-Maestrichtian.

*Hyotissa lunata* (Nilsson, 1827)

(pl. 15:1-7)

1840. *Ostrea lunata* Nilss.; Goldfuss: 11, pl. 7:2a-c.1869. *Ostrea unguolata* Coquand: 58, pl. 31:6-8, 10.

*Material*. — Twelve well preserved valves in different growth stages and five internal moulds (MZ VIII/ML-128/1-17).

*Supplementary description*. — The valves semilunar or highly oval, 10-30 mm in height, 6-17 mm in length. The umbo obtuse (pl. 15:4b, 5b, 6b), sometimes weakly prominent (pl. 15:1b, 2b, 3b) more or less declined backwards. The prodissoconch about 0.4 mm in diameter (pl. 15:3b, 6b). The medial portion of valves the most convex (pl. 15:1b, 2b, 5b, 6b), smooth or ornamented with undulated growth lines; the remaining surface ornamented with folds and growth lamellae. The lamellae and folds along the anterior margin undulate, are more numerous, upstanding and overlaying each other, what results in the high limbus. The margins of valves folded or denticulate; the folds and denticles are usually wider but less numerous on the anterior margin (pl. 15:2b, 4b) while narrower, smaller and more numerous on the posterior margin. The internal surface deepened unevenly, especially deep along the anterior margin and under the hinge, where the depth reaches to 3.5 mm (pl. 15:2a, 3a). The hinge typical of oysters is 1.5 mm high and 3 mm long; it lies obliquely at the dorsoposterior margin. The hinge margin is thickened, elevated above the valve surface. It is straight (pl. 15:6a) or arched (pl. 15:5a). The commissural shelves extend

along the valve periphery, being separated from their center with the proximal margin of commissural shelves. The upper surface of the shelves is covered with short, numerous chomata. The chomata on the denticulated margin of the right valves are pronounced as the small tubercles. These may be present along the entire periphery of valves, or disappear at the height of ventral edge of the adductor muscle scar (pl. 15:4a). The latter is flat, rounded, or with the straight dorsal edge; its diameter equals 4-5 mm (pl. 15:2a, 3a). The Quenstedt muscle scar is rounded and very small: its diameter increases during growth up to 0.45 mm (pl. 15:3a). The vesicular microstructure may be seen on the damaged surfaces of valves; it consists of irregular, tiny vesicles.

*Remarks.* — The Polish specimens of *H. lunata* are comparable to those described in the papers quoted in the synonymy. They are especially close to the specimens from Ciply (Belgium) illustrated by Coquand (1896: pl. 31:6, 7), both in the valve outline and the ornamentation. These specimens were included by Coquand (*l.c.*) into the synonymy of *Ostrea ungulata* Schlotheim, 1913 together with several other species, only some of which are in agreement with the diagnosis of Schlotheim's species (see Tschelzova 1969:51, pl. 2:5-7). The vesicular microstructure of *H. lunata* differs from that of *H. semiplana* in much smaller vesicles.

*Occurrence.* — Poland: Campanian-Maestrichtian (Nasiłów, Solec, Piotrowin), Maestrichtian (Mesozoic margin of the Holy Cross Mts). Europe, North America, North Africa: Campanian-Maestrichtian.

### *Hyotissa armata* (Goldfuss, 1840)

(pl. 12:4-5)

1840. *Ostrea armata* Goldfuss: 13, pl. 76:3.

1869. *Ostrea semiplana* Sowerby; Coquand: 74, pl. 25:1.

*Material.* — Three right and two left, partly damaged valves, one left valve well preserved (MZ VIII/ML-126/11-15).

*Description.* — Left valve obliquely oval, its height being 23 mm and the length — 19 mm. The umbo backwards, prominent, with the globular prodissoconch of about 0.33 mm diameter. The posterodorsal surface relatively large separated from the umbo with a contraction. The maximal convexity of valve, located in its upper portion, equals 5 mm. The anterior and ventral margin convex while the posterior depressed. The attachment area occupies an umbonal portion of the valve. Ornamentation consists of the small undulated growth lines and of about 12 radial folds with the uneven, nodular upper surface. A phased development of the ornamentation may be observed, which coincides with the successive growth stages of the valve. The youngest portion of the valve is ornamented with concentric sinuous growth lines and two low folds in its middle part. Successively, the number of folds increases up to 5, wider and higher than earlier, the spaces between them being larger than the folds themselves. The tubercles and upstanding growth lamellae appear on the upper surface of folds. These phases of growth are distinctly separated from each other by a deep, narrow, concentric furrow. The later growth changes concern the folds which become higher, wider and more numerous mainly as result of the dichotomous bifurcation. The widths of folds and of the spaces between them equalize. The height of folds at the ventral margin amounts to 4 mm. On the inner surface of the left valve there are traces of the radial folds visible, which are negatively marked as the spaces between the folds of the outer surface; the deeply incised lines, separating the successive growth stages are similarly pronounced on the inner surface (pl. 12:4a).



