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Middle Miocene (Badenian) brachiopods from the southern slopes of the Holy Cross Mountains, Central Poland

ABSTRACT: Rich brachiopod assemblage of the Middle Miocene (Badenian) deposits from the southern slopes of the Holy Cross Mountains, Central Poland, includes 17 species belonging to 14 genera (2 inarticulate and 7 articulate families). The commonest genera are *Megathiris* d'ORBIGNY, *Argyrotheca* DALL, and *Megerlia* KING, which occur in large concentrations in marls and lithothamnian limestones in Pińczów area. Less common are the genera *Terebratula* O. F. MÜLLER, *Pliothyrina* ROY, *Platidia* da COSTA, *Pantellaria* DALL, *Terebratulina* d'ORBIGNY, *Lingula* BRUGUIÈRE, *Crania* RETZIUS, *Neocrania* LEE & BRUNTON, and *Craniscus* DALL, with *Terebratula* O. F. MÜLLER and *Pliothyrina* ROY being the only ones to occur in the sandy facies in Świniary area. Rhynchonellids are almost absent, except for rare occurrences of *Cryptopora* JEFFREYS and *Notosaria* COOPER.

INTRODUCTION

A rich (6,500 specimens) collection of Middle Miocene (Badenian) brachiopods from the southern slopes of the Holy Cross Mountains, Central Poland, has arisen due to long-term fieldworks in a variety of lithofacies in the area between Pińczów and Świniary (*see* Text-fig. 1).

Although the brachiopod fauna from this area was first noted by PUSCH (1837), little detail has thus far been published (*cf.* FRIEDBERG 1924, 1930; KOWALEWSKI 1930, 1957, 1959; KRACH 1967; ŁUCZKOWSKA 1967; RADWAŃSKI 1969; PRZYBYSZEWSKI 1975; STUDENCKI 1988). Some taxa have been found in the Korytnica Basin (BARCZYK & POPIEL-BARCZYK 1977, RADWAŃSKI & RADWAŃSKA 1984, GUTOWSKI 1984), though only in small numbers and/or as juveniles. Mass occurrence of adult specimens of these taxa elsewhere, as well as appearance of other brachiopod taxa have prompted this report.

In this paper, 17 brachiopod species are described which belong to 14 genera (2 inarticulate and 7 articulate families). The commonest genera are

Megathiris d'ORBIGNY, which by far prevails in the assemblage, and *Argyrotheca* DALL and *Megerlia* KING, which occur abundantly in marls and lithothamnian limestones in Pińczów area. Less common are *Terebratula* O. F. MÜLLER and *Pliothyrina* ROY, which occur also in the sandy facies of Świniary area, as well as *Platidia* da COSTA, *Pantellaria* DALL, *Terebratulina* d'ORBIGNY, *Lingula* BRUGUIÈRE, *Crania* RETZIUS, *Neocrania* LEE & BRUNTON, and *Craniscus* DALL. The rhynchonellid genera *Cryptopora* JEFFREYS and *Notosaria* COOPER occur only sporadically.

Except for *Pliothyrina* ROY, all the other brachiopod genera whose representatives have been found in the Middle Miocene (Badenien) deposits exposed along the southern slopes of the Holy Cross Mountains have also living species. Some of these genera are shallow-water forms (*e.g.*, *Argyrotheca* DALL), others (*e.g.*, *Neocrania* LEE & BRUNTON, *Megerlia* KING) are eurybathial (LOGAN 1979). Out of the species described in this paper, 7 live today in the Mediterranean Sea or in the Atlantic or Pacific Ocean at various depths down to 580 metres. Some of these species have changed their habitat over time and inhabit presently at depths greater than they did in the Miocene (REVERT 1985).

