A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. 22 1977 No 1

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PELECYPODS FROM THE UPPER EOCENE OF EAST POLAND

Abstract. — The pelecypod assemblage from Upper Eocene sandy deposits of the vicinity of Siemień and Luszawa (eastern part of the Polish Lowlands) consists of 23 species. The majority of the species are typical of the Bartonian.

INTRODUCTION

Macrofauna of Siemień and Luszawa is the only hitherto known from the Late Eocene Polish Lowlands. Ciuk (1967, 1970) has mentioned another Late Eocene macrofauna finding, in the central Polish Lowlands, but this material has not been studied so far. The fauna from the borehole in central Polish Lowlands, considered as Late Cretaceous by Lewiński and Samsonowicz (1918), may be also of the Late Eocene age.

The pelecypods described here are derived from sandy Upper Eocene deposits cropping out in the Siemień area and those penetrated by the borehole Luszawa in the Lublin region (fig. 1). The pelecypods are accompanied by abundant macrofauna (see p. 98), microfauna as well as plant remains.

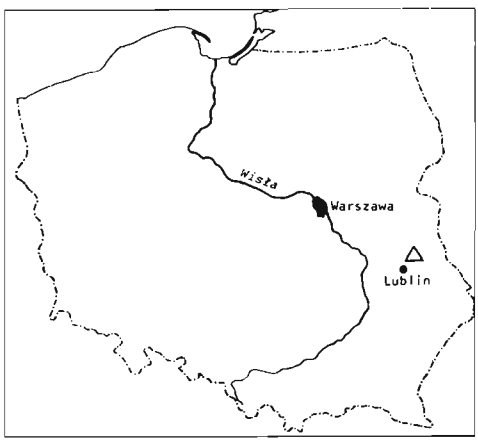

Fig. 1. Location of outcrops of the Upper Eocene deposits in E Poland.

Macrofossils described here are housed in the Geological Institute (abbrev. IG).

Acknowledgements. — Author is very indebted to Professor Wilhelm Krach (Institute of Geological Sciences, Polish Academy of Sciences, Cracow) and Professor Edward Rühle (Geological Institute, Warsaw), thanks to the enthousiasm of which the study was undertaken. Thanks are due to Dr Borys Areń, Dr Maria D. Domosławska, Dr Władysław Karaszewski, Dr Janina Łyczewska, Prof. Władysław Pożaryski (all from Geological Institute, Warsaw) and Prof. Krystyna Pożaryska (Institute of Palaeobiology Polish Academy of Sciences, Warsaw) for discussions, suggestions and comments. Thanks are also due to Dr. Anna Kecskemeti-Kormendy, Dr Endre Dudich, Jr., Dr Laszlo Gidai, Dr Gabor Kopek, Dr G. Radocz, Dr I. Cserpegi-Meznerics, Dr. Tibor Kecskemeti (Budapest), Prof. Charles Pomerol, Dr Alphonse Blondeau, and Prof. J. Roger (Paris), Dr Dennis Curry and Dr Claude Cavalier (Orleans), Dr Maria Luisa Tembrock, Dr E. Latzar and Dr D. Lotsch (Berlin) for their help.

The author acknowledges the possibility to examine the collections of the National Museum and the Museum of the Geological Institute in Budapest, the Museum of the Geological Institute in Berlin and the collections of the University of Paris and the Mining School in Paris for comparative purposes.

The photos were made by Mrs. J. Modrzejewska, Mrs. S. Pacuszko helped in preparation of the specimens.

LITHOLOGICAL AND FAUNISTIC CHARACTERISTIC OF UPPER EOCENE DEPOSITS FROM THE VICINITIES OF SIEMIEŃ AND LUSZAWA

Upper Eocene deposits cropping out in the Siemień area and penetrated by the borehole Luszawa are less than 10 m thick. They overlay the Maestrichtian and are covered by Quaternary sands (see Woźny 1966a and the profile in Pożaryska 1977). The Upper Eocene is represented by transgressive marine series. The basal part of the series is formed by quartz-glauconitic sands with quartz and lydite pebbles. Upwards the content of gravel decreases and numerous phosphatic nodules appear. The content of calcium and marly admixture in these sands is variable; in places intercalations of limestone are found. The deposit becomes devoid of calcium, silty, clay-sandy and clayey and gaizes appear towards the top of the series.

The fauna occurs throughout the profile, in places becoming very abundant. The organic assemblage comprises abundant microorganisms, such as: coccoliths (Locker *in*: Pożaryska & Locker 1971), foraminifera (Pożaryska 1977), problematica (Szczechura 1969) and representatives of various groups of vertebrates and invertebrates. Solitary corals and spher-

ical, discoidal or branched bryozoans are very numerous. Small, thin-walled brachiopods and gastropods are rare. Pelecypods and especially oysters and pectens occur in masses. Spondylus shells are rare in the Siemień area, occurring in masses in core material from the borehole Luszawa. Echinoid spines are fairly common; of these the spines belonging to *Rhabdocidaris anhaltina* are most common and usually best preserved. Ostracodes are represented by numerous species (Szczechura 1977). Moreover, vertebrates are represented by teeth and vertebrae of sharks and otoliths. The deposits yield numerous relics of terrestial plants (wood fragments and lumps of amber).

The macrofauna is generally poorly preserved because of strong decalcification of skeletons. Corals, bryozoans, brachiopods, pelecypods (and especially pectens, oysters and spondylus) as well as otoliths, teeth and vertebrae of fishes are best preserved. However, even in case of these groups it is difficult to extract complete specimens from rock because of partial decalcification and fracturing. It appears thus necessary to harden shells before extraction. Some specimens as e.g. spondylus shells and shark teeth display traces of mechanical destruction which took place before their burial.

Palaeoecological conclusions. — The reconstruction of ecological conditions is based on representatives of the genera whose recent species are characterized by limited bathymetric and temperature ranges. Such requirements are met by the genera *Hornera, Terebratulina, Chlamys, Spondylus, Ostrea* and *Odontaspis*. Of these genera only *Terebratulina* is known to live in temperate and cool waters. The recent representatives of the remaining genera are known from neritic and littoral zones of warm and temperate seas; for example, *Hornera* is known to live in the Mediterranean Sea at 10—80 m depths; *Chlamys* — mainly in warm and temperate seas 1 to 90 m deep, and the species *Chlamys biarritzensis* and *Ch. bellicostata* are considered as representatives of the *Ch. opercularis* group, known to occur in the Mediterranean Sea (Roger 1944); *Spondylus* — in warm waters at depths to 30 m; *Ostrea* — in warm waters (but it withstands high temperature changes during a years) 0—90 m deep; and *Odontaspis* — in littoral to pelagic zones of tropical to temperate seas. The presence of numerous corals in the Upper Eocene faunal assemblage indicates normal salinity of the waters.

This faunal assemblage indicates that the Upper Eocene deposits from the vicinities of Siemień and Luszawa originated in shallow, rather warm (mean annual temperature about 20°C) marine water of normal salinity. These are deposits of a transgressing and gradually deepening sea. They are initially rich in gravel size grains, becoming progressively finer grained upwards. At the base of the profile they are clearly littoral and in places it is possible to trace relics of oyster layer. Upwards, oysters become rarer and solitary corals and pectens appear in masses. Along with a trans-

istion from sands to silty deposit corals almost completely disappear, oyster become rare and only pectens are still fairly numerous.

Similar temperature conditions prevailed in the neighbouring areas during the Late Eocene. For example, a shallow sea with warm waters of somewhat reduced salinity existed in these times in the southern direction, at Bukowiec, in the area of the present source of the San river (Krach & Liszka 1961). In the same direction another basin, about 100 m deep and with warm water of normal salinity, existed at Magierowo, the Lwowsko-Rawskie Roztocze (Kudrin 1966). In Sambia situated about 600 km N of the area studied the climate was warm (mean annual temperature about 20°C) and the sea situated there — shallow, with normal or somewhat reduced salinity (Katinas 1971). It follows that the character of the macrofaunal assemblage and palaeogeographic setting of the Siemień-Luszawa marine basin between warm climate areas seem to indicate a warmer climate than that assumed on the basis of microfaunal data (Pożaryska 1977; Szczechura 1977).