The hinge of structure typical of the oysters, 4.5 mm high, 3 mm long. The resilifer and bourrelets equal in width, well developed. The narrow furrows extend on both sides of the hinge; they end at the hinge margin. The commissural shelves folded and denticulated exteriorly, separated from the interior of valve with the thickened proximal margin of shelves. Few, deeply incised chomata occur on the small portion of the commissural shelves. They are short and simple. The adductor muscle scar flat, rounded, 5 mm in diameter.

*Remarks.*— The left valve of *Hytissa armata* is described and illustrated for the first time. This species was described by Goldfuss (1840:13) on the basis of the right valve alone. The Polish specimens are in agreement with the diagnosis given for the species by Goldfuss (*l.c.*). In both cases there occur the phased growth of valves, the same outline and identical ornamentation. The spines illustrated on the specimen described by Goldfuss are not present on the specimens described here. However, such spines were also developed on the Polish specimens judging from the preserved tubercles and spine-like thickenings, as well as from elongated lamellae, present on the upper surface of the radial ribs. The species was included by Coquand (1869) into the synonymy of *H. semiplana* (Sowerby). But, both these species differ in several characters. E.g. there is no phased growth in *H. semiplana*, its radial folds are irregular and the whole surface of valves is folded nodularly. The valves in this species are wide, chomata vermiculate. *H. armata* has been so far known from the Santonian, thus its presence in the Campanian deposits of Poland extends its stratigraphic range.

*Occurrence.*— Poland: Campanian (Nasiłów). FRG (Westphalia): Upper Santonian.

Subfamily **Exogyrinae** Vyalov, 1936

Tribe **Exogyrini** Vyalov, 1936

Genus *Exogyra* Say, 1820

Subgenus *Exogyra* (*Exogyra*) Say, 1820

*Exogyra* (*Exogyra*) *costata* Say, 1820  
(pl. 12:1)

1971. *Exogyra* (*Exogyra*) *costata* Say; Stenzel: 1116, figs J 89, 1; J 90.

*Material.*— One left valve of a young individual, damaged at the posterior and anteroventral margin (MZ VIII/ML-129/1).

*Supplementary description.*— The valve is 13 mm high, 11 mm long, 7 mm convex. The umbo prominent, 4 mm high, strongly deflected backwards, not spiral. The attachment area narrow, elongated, relatively large occupying the dorsal part of valve posteriorly. The ornamentation consists of numerous riblets concentric on the umbo and radial on the remaining surface of valve. The concentric riblets are oblique or straight, and are often discontinuous, interrupted with concentric thick growth lines. The riblets are irregular on the dorsal surface of the valve, being cut with tiny growth lines and having an appearance of small tubercles. The spaces between ribs are unequally wide, those wider than the ribs located on the anteroventral part of valve, with the narrower ones—in the posteroventral part. Some ribs are dichotomously divided. The flat, slightly protruding growth lamellae are visible on the posterior side of the umbo. The hinge of the exogyroid type is low, elongated. The resilifer is relatively deep, the anterior bourrelet flattened, the posterior one is short and convex. The chomata are not numerous, short; they are

visible on the internal surface of the reflexed margin of the valve, anterior to the hinge.

*Remarks.*—Valves of the adult individuals of this species attain more than 100 mm in height; they display a high umbonal spiral. The chomata on the commissural shelves posterior to the hinge may be vermiculate, being long and meandric, often divided. The adductor muscle scar located in the upper part of the valve, close to its posterior margin (Stenzel 1971: fig. 90).

*Occurrence.*—Poland: Maestrichtian (Bochotnica). Corsica, Texas: Maestrichtian.

### Genus *Amphidonte* Fischer de Waldheim, 1829

#### *Amphidonte decussata* (Goldfuss, 1840)

(pl. 12:2)

1840. *Exogyra decussata* Goldfuss: 33, pl. 86:11.

1840. *Exogyra conica* Sowerby; Goldfuss: 36, pl. 87:1.

1964. *Amphidonta decussata* Goldfuss; Rengarten: 48, pl. 6:10, pl. 7:1.