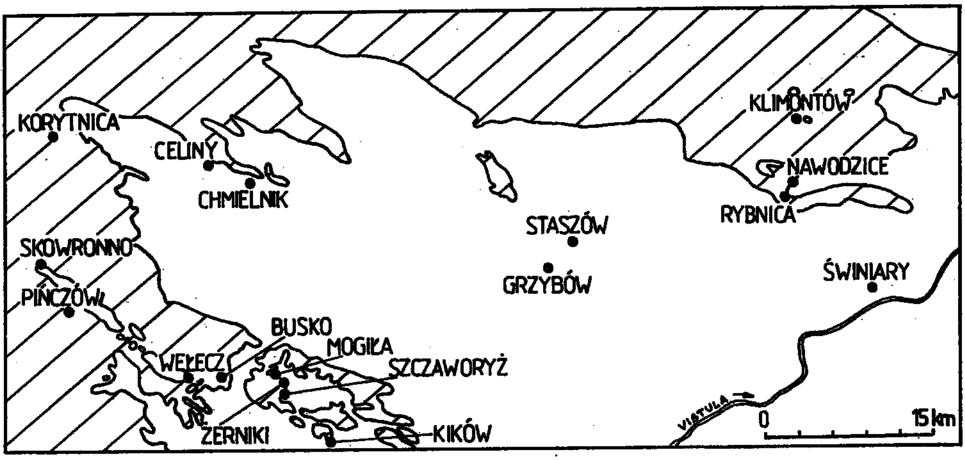

Fig. 1. Geological sketch-map of southern slopes of the Holy Cross Mountains, Central Poland, to show the extent of the Middle Miocene (Badenian) deposits (*blank*) in relation to the pre-Miocene substrate (*hachured*), and the brachiopod-bearing localities (*adopted from:* RADWAŃSKI 1973)

Life habitat of the investigated brachiopod taxa can be inferred from paleoecological analysis of the associated organisms in the study area (KRACH 1967; ŁUCZKOWSKA 1967; RADWAŃSKI 1969, 1973; PRZYBYSZEWSKI 1975; MAŁECKI 1980; STUDENCKI 1988) or elsewhere (KUDRIN 1961, PEDLEY 1976).

The investigated collection is kept in the Paleozoological Division of the Museum of the Earth, Polish Academy of Sciences (Warsaw), under the numbers *MZ VIII Bra-1565—1629.*

SYSTEMATIC ACCOUNT

Family **Lingulidae** MENKE, 1828
Genus *Lingula* BRUGUIÈRE, 1797

Lingula dregeri ANDREAE, 1893
(Text-fig. 2; Pl. 1, Figs 9—10)

1889. *Lingula Suessi* n. sp.; J. DREGER, p. 182, Pl. 5, Figs 17—18.
1911. *Lingula* cf. *Dregeri* ANDREAE; J. DREGER, p. 132, Figs 1—2.
1921. *Lingula* aff. *Dumontieri* NYST; W. FRIEDBERG, p. 5, Pl. 1, Fig. 1.
1943. *Lingula dregeri* ANDREAE; I. MEZNERICS, p. 19.

MATERIAL: 4 fragments of pedicle valves from Pińczów, 1 fragment of pedicle valve from Kików.

REMARKS: Valve shape, outline, and ornamentation are consistent with the specimens described by DREGER (1889, p. 182). Growth lines at the inner surface tonguelike bent toward the anterior. Muscle scars indistinct (Text-fig. 2). Two posteriorily located transmedian muscle scars reniform; two central muscle scars small and oval in shape, located symmetrically with respect to the valve axis; anterior muscle scars in the form of elongated swellings.

Due to their size, lanceolate outline, and ornamentation, the specimens described by FRIEDBERG (1921) as "*Lingula* aff. *Dumontieri* NYST" should be attributed to *L. dregeri* ANDREAE. In turn, the specimens of *L. dregeri* ANDREAE from Pińczów resemble somewhat the species *L. dumontieri* NYST, from the Korytnica Basin, but they differ in their more distinct central elevation and more centrally located transmedian muscle scars.