STRATIGRAPHIC POSITION OF FAUNAL ASSEMBLAGES FROM POLAND AND ITS RELATIONS TO THOSE FROM OTHER REGIONS OF EUROPE

The deposits from Siemień were dated at the Eocene by Rühle (1955). Subsequent macrofaunal studies (Woźny 1966*a*) made it possible to precise that dating at the Late Eocene and, finally, Bartonian (Woźny 1967), on account of the similarity of the faunal assemblage to that from the Bartonian of England. On the basis of analysis of planktonic foraminifers these deposits from Siemień were dated at the *Globigeraspis semiinvolute* Zone, that is the lower part of the Upper Eocene, by Pożaryska (*in* Pożaryska & Locker 1971), and on the basis of coccoliths — at the *Discoaster tani nodifer*, that is the uppermost Middle and lowermost Upper Eocene by Locker (op. cit.).

The Upper Eocene macrofaunal assemblage from the vicinities of Siemień and Luszawa does not comprise any guide forms. Fig. 2 presents stratigraphic ranges of elements of that assemblage, compiled in order to establish its age. This diagram shows the predominance of Eocene species (68%) as only 28% of species are also known from the Oligocene and the contribution of Paleocene and Miocene species is negligible (3% and 1%, respectively). The stratigraphic range of the assemblage comprises time interval from the Thanetian to Burdigalian; the largest number of species is known, however, from the Bartonian (28%), somewhat less from the Auversian (22%) and still less from the Lattorfian (19%) and Lutetian (13%). Attention should be paid to the record of *Chlamys carinata carinata* (Sowerby), hitherto known only from the horizon H, the beds with *Chama*, lower part of the Upper Bartonian of Hampshire (stratotype).

The assemblage comprises 23 species known from the Tertiary of Ukraine, somewhat less (10—15) species known from the western Europe and much less (4—9) known from the southern Europe and Egypt. A small number of species known also from Sambia (7 species) may be explained by insufficient knowledge of very poorly preserved fauna from the latter

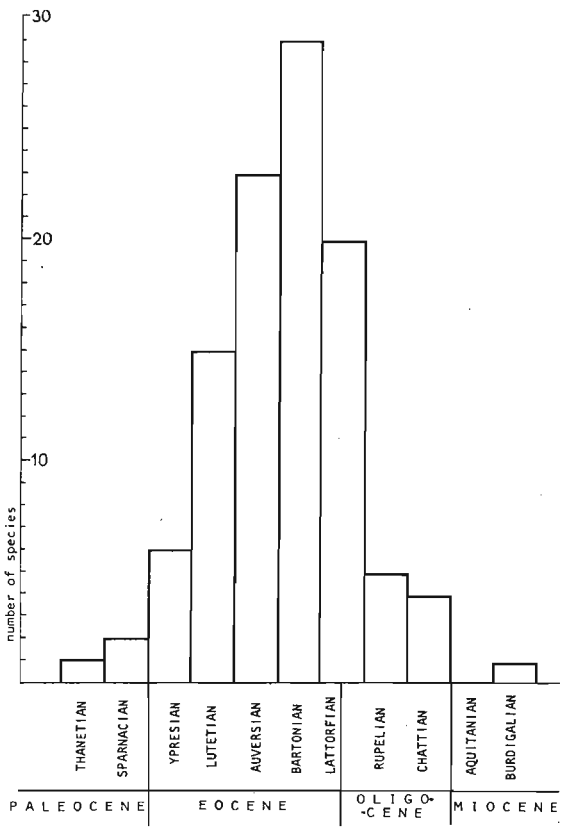

Fig. 2. Stratigraphical range of Siemień-Luszawa macrofauna (see also List of species p. 98).

region. Attention should be paid to a small number of species in common with Dutch fauna (2 species).

Upper Eocene deposits similar to those from the vicinities of Siemień and Luszawa are known from several boreholes throughout the Polish Lowlands (Ciuk 1969, 1970*a*, *b*: Cimaszewski 1964; Odrzywolska-Bieńkowa 1967, 1972*a*, *b*, *c*). Deposits from the vicinities of Siemień and Luszawa represent a basal part of sandy Upper Eocene series which attains 40—100 m in thickness in the Polish Lowlands. The analysis of geographic distribution of macrofauna derived from the deposits of the Siemień-Luszawa area has shown that the deposits originated in a basin connected

by efficient seaways with both western and eastern parts of European epicontinental sea. The sea occupied an area stretching from the Black Sea region through Ukraine, Byelorussia, Lithuania, Poland, northern G.D.R. and F.R.G. and Belgium to southern England and western France.

LIST OF SPECIES OF MACROFAUNA FROM THE UPPER EOCENE OF SIEMIEŃ-LUSZAWA REGION

Scleractinia:
- *Parasmilia* sp.
- *Balanophyllia subcylindrica* Philipp

Bryozoa:
- *Hornera porosa* Stoliczka
- *Orbitulipora petiolus* (Lonsdale)
- *Batopora stoliczkai* Reuss

Brachiopoda:
- *Terebratulina planicosta* Koenen

Gastropoda:
- *Mesalia* cf. *marginata* Kluschnikov
- *Tomyris ukrainae* Michajlovski
- *Casidaria* cf. *tenuis* Koenen

Pelecypoda:
- *Lentipecten corneus* (Sowerby)
- *Chlamys caillaudi* (Oppenheim)
- *Chlamys recondita* (Solander)
- *Chlamys carinata* (Sowerby)
- *Ch. biarritzensis subtripartita* (d'Archiac)
- *Chlamys biarritzensis biarritzensis* (d'Archac)
- *Chlamys bellicostata* (Wood)
- *Chlamys sokolovi* Kluschnikov
- *Spondylus buchi* Philippi
- *Spondylus tenuispina* Sandberger
- *Ostrea angusta* Deshayes
- *Ostrea ventilabrum* Goldfuss
- *Ostrea submissa* Deshayes
- *Ostrea plicata* (Solander)
- *Ostrea prona* Wood
- *Ostrea prona longa* Alekseev
- *Crassatella desmaresti* (Deshayes)
- *Crassatella sulcata* (Solander)
- *Crassatella compressa* (Lamarck)
- *Salaputium woodi* (Koenen)
- *S. woodi raricostata* (Kluschnikov)
- *Pitar sulcataria* (Deshayes)
- *Panopea gastaldi* Mikhajlov

Vertebrata:
- *Odontaspis hopei* (Agassiz)
- *Odontaspis macrota* (Agassiz)

DESCRIPTIONS OF PELECYPODS

Order **Pterioida** Newell, 1965
Suborder **Pteriina** Newell, 1965
Family **Pectinidae** Rafinesque, 1815
Genus *Lentipecten* Marwick, 1928
Lentipecten corneus (Sowerby, 1818)
(pl. 34: 11)

1818. *Pecten corneus* Sowerby: t. 3, pl. 204: 1, 2.
1957. *Pseudamussium coerneum* (Sowerby); Meszaros: 91, pl. 16: 2.
1958. *Pseudamussium corneum* Sowerby; Kluschnikov: 154, pl. 16: 4—7.

Material. — Seven complete valves and numerous fragments of valves.
Dimensions (in mm):

	height	length	apical angle
adult	60.0	61.0	124°
young	31.2	31.0	116°

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska, Luszawa). France and Italy: Lutetian — Rupelian. England: Ypresian — Bartonian. Belgium: Bartonian. Netherlands: Lower Oligocene. Germany: Lattorfian. USSR: Ypresian-Rupelian of Ukraine. Hungary: Lutetian. Rumania and Bulgaria: Priabonian. Switzerland: Lutetian-Auversian. N. Africa: Oligocene.

Genus *Chlamys* Roding, 1789
Chlamys caillaudi (Oppenheim, 1903)
(pl. 34: 9*ab*)

1903. *Pecten caillaudi* Oppenheim: 52, pl. 7: 15—16.

Material. — Two valves.
Dimensions (in mm):

height	length	apical angle	number of ribs
26	24	98°	20

Occurrence. — Poland: Bartonian (Siemień). N Egypt: Lutetian — Bartonian.