*Material.*—Two well preserved right valves of the young individuals (ZPAL Mo. XI/32-33).

*Supplementary description.*—The valves rounded, thin-walled, translucent, 11-13 mm in diameter. The opisthogyric umbo forming a flat spiral exceeding an angle of 180°. The prodissococonch globular about 0.33 mm in diameter. The external surface smooth, the fine growth lines being thicker in the umbonal portion of the valve, where they are slightly angular. The anteroventral margin of valves slightly upstanding (1 mm). The dorsal margin elevated, wide up to 1.5 mm. Few oblique growth lamellae upstanding, visible on the damaged dorsal portion of the margin. The internal surface smooth, somewhat convex along the anterior and ventral margins. The hinge is 0.5 mm high, 2.5 mm long, of the typical exogyroid structure. The anterior bourrelet flattened, the posterior convex, arcuate, covered with tubercles. The commissural shelves smooth, narrow, reflexed; on the small surface under the hinge they are covered with chomata developed as short, thickened riblets. The proximal margin of the commissural shelves roller-like thickened along the posterior margin of the valves, being flat along the remaining periphery (pl. 12:2a). The adductor muscle scar obliquely oval, 3.5 mm long, 2 mm high.

*Remarks.*—The Polish specimens are similar to the German ones described and illustrated by Goldfuss (1840) as *Exogyra conica* Sowerby. The similarities concern the outline of valve, the ornamentation, the elevated dorsal and anteroventral margins as well as the position and the outline of adductor muscle scar. The Polish specimens are half the size of the German ones.

*Occurrence.*—Poland: Campanian (Nasiłów). West Europe, India, Algeria, Tunisia: Campanian-Maestrichtian. The Small Caucasus: Upper Santonian—Lower Campanian.

### Genus *Rhynchostreon* Bayle, 1878

#### *Rhynchostreon* cf. *suborbiculatum* (Lamarck, 1801)

(pl. 15:8)

*Material.*—One left valve, damaged ventrally (MZ VIII/ML-129/2).

*Description.*—The valve strongly convex, the more so along the medial line extending between the umbo and the ventral margin where its convexity reaches up

to 15 mm. The outline ovate, narrowed at the umbo. The height amounts to 30 mm, the incomplete length is about 20 mm. The umbo long, narrow, arcuate directed backwards without the attachment trace. The external surface of valve smooth but for the umbo, where the thin growth lines are visible. The imprints of the growth lamellae are present on the mould of ventral portion of the valve. On the damaged surface of the lateral side numerous beekites are present. A faint keel extends along the 10 mm of the umbo surface.

*Remarks.* — The specimen resembles a representative of *Rhynchostreon suborbiculatum* described and illustrated by Stenzel (1971:1122, fig. J 97:1d-f) but differs from the latter in the lack of posterior sulcus and of the radial, thin riblets on the umbo, as well as in the less coiled umbo. The lack of ornamentation of the umbo may be caused by the preservation state of the Polish specimen. Other distinguishing features are those occurring on the adult growth stages. According to Stenzel (*l.c.*) the valves in this species attain 130 mm in height. *Rh. suborbiculatum* occurs in the lower stages of the Upper Cretaceous (Cenomanian-Turonian) in America (Mexico, Texas, Colorado) and in several European countries (Great Britain, France, the FRG, Czechoslovakia, Hungary, Spain, Portugal, Italy, Sardinia), the USSR and in India and Syria. The specimen described above has been found in the Campanian of the Middle Vistula region. Thus, it is not excluded that *Rh. suborbiculatum* may have more extensive stratigraphic and geographic range.

*Occurrence.* — Poland: Campanian (Nasiłów).

**Tribe Gryphaeostreini Stenzel, 1971**  
**Genus Gryphaeostrea Conrad, 1865**  
*Gryphaeostrea vomer* Stephenson, 1941  
(pl. 16:1-12)

1971. *Gryphaeostrea vomer* Stephenson; Stenzel: 1125, fig. J 98:2a-e.

*Material.* — Numerous valves and a dozen shells in good state of preservation (ZPAL Mo. XI/35-45; MZ VIII/ML-125/1-12).