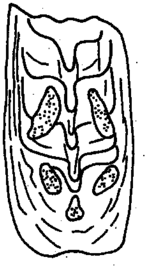

Fig. 2

Pattern of muscle scars in the pedicle valve of *Lingula dregeri* ANDREAE from Pińczów (specimen No. Bra-1616)

The name "*suessi*", attributed by DREGER (1889) to the species under discussion, was previously applied by STOPPANI (1860—1865) for an Upper Triassic species of *Lingula*. This incidence was first discovered by ANDREAE (1893) who introduced the name "*dregeri*" for the Miocene specimens from theVienna Basin. This decision has been accepted by DREGER (1911) as well as by other authors (MEZNERICS 1943, RADWAŃSKA & RADWAŃSKI 1984).

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), Sardinia (DREGER 1911), Podolia (FRIEDBERG 1921); and the Józefów Lubelski area in the Lublin Upland (KRACH 1968) in Poland.

Family **Craniidae** MENKE, 1828
Genus *Crania* RETZIUS, 1781

Crania badensis MICHALIK & ZÁGORŠEK, 1986
(Text-fig. 3; Pl. 1, Figs 2—3)

1986. *Crania badensis* sp. n.; J. MICHALIK & K. ZÁGORŠEK, p. 44, Text-fig. 3, Pl. 5, Figs 1—5.

MATERIAL: 3 well preserved brachial valves from Szczaworyż.

REMARKS: Valve size and ornamentation are consistent with the specimens illustrated by MICHALIK & ZÁGORŠEK (1986) from the Miocene of Devin-Zahradka area in south Slovakia. The specimens form Szczaworyż, however, are much smaller in size (no more than 2/3 of the type material in length) and less massive. Muscle scars distinct (Text-fig. 3). Two large, convex, oval posterior muscle scars beneath the limbus; triangular, unpaired, indistinct median muscle scar

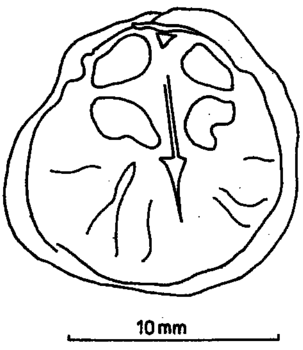

Fig. 3
Pattern of muscle scars in the brachial valve of *Crania badensis* MICHALIK & ZÁGORŠEK from Szczaworyż (specimen No. Bra-1614)

between the posterior ones; in the central part of the valve, low listlike median septum reaching the brachial protractor muscle scars; at both sides of the septum, anterior muscle scars located at prominent semilunar elevations. Indistinct, elongated pallial sinuses in the anterior part of the valve.

OCCURRENCE: Miocene of south Slovakia (MICHALIK & ZÁGORŠEK 1986).

Genus *Neocrania* LEE & BRUNTON, 1986
Neocrania anomala (O. F. MÜLLER, 1776)
(Text-fig. 4; Pl. 1, Figs 4—8)

1888. *Crania anomala* MÜLLER sp.; T. DAVIDSON, p. 183, Pl. 27, Figs 1—9.
1927. *Crania anomala* MÜLLER; A. THOMSON, p. 136, Fig. 40.
1979. *Crania anomala* (MÜLLER, 1776); A. LOGAN, p. 27, Text-figs 4—5, Pl. 1, Figs 1—10 (*cum syn.*).
1986. *Neocrania anomala* (MÜLLER); D. E. LEE & C. H. C. BRUNTON, p. 150, Figs 32—37.

MATERIAL: 12 well preserved brachial valves (4 from Pińczów, 6 from Skowronno, 2 from Kików) and 32 pedicle valves (12 from Pińczów, 20 from Szczaworyż).

REMARKS: The investigated brachial valves have the characteristics consistent with those observed by LOGAN (1979) in modern representatives of *Neocrania anomala* (O. F. MÜLLER) as well as with features found in its congeners (LEE & BRUNTON 1986), though both the brachial and the pedicle valves are more massive and more pentagonal in outline. At the brachial valve (Text-fig. 4),