Chlamys recondita (Solander, 1766)
(pl. 34: 3, 4*ab*, 5)

1766. *Ostrea recondita* Solander *in* Brander: 42, pl. 8: 107.
1861. *Pecten reconditus* Solander; Wood: 42, pl. 9: 3.
1861. *Pecten trigenti — radiatus* Sowerby; Wood: 45, pl. 9: 4a-d.
1905. *Pecten radkiewiczi* Sokolov: 41, pl. 10: 6—7.

Material. — Twenty seven partly damaged specimens.
Dimensions (in mm):

	height	length	apical angle	number of ribs
adult	25.8	21.9	90°	23

Remarks. — The Polish specimens are similar to that illustrated by Brander except for smaller size. It seems that Brander's figure is somewhat enlarged. The valves assigned by Wood (1861) to the same species are similar in size to the Polish specimens. The Polish specimens are also similar to those described as *Ch. radkiewiczi* Sokolov by Sokolov (1905), differing in higher, narrower and les rounded radial ribs.

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska, Luszawa). England: Ypresian-Auversian. Belgium: Lower Oligocene. USSR: Middle and Upper Eocene of Ukraine.

Chlamys carinata (Sowerby, 1828)

1828. *Pecten carinatus* Sowerby: pl. 575: 4.
1861. *Pecten carinatus* Sowerby; Wood: 38, pl. 5: 5.

Material. — Nine slightly damaged specimens.
Dimensions (in mm):

	height	length	apical angle	number of ribs
adult	31.2	29.2	101°	26

Remarks. — The Siemień specimens display 23 to 26 ribs which differs them from Sowerby's (1828, fig. 4) specimen having 14 wide ribs. According to Wood (1861), the representatives of this species from Barton (England) have 20 ribs. The topotype of the species, obtained by the present author from Dr. D. Curry, is 22 mm high and 21 mm wide and displays 22 markedly keeled ribs. It seems that the specimen with 26—28 sharp ribs, identified as a variety d or f of *Pecten trigenti radiatus* Sowerby by Wood (1861: 46, pl. 9: 4h) should be assigned to this species.

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Luszawa). England: Upper Bartonian.

Chlamys biarritzensis subtripartita (d'Archiac, 1847)
(pl. 34: 1, 2*ab*)

1847. *Pecten subtripartitus* d'Archiac: 1010.
1964. *Chlamys (Aequipecten) subtripartita* (d'Archiac); Karagiuleva: 38, pl. 4: 6; pl. 5: 4*ab*, 11.

Material. — Six well preserved specimens and numerous fragments of valves.
Dimensions (in mm):

	height	length	apical angle	number of ribs
	24.2	21.0	95°	22
adult	34.4	30.9	95°	27

Remarks. — The Polish specimens are similar to *Ch. carinata* (Sowerby), differing in development of incipient scales on high triangular radial ribs; the scales are arranged in three of five rows, one of which is situated on the crest of rib and others symmetrically on its sides. The Polish specimens are also similar to *Ch. biarritzensis biarritzensis* (d'Archiac), characterized by stronger development of the scales.

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska, Luszawa). France: Lutetian — Auversian. Germany: Lutetian. USSR: Lutetian — Lower Oligocene. Rumania and Bulgaria: Priabonian. Yougoslavia: Middle and Upper Eocene. Switzerland: Auversian.

Chlamys biarritzensis biarritzensis (d'Archiac, 1846)
(pl. 33: 8—10)

1846. *Pecten biarritzensis* d'Archiac: 210, pl. 8: 9*ab*.
1864. *Chlamys (Aequipecten) biarritzensis* (d'Archiac); Karagiuleva: 38, pl. 4: 7, 12, 15; pl. 5: 6.

Material. — Seven slightly damaged specimens.
Dimensions (in mm):

	height	length	apical angle	number of ribs
adult	27.3	23.3	90°	25

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Luszawa). France: Priabonian-Rupelian. USSR: Upper Eocene of Ukraine, Priabonian of Georgia. Hungary: Lutetian. Rumania, Bulgaria, Italy, Austria and Switzerland: Priabonian. N. Africa: ?Eocene — Oligocene.

Chlamys bellicostata (Wood, 1861)
(pl. 33: 1, 2, 3*ab*, 4*ab*, 5*ab*, 6*ab*, 7*ab*)

1861. *Pecten bellicostatus* Wood: 38, pl. 8: 11ab.
1861. *Pecten trigentiradiatus* Sowerby; Wood: 45, pl. 9: 4 fg.
1905. *Pecten bellicostatus* Wood var. *orientalis* Sokolov: p. 35, pl. 9: 5, 10; pl. 10: 3—5.
1958. *Chlamys (Aequipecten) bellicostatus* Wood var. *orientalis* Sokolov; Kluschnikov: 164, pl. 17: 9—12; pl. 18: 1, 2.

Material. — Sixty well preserved specimens.
Dimensions (in mm):

	height	length	apical angle	number of ribs
adult	36.3	33.2	94°	29

Remarks. — The Polish specimens are most similar to valves described as *Pecten bellicostatus orientalis* Sokolov by Sokolov (1905). The Polish specimens are identical with those illustrated by Wood (1861) in size and shape of valve, apical angle and shape of ribs and scales, differing in more variable number of radial ribs (equal 20—30 and 20—24, respectively). It seems possible that the forms having more than 24 ribs were assigned by Wood (1861: 46, pl. 9: 4fg) to the varieties *d-e* of *P. trigentiradiatus* Sowerby. The Polish specimens appear also similar to those described as *Pecten biarritzensis* d'Archiac and *P. thorenti* d'Archiac by d'Archiac (1846: 210, pl. 8: 8—9), differing in finer scales on radial ribs.

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Wólka Siemieńska, Luszawa). France: Priabonian — Rupelian. England: Lower Oligocene. Belgium: Lower Oligocene. Germany: Lattorfian. USSR: Upper Eocene — Lower Oligocene of Sambia, Upper Eocene — Lower Oligocene of Ukraine.

Chlamys sokolovi Kluschnikov, 1958
(pl. 34: 6*ab*, 7*ab*, 8*ab*)

1958. *Chlamys sokolovi* Kluschnikov: 158, pl. 17: 2, 3.

Material. — Seventeen well preserved valves and several valves partly damaged.
Dimensions (in mm):

	height	length	apical angle	number of ribs
adult	34.2	31.3	90°	15

Remarks. — The Siemień specimens are similar to those described by Kluschnikov (1958), differing in more variable valve size and apical angle (85°—90°). Moreover, no forms with clearly marked second-order ribs are represented in the assemblage described by that author. The Polish forms are also similar to those described as *Pecten plebeius* Lamarck by Deshayes (1837: pl. 44: 1—2).

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Wólka Siemieńska, Luszawa). USSR: Auversian — Bartonian of Ukraine.

Family **Spondylidae** Gray, 1826
Genus *Spondylus* Linné, 1758
Spondylus buchi Philippi, 1846
(pl. 37: 8)

1846. *Spondylus buchi* Philippi: 55, pl. 7: 9ab.
1964. *Spondylus buchi* Philippi; Karagiuleva: 48, pl. 7: 3.

Material. — Several scores of damaged valves.

Occurrence. — Poland: Bartonian (Luszawa, Siemień). France: Lutetian — Bartonian. Belgium: Lower Oligocene. Germany: Lutetian — Lattorfian. USSR: Middle and Upper Eocene and Lower Oligocene of Ukraine, Upper Eocene of Dagestan, Transcaucasus and Middle Asia, Lower Oligocene of Georgia. Rumania: Priabonian. Bulgaria: Priabonian and Oligocene. Switzerland, Yougoslavia and Egypt: Lutetian.

Spondylus tenuispina Sandberger, 1863
(pl. 37: 7)

1863. *Spondylus tenuispina* Sandberger: 374, pl. 32: 1; pl. 35: A.
1958. *Spondylus tenuispina* Sandberger; Kluschnikov: 177, pl. 20: 1—5.

Material. — Two damaged valves.

Occurrence. — Poland: Bartonian (Siemień). France: Rupelian. Germany: Lattorfian and ?Upper Oligocene (Koenen 1893). USSR: Upper Eocene of Ukraine. Switzerland: Rupelian.