*Supplementary description.* — The largest shell in the collection is 45 mm high, 30 mm long, 12 mm convex. The attachment area large, depressed occupies the posterodorsal portion of the left valve. The growth lamellae adjoining the attachment area elongated into an irregular bent, thickened shelly claspers fastening the attachment of the shell to substratum (pl. 16:7, 11, 12). The posterodorsal lobe usually large, with numerous growth lines on its inner surface, developed in places in the form of growth lamellae directed upwards (pl. 16:11, 12). This mode of development of lamellae may be explained as a more economic way of a fast thickening of valves. Similarly pronounced growth lines and lamellae are present along the commissural shelves. These latter are separated from the inner surface of valves with the proximal margin of commissural shelves. Chomata are absent.

*Growth changes.* — The youngest valves in the collection are round or regularly oval with the prodissoconch directed dorsally. There occurs a change of the growth direction during the successive developmental stages, the young valves becoming coiled backwards usually at the right angles to the adult valve. They form sometimes an umbonal spiral of 180° (pl. 16:3a). The growth lines, well developed on the right valves, transform during the growth into more or less thickened and projecting growth lamellae (pl. 16:2, 3a, 4, 5a, 6a). The distance between lamellae successively increases and in the adults it exceeds 4 mm. The prodissoconch is large, 0.5 mm in diameter and has a triangular shape on the youngest valves. It does not change in

size during the growth, but its position, at first dorsal to the valve, becomes opisthogyric (pl. 16:3a, 9, 10).

The individual variability is very extensive and concerns almost all the specific characters, two identical valves not to be found. The variability is manifested at most in the general shape, which may change from a rounded one, through oval with a larger height, to a symmetrical or asymmetrical triangle with a different umbo position; often the shape of valve resembles a reversed triangle. The variability concerns also the number of lamellae, their height, thickness and spacing. The adductor muscle scar on the right valves mainly varies in the outline, depth and position. Generally, it is oval with a larger height, slightly depressed along the periphery, and placed somewhat above the valve center.

*Remarks.* — The Polish specimens resemble mostly those described and illustrated by Stephenson (1941) and Stenzel (1971). The extensive variability of this species allows one to compare the specimens with many representatives of other species within the genus *Gryphaeostrea*, e.g. *G. eversa* (Melleville) from the Lower Eocene, *G. plicatella* (Morton) from the Upper Eocene, *G. canaliculata* (Sowerby) from the Albian and *G. lateralis* (Nilsson) from the Cretaceous and Oligocene. The lack of distinct morphological differences between the above species was also noticed by other authors (Archangelsky in Mirkamalov 1966:46); the only difference is in their stratigraphic age. *G. vomer* from Europe has been described for the first time in the present paper.

*Occurrence.* — Poland: Campanian-Maestrichtian (Nasiłów, Bochoznica). North America: Maestrichtian.

### Family **Ostreidae** Rafinesque, 1815

#### Subfamily **Ostreinae** Rafinesque, 1815

#### Genus *Crassostrea* Sacco, 1897

#### *Crassostrea subtriangularis* (Evans & Shumard, 1857)

(pl. 14:4)

1970. *Crassostrea subtrigonalis* (Evans & Shumard); Speden: 93, pl. 19:23, 24; pl. 20: 1-11 (with synonymy).

*Material.* — Two right valves, one imprint (MZ VIII/ML-127/1-3).

*Supplementary description.* — The valves thick-walled, high and narrow. The largest specimen in the collection is 45 mm high, 23 mm long. The greatest convexity (7 mm) in umbonal part. The umbo small, projecting and overhanging the hinge, with a large prodissoconch 1 mm in diameter. The dorsoposterior margin oblique, lower at the posterior margin. The lateral margins almost parallel, reflexed upwards. Along the posterior margin, runs a furrow which widens during growth, becoming a broad depression occupying the ventral part of valve. The irregular thickenings and nodules are visible on the outer surface, as well as the growth lamellae which are well developed at margins, being occasionally upstanding. The nodules cover also the umbonal part of valves, being arranged in vertical rows. They correspond to the radial folds present in the different representatives of genus *Crassostrea* (Stenzel 1971:1129). The inner surface of valves is smooth, but for the ventral region which has unequally convex, irregular thickenings. The hinge is obliquely triangular, lowered posteriorly, of the oyster type, its maximal height of 4 mm occurring under the overhanging umbo; its length equals about 10 mm. The resilifer is faintly convex, the bourrelets somewhat deepened. The posterior one is higher than the anterior. The dorsoanterior margin declining, short and thickened.

Ten chomata placed below the hinge, on the 3 mm short portion of the posterior margin of the valve. They are short, simple, perpendicular to the edge of the valve. The adductor muscle scar rounded, flat, with somewhat depressed dorsal margin. Its diameter (being slightly larger along its height) equals about 10 mm.