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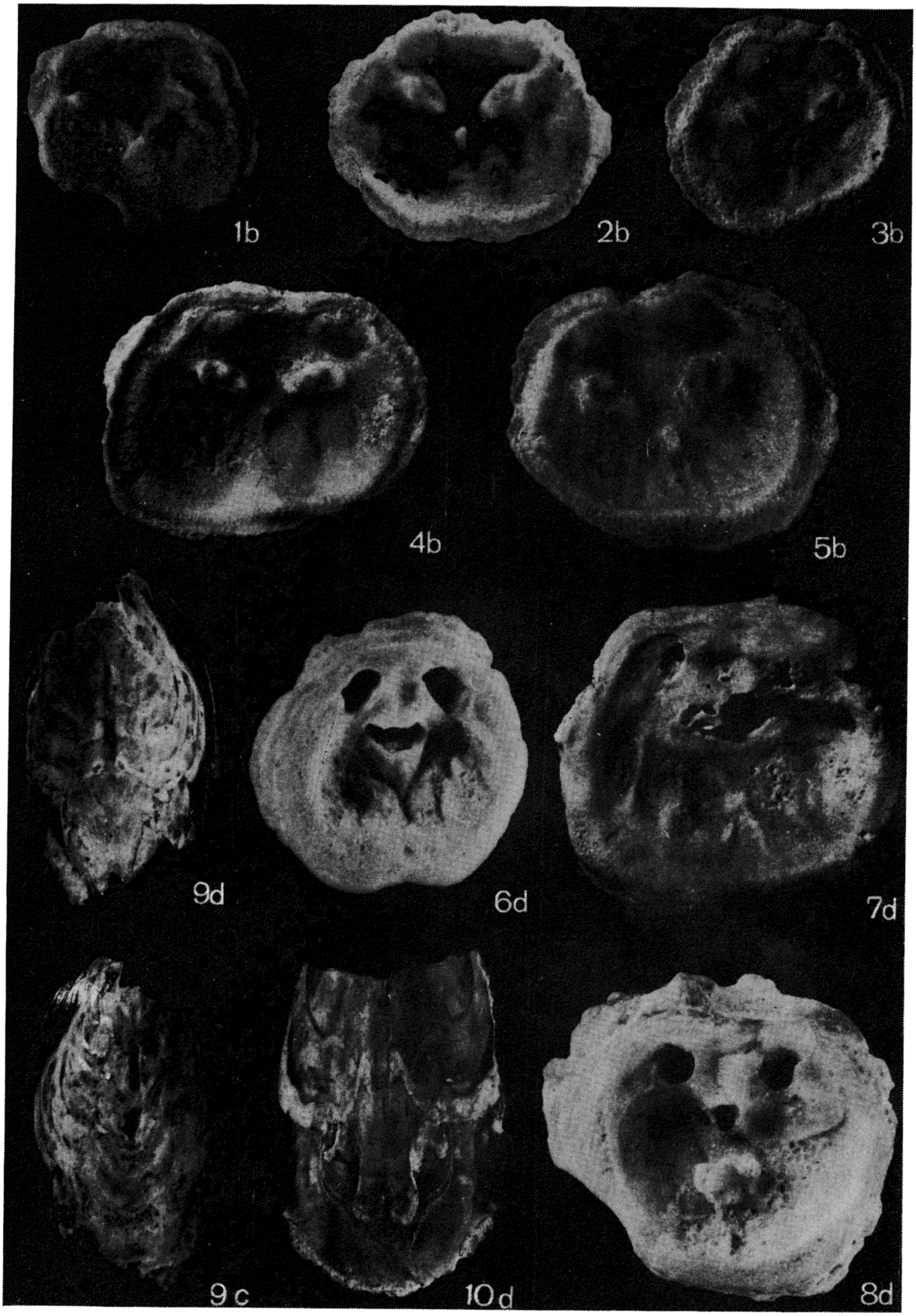
PLATE 1

1 — *Craniscus japonicus* (ADAMS) from Szczaworyż (specimen No. Bra-1615), × 7
2-3 — *Crania badensis* MICHALIK & ZÁGORŠEK from Szczaworyż (specimens No. Bra-1614), × 7
4-8 — *Neocrania anomala* (O.F. MÜLLER): *4*, *5* from Pińczów (specimen No. Bra-1611), × 7; *6*, *8* from Szczaworyż (specimens No. Bra-1610), × 7; *7* from Skowronno (specimen No. Bra-1613), × 7
9-10 — *Lingula dregeri* ANDREAE from Pińczów (specimens No. Bra-1616), × 5