Suborder **Ostreina** Férussac, 1822
Superfamily **Ostreicea** Rafinesque, 1815
Family **Ostreidae,** Lamarck, 1818
Genus *Ostrea* Linné, 1758
Ostrea angusta Deshayes, 1824
(pl. 37: 5*ab*)

1824. *Ostrea angusta* Deshayes: 362, pl. 58: 1—3.

Material. — One complete left valve and serveral fragmentary left valves.

Remarks. — The Siemień specimens markedly differ from those described by Deshayes (1824) in two-times smaller size (Siemień specimens are 58 mm high and 33 mm wide whereas Deshayes's specimens — 120 mm high and 50 mm wide), higher and narrower radial ribs, wider inter-rib space and more strongly folded lower part of shell. The Siemień specimens resemble left valve of *Ostrea flabellulata* Lamarck figured by Goldfuss (1826—44: pl. 76: 6*d*), differing merely in thinner radial ribs.

Occurrence. — Poland: Bartonian (Siemień, Luszawa). France: Sparnacian, Ypresian.

Ostrea ventilabrum Goldfuss, 1826
(pl. 36: 3*ab*)

1826. *Ostrea ventilabrum* Goldfuss: 13, pl. 76: 4.
1843. *Ostrea ventilabrum* Goldfuss; Nyst: 320, pl. 29: 2; pl. 30: 2.
1943. *Ostrea ventilabrum* Goldfuss; Albrecht & Valk, 122, pl. 12: 401—404.

Material. — Six damaged valves.

Remarks. — Polish specimens are more similar to those from Limburgia (Nyst 1843, pl. 29: 2, Albrecht & Valk 1943 pl. 12: 404) than to the German ones (Goldfuss 1826, Koenen 1893). They are markedly elliptical and semilunar in outline.

Occurrence. — Poland: Bartonian (Siemień). Belgium: Lower Oligocene. Netherlands: Lattorfian. USSR: Upper Eocene — Lower Oligocene of Sambia, ?Lower Oligocene of Ukraine.

Ostrea submissa Deshayes 1864
(pl. 37: 1—3, 4*ab*)

1864. *Ostrea submissa* Deshayes: 120, pl. 84: 9, 12.
1904—1906. *Ostrea submissa* Deshayes; Cossmann & Pissarro: pl. 44: 135—30.
1958. *Ostrea* (*Cubitostrea*) *plicata* Solander; Kluschnikov: 193, pl. 23: 6; pl. 25: 1—7.

Material. — Eleven complete valves and several scores of fragments.

Dimensions (in mm):

	height	length	number of ribs
adult	39.7	26.0	22

Remarks. — Because of a high variability in shape of shell only some Siemień specimens are morphologically similar to those figured by Deshayes (1864), Cossmann and Pissarro (1904—1906). However, all the specimens meet the definition given by Deshayes; according to that definition *Ostrea submissa* is similar to *Ostrea flabellula* Lamarck, except for thinner shell and lower and wider radial ribs.

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Wólka Siemieńska, Luszawa). France: Thanetian-Lutetian.

Ostrea plicata (Solander, 1766)
(pl. 35: 1*ab*, 2*ab*, 3*ab*, 4*ab*, 5*ab*, 6*ab*)

1766. *Chama plicata* Solander *in* Brander: 36, pl. 7: 84, 85.
1806. *Ostrea flabellula* Lamarck: 164, pl. 20: 3ab.
1861. *Ostrea flabellula* Lamarck; Wood: 21, pl. 3: 4.
1918. *Ostrea flabellulata* Lamarck; Favre, pl. 18: 56ab.
1964. *Ostrea* (*Cubitostrea*) *plicata plicata* (Solander); Karagiuleva, 58, pl. 10: 3—7; pl. 12: 1ab.

Material. — Several scores of left valves and more than 100 well preserved right valves.

Dimensions (in mm):

	height	length	number of ribs
adult left valve	39.7	29.0	43
adult right valve	39.6	22.8	

Remarks. — Among the Siemień specimens there are some forms similar to *Ostrea flabellula* Lamarck (see pl. 35: 2*ab*), *O. plicata* (Sol.) (see pl. 35: 3*ab*) or *O. cubitus* Deshayes (pl. 35: 4*ab*). The specimens, however, form a continuous series

unseparable into the species. The Siemień specimens are most similar to those figured by Brander (1766: pl. 7: 85) and Wood (1861). Wood assigned his specimens to *O. flabellula* Lamarck; however, the majority of authors and especially Boussac (1911) and Vjalov (1930) considered them to be *O. plicata*. According to the present author *O. plicata* and *O. flabellula* Lamarck are synonyms; this conclusions is drawn from the comparison of a topotype of *O. plicata*, obtained from Dr. D. Curry, and illustrations of specimens of *O. flabellula* from the original collection of Lamarck (Favre 1918). The latter specimens are small, short, high valves ornamented with innumerous thick ribs; the specimen from pl. 18: 56ab probably is the holotype (Lamarck 1806, pl. 20: 3ab).

Specimens assigned here to *O. plicata* form a morphological series uniting *O. submissa* Deshayes and *O. prona* Wood. The comparison of the shell morphology and stratigraphic ranges of the species enabled to reconstruct the possible evolution of that group of oysters. *Ostrea submissa* Desheayes is interpreted here as an ancestral form giving rise to *O. flabellula* Lamarck; *O. flabellula* is the ancestor of *O. plicata* (Solander) and the latter — of *O. cubitus* Deshayes which gave rise to *O. prona prona* Wood and *O. prona longa* Alekseev. The evolution is expressed in gradual thickenning of valve walls, increase in height of radial ribs on left valve and progressively stronger curvature of shell. This reconstruction based on morphological data is further supported by the time sequence of appearance of the species: *O. submissa* Deshayes is known from the Ypresian and Lutetian of the Paris Basin, *O. flabellula* Lamarck from the Lutetian and Auversian, the holotype of *O. plicata* (Solander) — from the Bartonian of the Paris Basin, and *O. prona* Wood — from the Late Eocene and Early Oligocene.

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Wólka Siemieńska, Luszawa). France: Ypresian-Bartonian. England: Auversian, Bartonian. Belgium: Wemmel. Germany: Lutetian, Lattorfian. USSR: Upper Eocene of Sambia, Middle and Upper Eocene of European part of the country and of the Middle Asia. Hungary: Ypresian and Lutetian. Bulgaria: Priabonian. Switzerland: Lutetian. Egypt: Auversian — Bartonian.

Ostrea prona prona Wood, 1861
(pl. 36: 1, 2*ab*)

1861. *Ostrea prona* Wood: 29, pl. 3: 3.
1930. *Ostrea* (*Cubitostrea*) *prona* Wood; Vjalov: 92, pl. 4: 1, 2.

Material. — One shell partly damaged.

Remarks. — The specimen from Siemień is similar to the holotype (Wood 1861) in shape, differing in coarser and less rounded radial ribs. The Siemień specimen is almost identical with the valves illustrated by Vjalov (1930). The specimens of Koenen (1893) and Sokolov (1905) do not belong to this species but possibly to *O. plicata* (Solander).

Occurrence. — Poland: Bartonian (Siemień). England: Lower Oligocene. USSR: Upper Eocene of Ukraine, Lower Oligocene of Middle Asia.

Ostrea prona longa Alekseev, 1963

1963. *Ostrea prona* Wood var. *longa* Alekseev: 50, pl. 9: 3—5; pl. 10: 1—6.

Material. — Seven damaged left valves.

Occurrence. — Poland: Bartonian (Siemień, Kolonia Siemień, Wólka Siemieńska, Luszawa), USSR: Upper Eocene of Middle Asia.

Order **Veneroida** Adams & Adams, 1856
Superfamily **Crassatellacea** Ferussac, 1822
Family **Crassatellidae** Ferussac, 1822
Genus *Crassatella* Lamarck, 1799
Crassatella desmaresti Deshayes, 1866
(pl. 38: 3—5)

1866. *Crassatella desmaresti* Deshayes: 337, pl. 7: 3.
1958. *Crassatella desmaresti* Deshayes; Kluschnikov: 82, pl. 6: 4, 5.

Material. — One complete right valve and four moulds.
Dimensions (in mm):

	height	length
adult	22.8	40.3

Remarks. — The Siemień specimens are almost identical with those illustrated by Deshayes (1866). This species is similar to *Crassatella lamellosa* Lamarck, differing in more crowded concentric ribs and the lack of sinus in posterior part of lower valve margin.