*Remarks.* — The Polish specimens do not differ from those described by Speden (1970) from North America.

*Occurrence.* — Poland: Campanian-Maestrichtian (Piotrawin). North America (Canada, Dakota): Maestrichtian.

Zakład Paleobiologii  
Polska Akademia Nauk  
Al. Zwirki i Wigury 93  
02-089 Warszawa  
Maj, 1976

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HALINA PUGACZEWSKA

OSTRYGI GÓRNOKREDOWE Z PRZEŁOMU ŚRODKOWEJ WISŁY (POLSKA)

*Streszczenie*

Ostrygi z osadów górnokredowych przełomu środkowej Wisły (fig. 1) są bogate ilościowo i zróżnicowane gatunkowo. Opisano 12 gatunków należących do 8 rodzajów i 3 podrodzin: Pycnodontinae, Exogyrinae i Ostreinae (pls 11—16). Pycnodontinae reprezentowane są najliczniej (7 gatunków). Najbogatsza ilościowo fauna pochodzi z kampanu w Nasiłowie, stanowiąc 80% całego materiału. Obejmuje ona głównie dwa gatunki: *Pycnodonte (Phygraea) vesicularis* (Lamarck, 1806) i *Gryphaeostrea vomer* Stephenson, 1941, na których przeprowadzono obserwacje dotyczące zmian wzrostowych. Na wewnętrznej powierzchni skorupki *Pycnodonte (Phygraea) vesicularis* zidentyfikowano brunatny ślad przypominający linie papilarne (fingerprint shell structure) jako ślad błonki konchiolinowej w warstwie perlówatej (subnacrée — według Ransona 1966). Z analizy fauny towarzyszącej w omawianych utworach wynika, że w starszych poziomach górnej kredy dominowały Ostreidae, zaś w młodszych ramienionogi i belemnity.

Praca wykonana w ramach problemu MR. II/3.

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ХАЛИНА ПУГАЧЕВСКА

УСТРИЦЫ ВЕРХНЕГО МЕЛА ИЗ РАЙОНА ЦЕНТРАЛЬНОЙ ВИСЛЫ  
(ПОЛЬША)

## Резюме

В районе Центральной Вислы (фиг. 1) встречаются в большом многообразии и в большом количестве устрицы отложений верхнего мела. Было описано 12 видов, которые принадлежат к 8 родам и 3 подсемействам: *Pycnodonteinae*, *Exogyrinae* и *Ostreinae* (табл. 11—16). Самое многочисленное подсемейство *Pycnodonteinae* (7 видов). Большая часть фауны, которая составляет 80% всей коллекции, относится к кампану из Насилова. Она состоит, главным образом, из двух видов: *Pycnodonte (Phygraea) vesicularis* (Lamarck, 1806) и *Gryphaeostrea vomer* Stephenson, 1941, на которых были проведены наблюдения изменения роста раковины. На внутренней поверхности раковины *Pycnodonte (Phygraea) vesicularis* обнаружен коричневый след, похожий на папиллярные линии (finger-print shell structure), который является следом конхиолиновой плёнки в перламутровом слое (subnacre — по Рансону 1966). Из анализа фауны, сопутствующей устрицам следует, что в древних толщах верхнего мела преобладали *Ostreidae*, в то время как в более молодых — плеченогие и белемниты.

## EXPLANATION OF THE PLATES

## Plate 11

*Pycnodonte (Phygraea) bechkochensis* (Weber)  
Maestrichtian, Parchatka near Bochoznica

1. Left valve of adult specimen (MZ. VII/ML-124/9): a internal, b external views,  $\times 2$ .
2. Left valve of adult specimen (MZ VIII/ML-124/10): a internal, b external views,  $\times 2$ .

*Pycnodonte (Pycnodonte) biauriculata* (Lamarck)  
Maestrichtian, Nasilów

3. Left valve of adult specimen (MZ VIII/ML-124/12): both auricles with chomata, well developed: a internal, b external views,  $\times 1.5$ .