In all figures: **b** — interior of brachial valve, **c** — pedicle valve view, **d** — interior of pedicle valve


1b
2b
3b
4b
5b
9d
6d
7d
9 c
10 d
8d

the brachial valve (Text-fig. 5), indistinct, oval, paired posterior muscle scars located close to the posterior margin and to a broad limbo; anterior muscle scars conspicuous, *V*-shaped, located at elongated elevations; brachial muscle scar indistinct. Median septum thin, low, and long (approximately 1/4 of the valve in length).

Modern representatives of *Craniscus japonicus* (ADAMS) inhabit a wide depth interval, 20 to 885 meters (COOPER 1978).

OCCURRENCE: Miocene of Japan (ZEZINA 1985); present-day west Pacific Ocean, *viz*. Japan, the Philippines, and Indonesia (THOMSON 1927, COOPER 1978, LEE & BRUNTON 1986).

Family **Hemithyrididae** RZHONSNITSKAYA, 1956
Genus *Notosaria* COOPER, 1959
Notosaria sp.
(Pl. 2, Fig. 19)

MATERIAL: 1 pedicle valve, a bit damaged at the anterior margin, from Szczaworyż.

DESCRIPTION: Valve triangular in outline, with long and sharp beak. Maximum width (8.7 mm) achieved at mid-length (total length 10.2 mm). Valve ornamented with 26 ribs increasing in width and thickness anteriorily. Ribs are singular, equally spaced, with rounded crests but no tubercles of spines.

Deltidial plates are not preserved. Remains after the pedicle collar preserved at the top of the foramen. Teeth are delicate, supported by dental plates which run almost parallel to each other, slightly diverging anteriorily. Adductor muscle scars cordate in outline; diductor muscle scars pearlike widened anteriorily, located at both sides of the adductors.

REMARKS: The form of the ribs makes the specimen attributable to the genus *Notosaria* COOPER.

OCCURRENCE: Modern species of the genus *Notosaria* COOPER occur in New Zealand, 35 to 315 meters in depth (ZEZINA 1985). In Europe, the genus has been known from the Pliocene of Belgium (COOPER 1959, LEE & WILSON 1979). This is the first record of the genus *Notosaria* from the Miocene deposits of Europe.

Family **Cryptoporidae** MUIR-WOOD, 1955
Genus *Cryptopora* JEFFREYS, 1869
Cryptopora lovisati (DREGER, 1911)
(Pl. 2, Figs 7—8)

1980. *Cryptopora lovisati* (DREGER, 1911); E. POPIEL-BARCZYK, p. 113, Text-figs 2A and 3—4, Pl. 2, Figs 1—12 (*cum syn.*).

MATERIAL: 1 specimen from Pińczów, 3 specimens from Busko.

REMARKS: The specimens from Busko (Pl. 2, Figs 7—8) are smaller-sized but closely resembling those described by POPIEL-BARCZYK (1980, Pl. 2, Figs 1—10) from Roztocze. The specimen from Pińczów is larger-sized but its shell dimensions and outline are consistent with the specimens form Długi Goraj in Roztocze (POPIEL-BARCZYK 1980, Pl, 2, Figs 8a and 9a). Deltidial plates in two specimens from Busko are strongly triangular, as in those from Roztocze (POPIEL-BARCZYK 1980, Pl. 2, Figs 6a and 10a); the third specimen has its deltidial plates wider, more like those in specimens from the type locality Cadreas in Sardinia (POPIEL-BARCZYK 1980, Pl. 2, Figs 11a and 12a).

OCCURRENCE: Miocene of Sardinia (DREGER 1911, THOMSON 1927, COOPER 1959); and Roztocze (JAKUBOWSKI & MUSIAŁ 1977, POPIEL-BARCZYK 1980), and Pińczów and Busko area (STUDENCKI 1988) in Poland.