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska, Luszawa). France: Bartonian. Germany: Lattorfian. USSR: Upper Eocene of Ukraine.

Crassatella sulcata (Solander, 1766)

1766. *Tellina sulcata*, Solander *in* Brander: 37, pl. 7: 89.
1964. *Crassatella sulcata* Solander; Karagiuleva: 126, pl. 31: 1, 2.

Material. — One complete specimen and one damaged specimen.
Dimensions (in mm):

height	length	apical angle
15.5	21.5	125°

Remarks. — The Siemień specimens are almost identical with the holotype. They differ from the valves of *C. desmaresti* Deshayes in more loosely spaced ribs, and from *C. lamellosa* Lamarck in valves higher in relation to their length and ribs lower and less sharp and less blade-like.

Occurrence. — Poland: Bartonian (Siemień). France: Bartonian. England: Auversian, Bartonian. Bulgaria: Priabonian. Italy: Priabonian, Lower Oligocene.

Crassatella compressa Lamarck, 1806
(pl. 38: 2)

1806. *Crassatella compressa* Lamarck: 410, pl. 20: 5ab.
1958. *Crassatella compressa* Lamarck; Kluschnikov: 78, pl. 5: 23, 24.

Material. — One damaged specimen.

Occurrence. — Poland: Bartonian (Siemień). France and England: Lutetian. USSR: Middle — Upper Eocene of Ukraine.

Genus *Salaputium* Iredale, 1924
Salaputium woodi woodi (Koenen, 1865)
(pl. 36: 6*ab*)

1864. *Astarte bosqueti* Nyst, Giebel: 69, pl. 2: 3ab.
1958. *Crassatella (Pseudoriphyla) woodi* Koenen; Kluschnikov: 90, pl. 8: 1—4.

Material. — Three valves partly damaged, several fragments and moulds.
Dimensions (in mm):

	height	length	apical angle
adult	7.5	10.2	109°

Remarks: — The features of this species seem to be more typical of the genus *Salaputium* than of the *Crassatella*, so it is assigned here to the former.

The Polish specimens are very similar to the German forms described by Koenen (1865) as well as the Ukrainian described by Sokolov (1905). Some of them display concentric ribs somewhat lower and wider than those of the holotype, which makes them morphologically similar to the forms assigned to *Crassatella woodi raricostata* Kluschnikov.

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska, Luszawa). Germany: Lattorfian. USSR: Upper Eocene of Ukraine.

Salaputium woodi raricostata (Kluschnikov, 1958)
(pl. 36: 4, 5)

1958. *Crassatella* (*Pseudoriphylla*) *woodi* Koenen var. *raricostata* Kluschnikov: 91, pl. 8: 5.

Material. — Several valves slightly damaged and numerous fragments and moulds.
Dimensions (in mm):

	height	length	apical angle
adult	7.3	8.8	109°

Remarks. — The Polish specimens are identical with the type specimen illustrated by Kluschnikov. They differ from *S. woodi woodi* (Koenen) in the shape of concentric ribs.

Occurrence. — Poland: Bartonian (Siemień, Luszawa). USSR: Upper Eocene of Ukraine.

Superfamily **Veneracea** Rafinesque, 1815
Family **Veneridae** Rafinesque, 1815

Genus *Pitar* Römer, 1857
Pitar sulcataria (Deshayes, 1824)
(pl. 37: 6*ab*)

1824. *Cytherea sulcataria* Deshayes: 133, pl. 20: 14, 15.
1964. *Pitar* (*Calpitaria*) *sulcataria* (Deshayes); Kluschnikov: 95, pl. 28: 10—12.

Material. — Three specimens partly damaged and several moulds of left and right valves.
Dimensions (in mm):

height	length	apical angle
27.7	33.5	130°

Remarks. — The Siemień specimens are identical with those illustrated by Deshayes (1824) and Cossmann & Pissarro (1904—1906). They differ from those illustrated by Kluschnikov (1958) in more regularly rounded valves and from that figured by

Korobkov (1962: pl. 2: 10) — in more elliptical outline and less convex lower valve margin.

Occurrence. — Poland: Bartonian (Siemień, Wólka Siemieńska). France and England: Lutetian. Belgium: Lower Oligocene. USSR: Lower Oligocene of Middle Asia, Middle Eocene — Lower Oligocene of Ukraine. Egypt: Middle and Upper Eocene.

Order **Myoida** Stoliczka, 1870
Suborder **Myina** Stoliczka, 1870
Superfamily **Hiatellacea** Gray, 1824
Family **Hiatellidae** Gray, 1824
Genus *Panopea* Menard, 1807
Panopea gastaldi (Michelotti, 1861)
(pl. 38: 6*ab*)

1900—1901. *Panopaea gastaldi* Michelotti; Oppenheim: 173, pl. 14: 6, 6a.
1958. *Panopaea gastaldi* Michelotti; Kluschnikov: 141, pl. 14: 5—8.
1964. *Panopea gastaldi* (Michelotti); Karagiuleva: 118, pl. 37: 2.

Material. — Three valves.
Dimensions (in mm):

height	length	apical angle
45.0	65.0	120°

Remarks. — The Polish specimens differ from those illustrated by Oppenheim (1900—1901) in apex shifted more anteriorly, shorter valves and smaller size. They are most similar to those illustrated by Kluschnikov (1958): the specimens from pl. 14: 5 and 7 (op. cit.) are characterized by anterior margin obliquely truncated from below, which is also the case of the Polish specimens, and the specimen from pl. 14: 5 — by apex strongly shifted towards the anterior.

Occurrence. — Poland: Bartonian (Wólka Siemieńska). France: Auversian, Priabonian. USSR: Upper Eocene of Ukraine. Bulgaria: Priabonian. Italy: Priabonian, Oligocene.

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MAŁŻE GÓRNOEOCEŃSKIE WSCHODNIEJ POLSKI

Streszczenie

W okolicy Siemienia i w wierceniu Luszawa n/Wieprzem występują górnoeoceńskie piaski kwarcowe z glaukonitem, otoczakami kwarcu i lidytu, konkrecjami fosforytowymi i bogatą fauną (Szczechura 1969, 1977; Pożaryska & Locker 1971; Pożaryska 1977). Ku górze utwory te przechodzą w mułki margliste i gezy odwapnione z bursztynami.

Makrofauna obejmuje: koralowce, mszywioły, ramienionogi, mięczaki, szkarłupnie i kręgowce. Skład gatunkowy tego zespołu, który jest pierwszym dotychczas zbadanym zespołem górnoeoceńskim z Niżu Polskiego pozwala na określenie wieku osadu na barton. Zespół ten ma najwięcej wspólnych gatunków z górnoeoceńskim utworami Ukrainy (Mandrikowka) Sambii, Niemiec, Anglii, Belgii, oraz Francji północnej i zachodniej. Pokrewieństwo fauny oraz rozmieszczenie osadów glaukonitowo-fosforytowych pozwalają wnioskować, że morze górnoeoceńskie z terenu E Polski stanowiło część zbiornika, który sięgał od rejonu Morza Czarnego przez Ukrainę i tereny sąsiednie, Niż Polski do Europy zachodniej. Charakter makrofauny z utworów glaukonitowych północnej Lubelszczyzny, której większość rodzajów żyje do dziś, wskazuje, że osady powstały w płytkiej, ciepłej wodzie morskiej o zasoleniu normalnym.

ЭМИЛЬ ВОЗЬНЫ

ДВУСТВОРЧАТЫЕ ВЕРХНЕГО ЭОЦЕНА ВОСТОЧНОЙ ПОЛЬШИ

Резюме

В окрестностях Семеня, а также при бурениях в Лушаве над Вепшем встречаются кварцовые пески с глауконитом, галечником лидита и кварца, фосфоритовыми конкрециями и с богатой фауной (Щехура 1969, 1977; Пожарыска и Локкер 1971; Пожарыска 1977). В верхней части эти отложения переходят в мергелистые илы и декальцированные гезы с янтарём.