## Plate 12

*Exogyra (Exogyra) costata* Say  
Maestrichtian, Bochothnica

1. Left valve of young specimen (MZ VIII/ML-129/1): *a* internal, *b* external views,  $\times 2$ .

*Amphidonte decussata* (Goldfuss)  
Campanian, Nasiłów

2. Right valve of young specimen (ZPAL Mo/XI/32): *a* internal, *b* external views,  $\times 2$ .

*Pycnodonte (Costeina) cf. akkaptshigensis* (Bobkova)  
Campanian, Nasiłów

3. Left valve of young specimen (ZPAL Mo/XI/31): *a* interna, *b* external views,  $\times 2$ .

*Hyothissa armata* (Goldfuss)  
Campanian, Nasiłów

4. Underformed left valve of young specimen (MZ VIII/ML-126/11): *a* internal, *b* external views,  $\times 1.5$ .  
5. Deformed right valve of young specimen (MZ VIII/ML-126/12): *a* internal, *b* external views,  $\times 3$ .

## Plate 13

*Pycnodonte (Phygraea) vesicularis* (Lamarck)  
Campanian, Nasiłów (1—11); Maestrichtian, Bochothnica (12);  
Maestrichtian, Nasiłów (13)

1. Left valve of a young specimen (ZPAL Mo. XI/1): *a* internal, *b* external views,  $\times 1.5$ .  
2. Elongate left valve of a young specimen (ZPAL Mo. XI/2): *a* internal, *b* external views,  $\times 2$ .  
3. Rounded right valve of a young specimen (ZPAL Mo. XI/3): *a* internal, *b* external views,  $\times 2$ .  
4. Ovate right valve of a young specimen with rounded dorsal margin (ZPAL Mo. XI/4): *a* internal, *b* external views,  $\times 2$ .  
5. Ovate right valve of a young specimen with rounded dorsal margin (ZPAL Mo. XI/5): *a* internal, *b* external views,  $\times 2$ .  
6. Valve with vesicular structure visible (ZPAL Mo. XI/19),  $\times 6$ .  
7. Left valve of young specimen (ZPAL Mo. XI/24): side view, arcuate shape of valve visible,  $\times 2$ .  
8. Left valve (ZPAL Mo. XI/8): short claspers around the attachment area visible,  $\times 1$ .  
9. Right valve (ZPAL Mo. XI/22): internal view; resilifer concave, dichotomous chomata well developed,  $\times 1.5$ .  
10. Right valve of an adult specimen (ZPAL Mo. XI/6): external view; radial riblets on lower part of the valve visible,  $\times 2$ .



11. Quenstedt muscle scar (ZPAL Mo. XI/11): growth lines on the scar and radial furrow near the scar visible,  $\times 11$ .
12. "Fingerprint shell structure" on internal surface of a left valve visible (ZPAL Mo. XI/26),  $\times 3$ .
13. Left valve of an adult specimen (ZPAL Mo. XI/18): posteroventral lobe and radial sulcus well defined,  $\times 0.8$ .

## Plate 14

*Hyotissa semiplana* (Sowerby)  
Campanian, Nasiłów

1. Left valve of a young specimen (MZ. VIII/ML-126/1): *a* internal, *b* external views,  $\times 2.5$ .
2. Left valve of a young specimen (MZ VIII/ML-126/2): umbo strongly opistogyrate, *a* internal, *b* external views,  $\times 2.5$ .
3. Left valve of an adult specimen (MZ VIII/ML-126/3): dorsoventral lobe visible, *a* internal, *b* external views,  $\times 1.5$ .

*Crassostrea subtrigonalis* (Evans & Shumard)  
Maestrichtian, Piotrowin

4. Right valve of a young specimen (MZ VIII/ML-127/1): *a* internal, *b* external views,  $\times 2$ .

## Plate 15

*Hyotissa lunata* (Nilsson)  
Campanian, Nasiłów (1—5); Maestrichtian, near Solec (6, 7)

1. Right valve of a young specimen (MZ VIII/ML-128/1): *a* internal, *b* external views,  $\times 3$ .
2. Right valve of a young specimen (MZ VIII/ML-128/2): valve geniculate, semilunar in shape, *a* internal, *b* external views,  $\times 3$ .
3. Right valve of an adult specimen (MZ VIII/ML-128/3): upper surface of the valve unevenly unfolded with numerous, upstanding growth lamellae, *a* internal, *b* external views,  $\times 3$ .
4. Left valve of a young specimen (MZ VIII/ML-128/4): valve arcuate in shape, radial folds on upper surface of the valve visible, *a* internal, *b* external views,  $\times 2.5$ .
5. Left valve of a young specimen (MZ VIII/ML-128/5): unevenly folded valve, *a* internal, *b* external views,  $\times 2.5$ .
6. Left valve of a young specimen (MZ VIII/ML-128/6): lamellate ornamentation visible, *a* internal, *b* external views,  $\times 2.5$ .
7. External mould of right valve of an adult specimen (MZ VIII/ML-128/7): radial riblets visible,  $\times 1.5$ .