Family **Cancellothyrididae** THOMSON, 1926
Genus *Terebratulina* d'ORBIGNY, 1847
Terebratulina sp.
(Pl. 2, Figs 4—6)

MATERIAL: 6 specimens from Szczaworyż, 7 from Kików, and 12 from Mogiła, all poorly preserved.

DESCRIPTION: The investigated shells are very small (1.2—1.6 mm in length, 0.8—1.2 mm in width), biconvex. Pedicle valve oval to subpentagonal in outline, with long beak and rounded to almost straight anterior commissure. Foramen large, triangular in outline; deltidial plates narrow, poorly developed. Brachial valve circular to subsquare in outline, with well developed auricles at the narrow hinge margin. The valves bear each 6—8 thick, mostly straight ribs, with indistinct granulation; in the specimens from Mogiła, some dichotomous ribs appear at the mid-length, as well as intercalated ones close to the anterior margin.

REMARKS: The characters of the specimens point to their juvenile age. The small number and form of the ribs resemble the species *Terebratulina karreri* DREGER from the Miocene of the Vienna Basin (DREGER 1889, Pl. 2, Fig. 5) and *Terebratulina caputserpentis* LINNAEUS var. *granosa* PONZI from the Miocene of Italy (SACCO 1902, Pl. 5, Figs 16—18). The former species was also noted in the 1930s in the Miocene of Hungary (*cf.* MEZNERICS 1943, p. 33).

OCCURRENCE: Miocene of Pińczów and Mogiła area (STUDENCKI 1988).

Family **Terebratulidae** GRAY, 1840
Genus *Terebratula* O. F. MÜLLER, 1776
Terebratula styriaca DREGER, 1889
(Text-fig. 6; Pl. 3, Figs 1—9)

1977. *Terebratula styriaca* DREGER, 1889; W. BARCZYK & E. POPIEL-BARCZYK, p. 160, Text-fig. 3, Pl. 2, Fig. 10 (*cum syn.*).

MATERIAL: 41 specimens from Pińczów, 50 from Busko, 30 from Szczaworyż, 10 from Mogiła, and 1 from Łysa Góra by Skotniki; their preservation state is variable, adult specimens (more than 10 mm in length) being often crushed and incomplete but juveniles being in a fair condition.

REMARKS: Shell elongate oval (Pl. 3, Figs 1—3) to subpentagonal (Pl. 3, Fig. 5) in outline does not change its shape in ontogeny. Anterior commissure nonsulcate in the juveniles, with sulcation appearing only in shells more than 20 mm in length.

Cardinal process and loop of the investigated specimens resemble closely those observed in *Terebratula styriaca* from the Miocene of the Vienna Basin (*cf.* DREGER 1889; Pl. 3, Fig. 5a, b) as well as in representatives of the genera *Terebratula* O. F. MÜLLER and *Maltaia* COOPER of the Miocene and Pliocene of Italy (*cf.* COOPER 1983; Pl. 4, Figs 11, 13, 15, 18—19 and Pl. 6, Figs 24—28). Loop statistics of the studied specimens (Table 1) are in fact consistent with figures for the latter two genera (*cf.* COOPER 1983, pp. 14, 231, 243), except that Wl/Ll resembles more closely the genus *Pliothyrina* ROY (*cf.* COOPER 1983, p. 238). In the investigated specimens, brachial valves bear a poorly developed euseptum located between the adductor muscle scars. This feature resembles a certain variety of *Terebratula sinuosa* BROCCHI from the Miocene of Italy (*cf.* BONI 1935; Pl. 14, Fig. 15), although according to COOPER (1983) it does not occur in representatives of the genus *Terebratula* O. F. MÜLLER.