Макрофауну представляют: кораллы, мшанки, плеченогие, двустворчатые, иголкожие и позвоночные (список видов см. стр. 98). Такой состав фауны, кото-

рая является до сего времени первой изученной макрофауной верхнего эоцена Польской низменности, позволяет определить возраст отложений — бартонский. По своим видам эта ассоциация подобная верхне эоценским ассоциациям Украины (Мандриковка), Калининградской Области РСФСР (Земляндия), Германии, Англии, Бельгии, а также северной и западной Франции. Родство фауны, залегание глауконито-фосфоритовых отложений позволяют сделать вывод о том, что верхне эоценское море на территории Восточной Польши являлось частью бассейна, который простирался от районов Чёрного моря, включая Украину, Польскую низменность и окружающие её территории, до Западной Европы. Характер макрофауны глауконитовых отложений северной части Люблинского воеводства, представители большей части которой живут и в настоящее время, указывает на то, что эти отложения образовались на мелководье, в тёплой морской воде нормальной солёности.

EXPLANATION OF PLATES

All specimens are from the Upper Eocene of Siemień locality with the exception of pl. 38: 3—7

All figures in natural size with the exception of pl. 35: 4—6

Plate 33

1—7. *Chlamys bellicostata* (Wood): *1* juvenile left valve, IG-1370.II.101; *2* juvenile right valve, IG-1370.II. 106; *3* ephebic right valve in external (*a*) and internal (*b*) views, IG-1370.II.130; *4* ephebic left valve in external (*a*) and internal (*b*) views, IG-1370.II.129; *5* adult right valve in external (*a*) and internal (*b*) views, IG-1370.II.141; *6* adult right valve in external (*a*) and internal (*b*) views, IG-1370.II.147; *7* adult left valve in external (*a*) and internal (*b*) views, IG-1370.II.144.

8—10. *Chlamys biarritzensis biarritzensis* (d'Archiac): *8* ephebic right valve, IG-1370.II.92; *9* ephebic left valve, IG-1370.91; *10* adult left valve, IG-1370.II.97.

Plate 34

1, 2. *Chlamys biarritzensis subtripartita* (d'Archiac): *1* left valve, IG-1370.II.87; *2* right valve in external (*a*) and internal (*b*) views, IG-1370.II.85.

3—5. *Chlamys recondita* (Solander): *3* right valve, IG-1370.II.59; *4* right valve in external (*a*) and internal (*b*) views, IG-1370.II.58; *5* left valve, IG-1370.II.57.

6—8. *Chlamys sokolovi* Kluschnikov: *6* left valve in external (*a*) and internal (*b*) views, IG-1370.II.159; *7* right valve in external (*a*) and internal (*b*) views,

IG-1370.II.161; *8* adult right valve in external (*a*) and internal (*b*) views, IG-1370.II.170.

9. *Chlamys caillaudi* (Oppenheim): left valve in external (*a*) and internal (*b*) views, IG-1370.II.47.
10. *Lentipecten corneus* (Sowerby): left valve in external view, IG-1370.II.43.

Plate 35

1—6. *Ostrea plicata* (Solander): *1* juvenile left valve in external (*a*) and internal (*b*) views, IG-1370.II.207; *2* left valve in external (*a*) and internal (*b*) views, IG-1370.II.212; *3* adult, short left valve in external (*a*) and internal (*b*) views, IG-1370.II.215; *4* adult, elongated left valve in external (*a*) and internal (*b*) views, IG-1370.II.219; *5* right valve in external (*a*) and internal (*b*) views, IG-1370.II.232; *6* adult right valve in external (*a*) and internal (*b*) views, IG-1370.II.235.

Plate 36

1. *Ostrea prona prona* (Wood): left valve, IG-1370.II.239.
2. *Ostrea prona longa* Alekseev: left valve in external (*a*) and internal (*b*) views, IG-1370.II.240.
3. *Ostrea ventilabrum* Goldfuss: left valve in external (*a*) and internal (*b*) views, IG-1370.II.185.

4, 5. *Salaputium woodi raricostata* (Kluschnikov): left and right valves, × 2.5, IG-1370.II.253, 252.

6. *Salaputium woodi woodi* Koenen: right valve in external (*a*) and internal (*b*) views, × 2.5, IG-1370.II.251.

Plate 37

1—4. *Ostrea submissa* Deshayes: *1*, *2*, *3* juvenile left valves, IG-1370.II.189, 190, 194; *4* adult left valve in external (*a*) and internal (*b*) views, IG-1370.II.198.

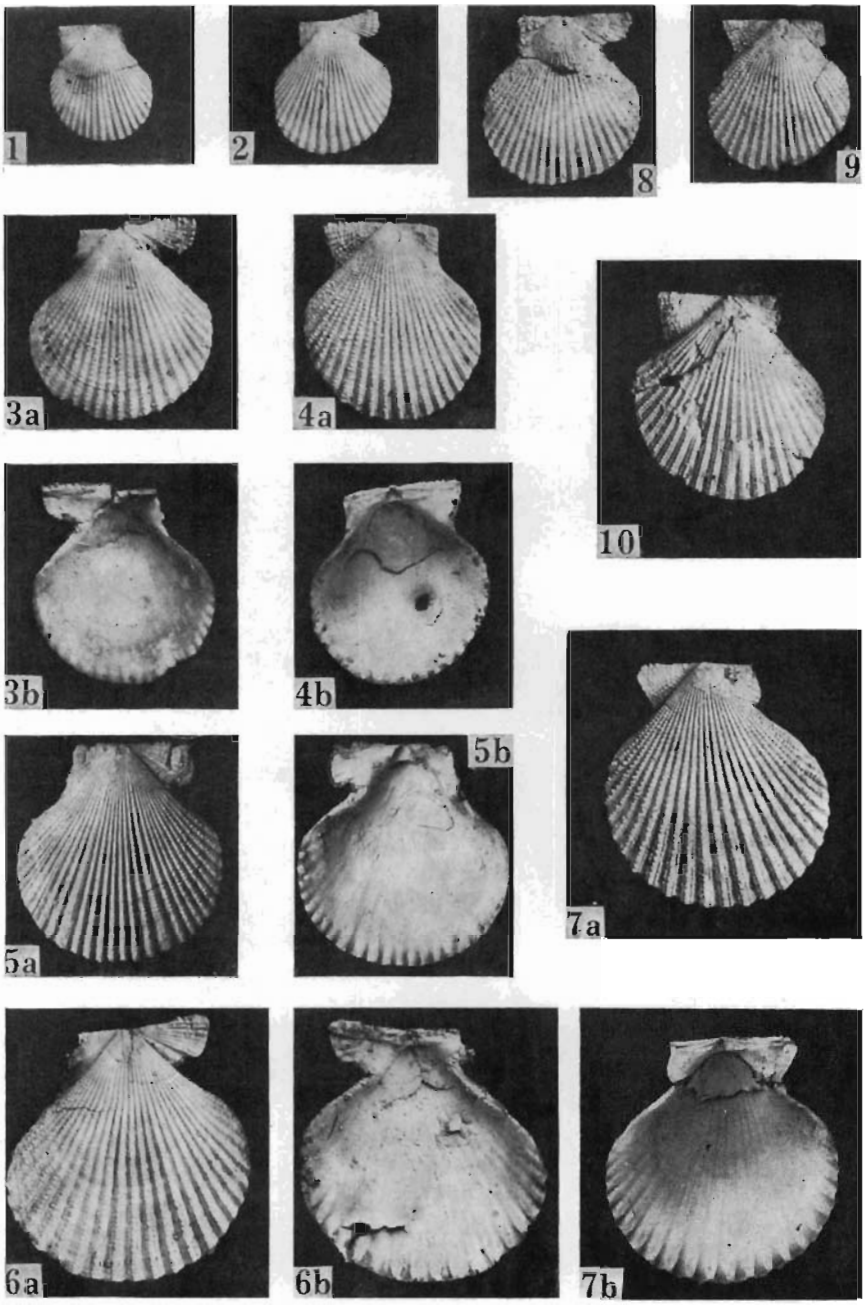
5. *Ostrea angusta* Deshayes: adult left valve in external (*a*) and internal (*b*) views, IG-1370.II.184.
6. *Pitar sulcataria* (Deshayes): right valve in external (*a*) and internal (*b*) views, slightly damaged, IG-1370.II.256.
7. *Spondylus tenuispina* Sandberger: fragment of the right valve, IG-1370.II.183.
8. *Spondylus buchi* Philippi: fragment of the right valve, IG-1370.II.182.