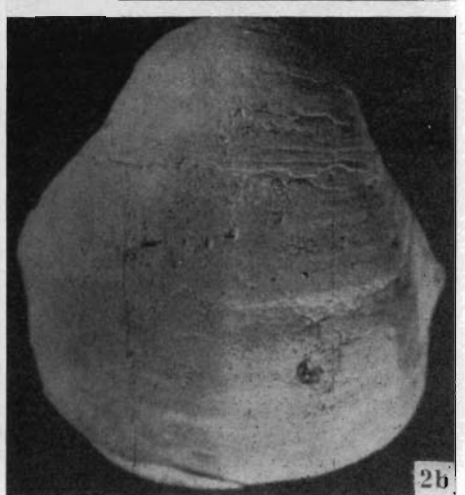
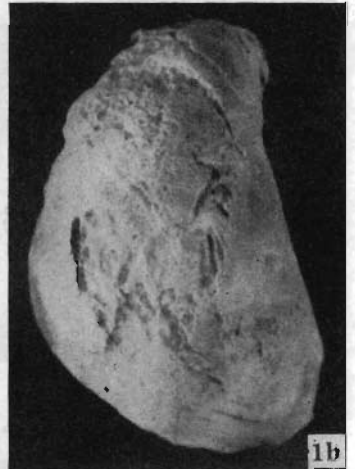
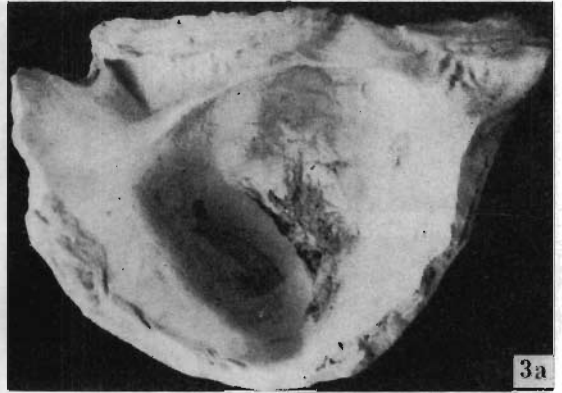
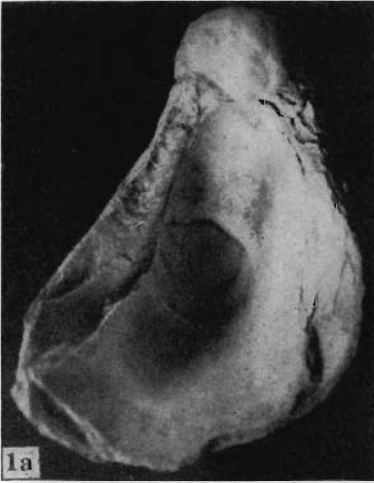
*Rhynchostreon* cf. *suborbiculatum* (Lamarck)  
Campanian, Nasiłów

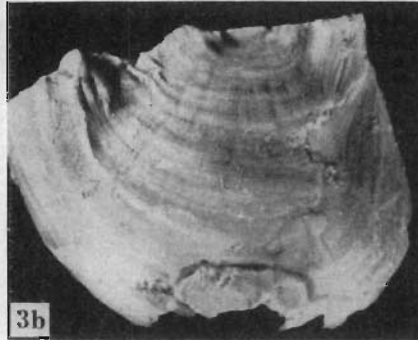
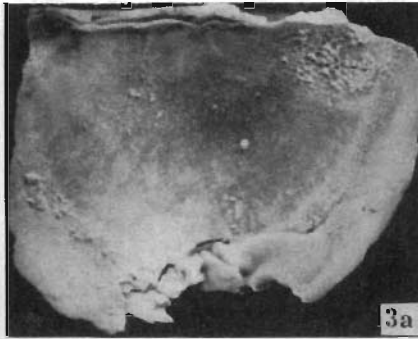
8. Left valve of a young specimen (MZ. VIII/ML-129/2): view from posterior margin,  $\times 3$ .