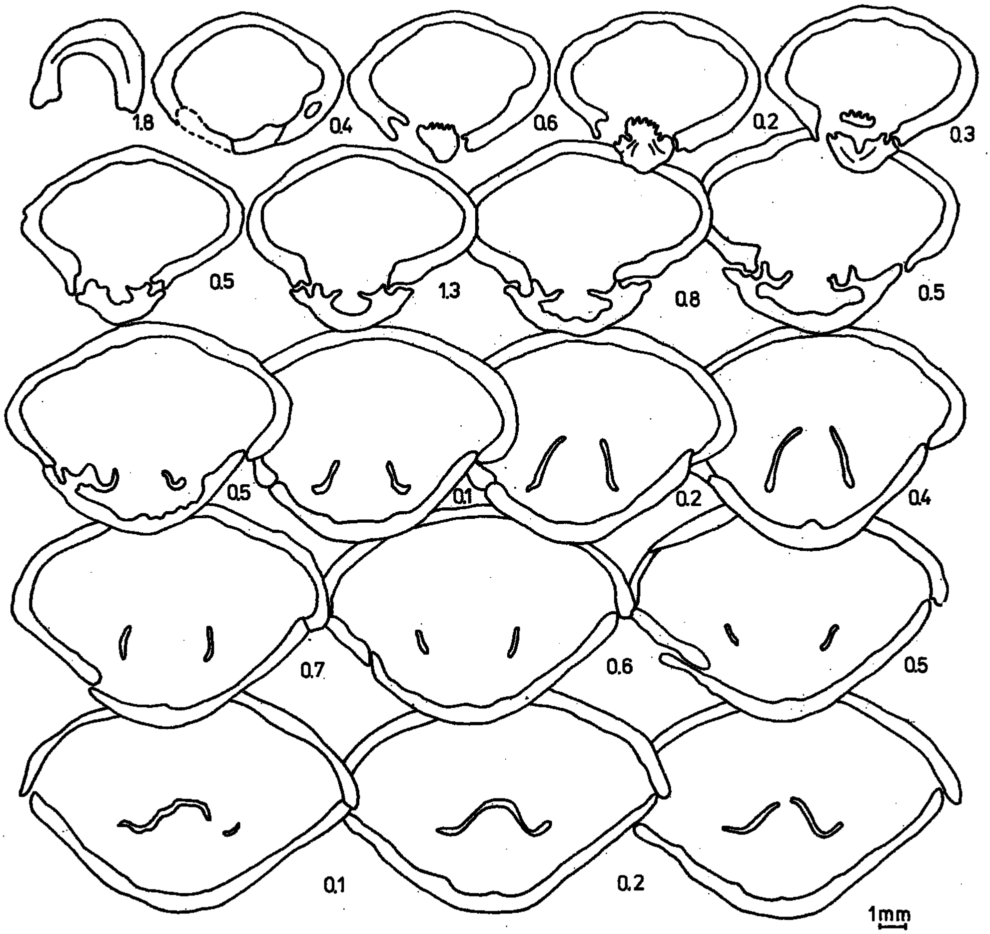


Fig. 6. Serial transverse sections of *Terebratula styriaca* DREGER from Szczaworyż, to show the well preserved loop (specimen No. Bra-1580: L—22.3, W—15.5, T—10.2 mm)

PLATE 2

1-3 — *Platidia anomioides* (SCACCHI & PHILIPPI) from Pińczów (specimens No. Bra-1561); *1, 2* × 3, *3* × 6

4-6 — *Terebratulina* sp.; *4, 5* from Kików (specimens No. Bra-1620), *6* from Mogiła (specimen No. Bra-1621); *4* × 6; *5, 6* × 10