Plate 38

1. *Crassatella sulcata* (Solander): right valve, IG-1370.II.249.
2. *Crassatella compressa* Lamarck: right valve partly damaged, IG-1370.II.250.

3—5. *Crassatella desmaresti* Deshayes, Wólka Siemieńska: *3* mould of the left valve, external side, IG-1370.II.246; *4* mould of the left valve, internal side, IG-1370.II.248; *5* mould of the right valve, external side, IG-1370.II.245.

6. *Panopea gastaldi Michelotti,* Wólka Siemieńska: mould in upper (*a*) and in side (*b*) views, IG-1370.II.255.



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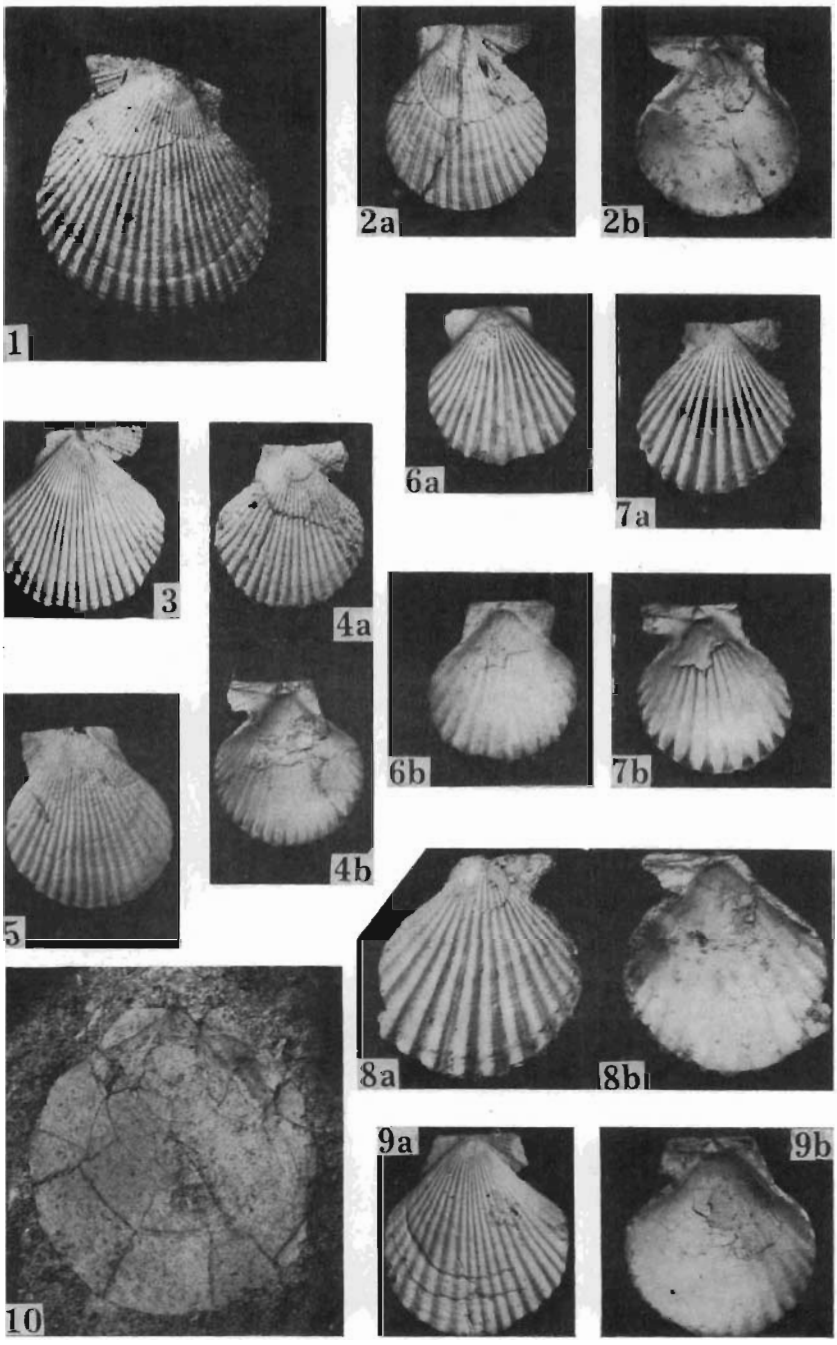

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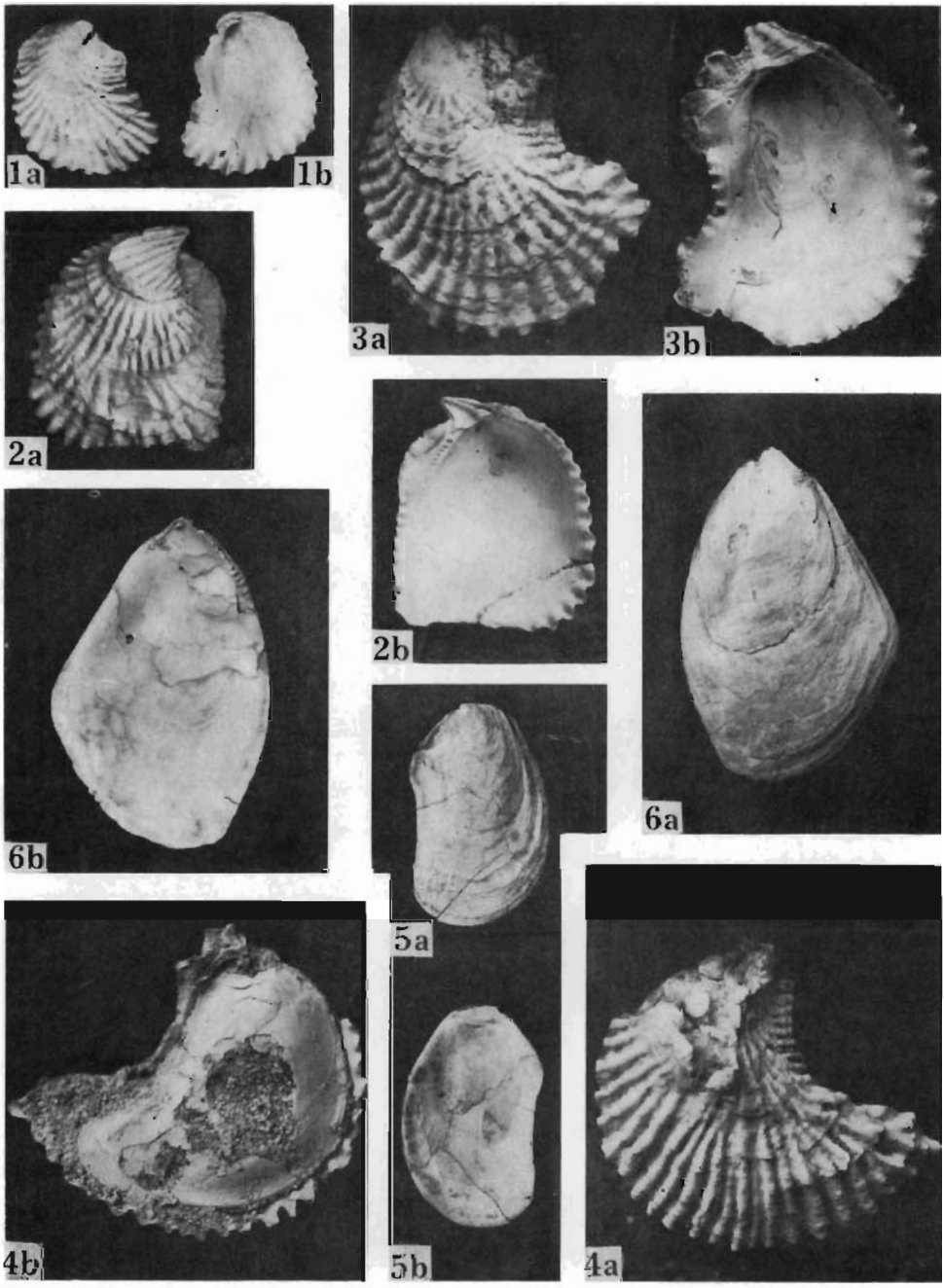