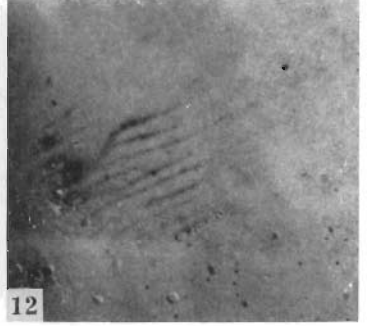
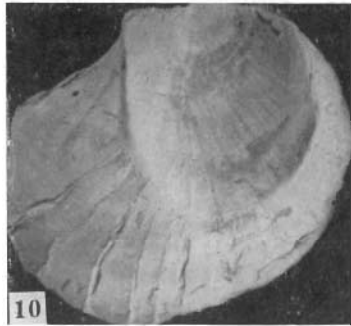
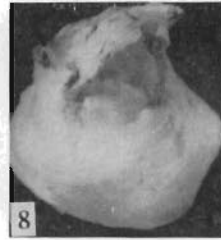
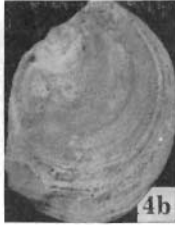
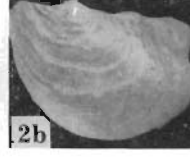
## Plate 16

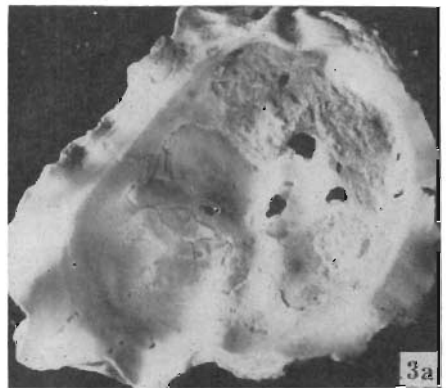
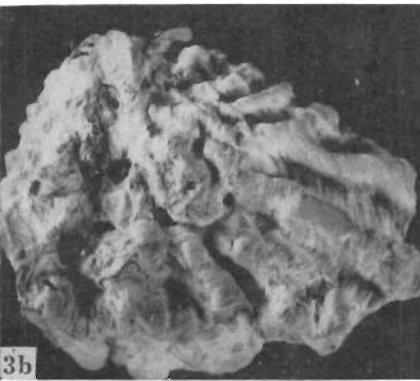
*Gryphaeostrea vomer* Stephenson  
Campanian, Nasiłów

1. Right valve of an adult specimen (MZ VIII/ML-125/1): posterodorsal, oblique margin and posteroventral lobe visible,  $\times 2$ .
2. Right valve of a young specimen (MZ VIII/ML-125/2): valve rounded, umbo shifted posteriorly,  $\times 2$ .
3. Right valve of a young specimen (MZ VIII/ML-125/3): valve ovate, higher than long; *a* internal, *b* external views,  $\times 2$ .
4. Right of an adult specimen (MZ VIII/ML-125/4): valve ovate, higher than long; thick, upstanding growth squamae well separated from each other,  $\times 2$ .
5. Right valve of an adult specimen (MZ VIII/ML-125/5): growth squamae numerous, *a* external, *b* internal views,  $\times 2$ .
6. Right valve of an adult specimen (MZ VIII/ML-125/6): valve subrectangular with small posterodorsal auricle-like extension, *a* external, *b* internal views,  $\times 2$ .
7. Shell short claspers visible (MZ VIII/ML-125/7): *a* side view, *b* external surface of right valve,  $\times 2$ .
8. Shell with few very short claspers developed (MZ VIII/ML-125/8): *a* side view, *b* right valve with wide depressed growth squamae,  $\times 2$ .
9. Left valve of a young specimen (MZ VIII/ML-125/9): umbo slightly opisthogyral, prodissoconch large, subspherical,  $\times 10$ .
10. Fragment of left valve of an adult specimen (MZ VIII/ML-125/10): large prodissoconch on the top of strong opisthogyral umbo visible,  $\times 10$ .
11. Fragment of left valve of an adult specimen (ZPAL Mo. XI/34): growth lines and fine, upstanding lamellae on inner surface of the valve margin visible,  $\times 5$ .
12. Fragment of left valve of an adult specimen (ZPAL Mo. XI/35): same ornamentation as on fig. 11,  $\times 5$ .











1a



4a



4b



1b



5a



6a



6b



5b



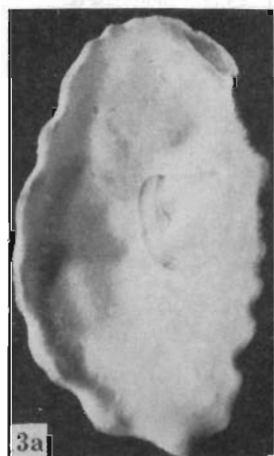
2a



7



2b



3a



8



3b