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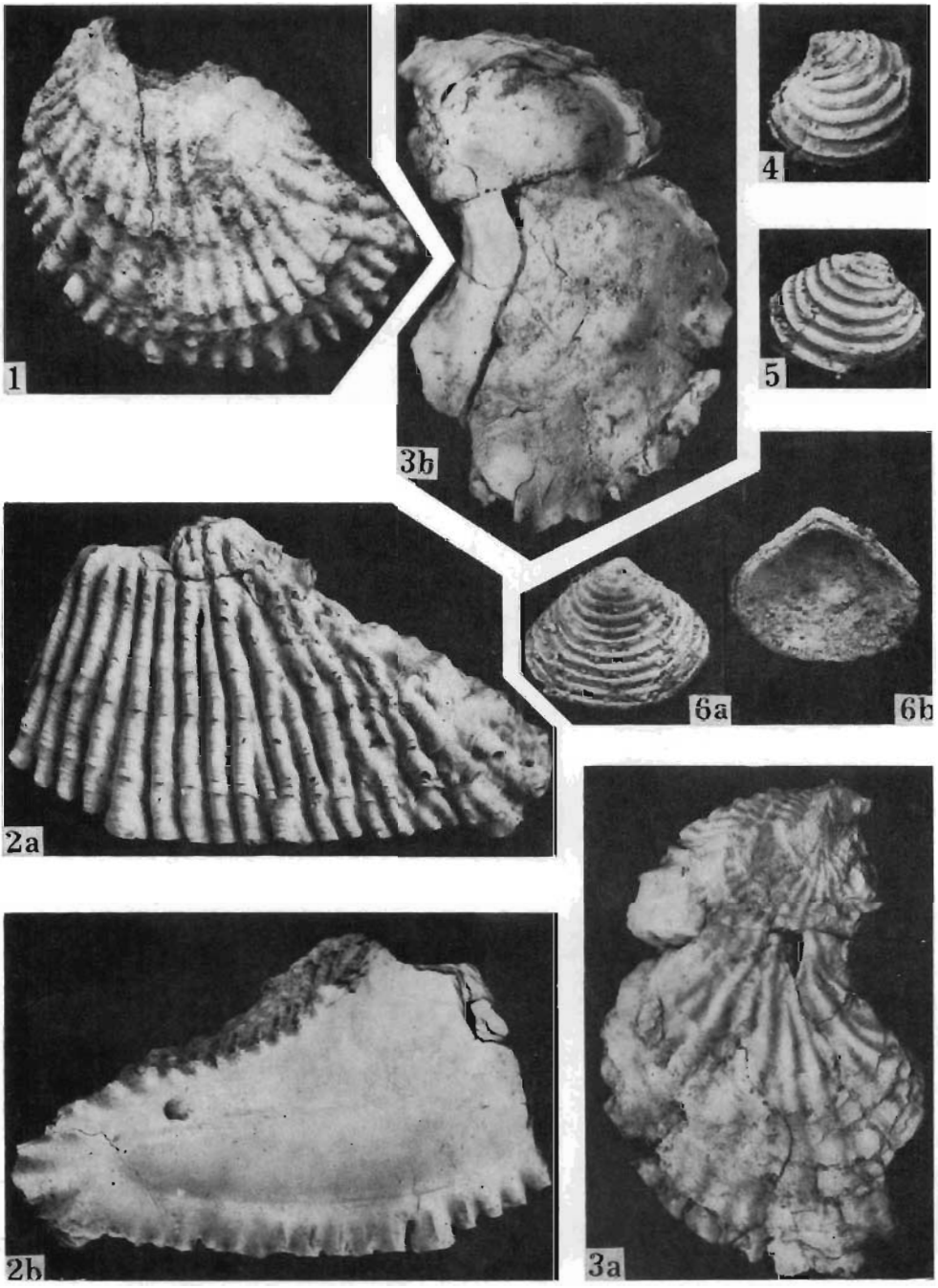

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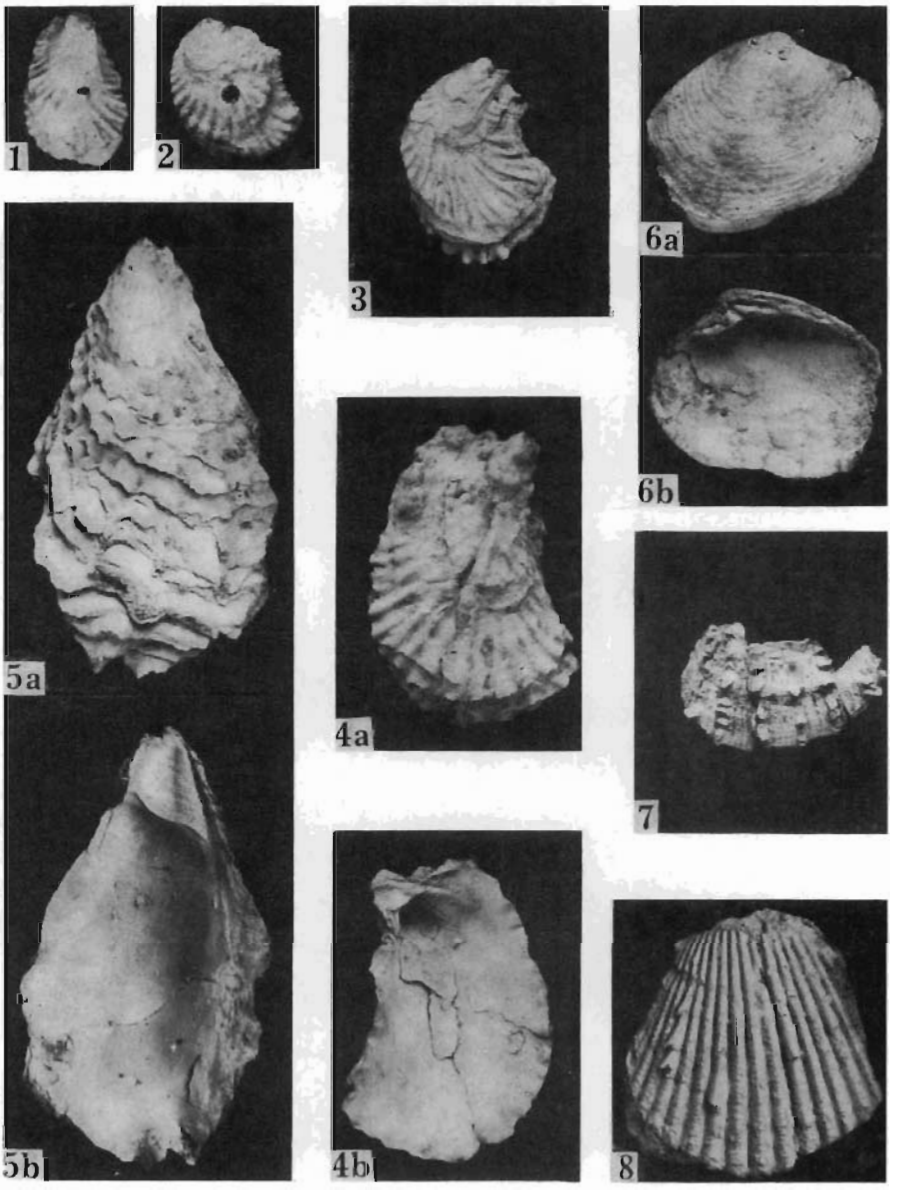

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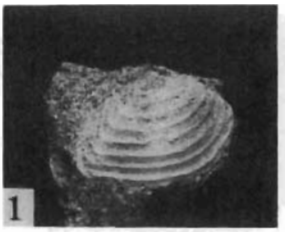
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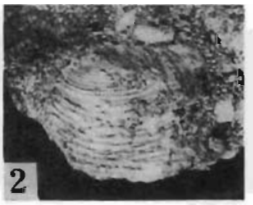
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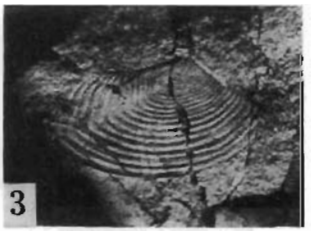
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4


5


6a


6b

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