7-8 — *Cryptopora lovisati* (DREGER) from Busko (specimens No. Bra-1619), × 7

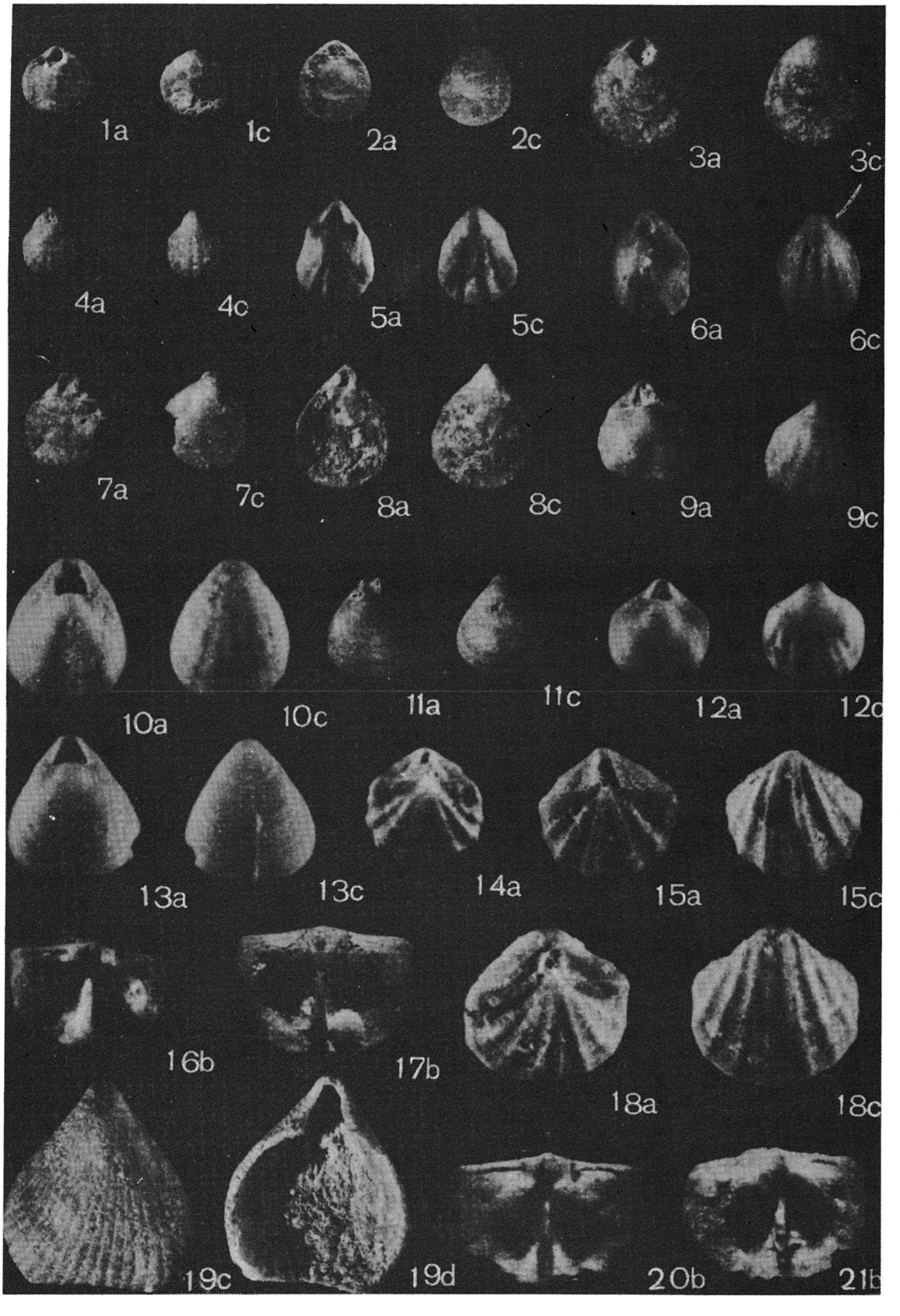
9-10, 12, 21 — *Argyrotheca subcordata* (BOETTGER): *9, 10, 21* from Pińczów (specimens No. Bra-1572), *12* from Celiny (specimen No. Bra-1599); *9, 10* × 7, *12, 21* × 10

11, 13 — *Argyrotheca cistellula* (S. WOOD): *11* from Pińczów (specimen No. Bra-1573), × 7; *13* from Celiny (specimen No. Bra-1602), × 10

14-18, 20 — *Argyrotheca costulata* (SEGUENZA): *14, 18* from Grzybów (specimens No. Bra-1589), × 7; *15–17, 20* from Pińczów (specimens No. Bra-1574), × 10

19 — *Notosaria* sp. from Szczaworyż (specimen No. Bra-1631), × 3

In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view, **d** — interior of pedicle valve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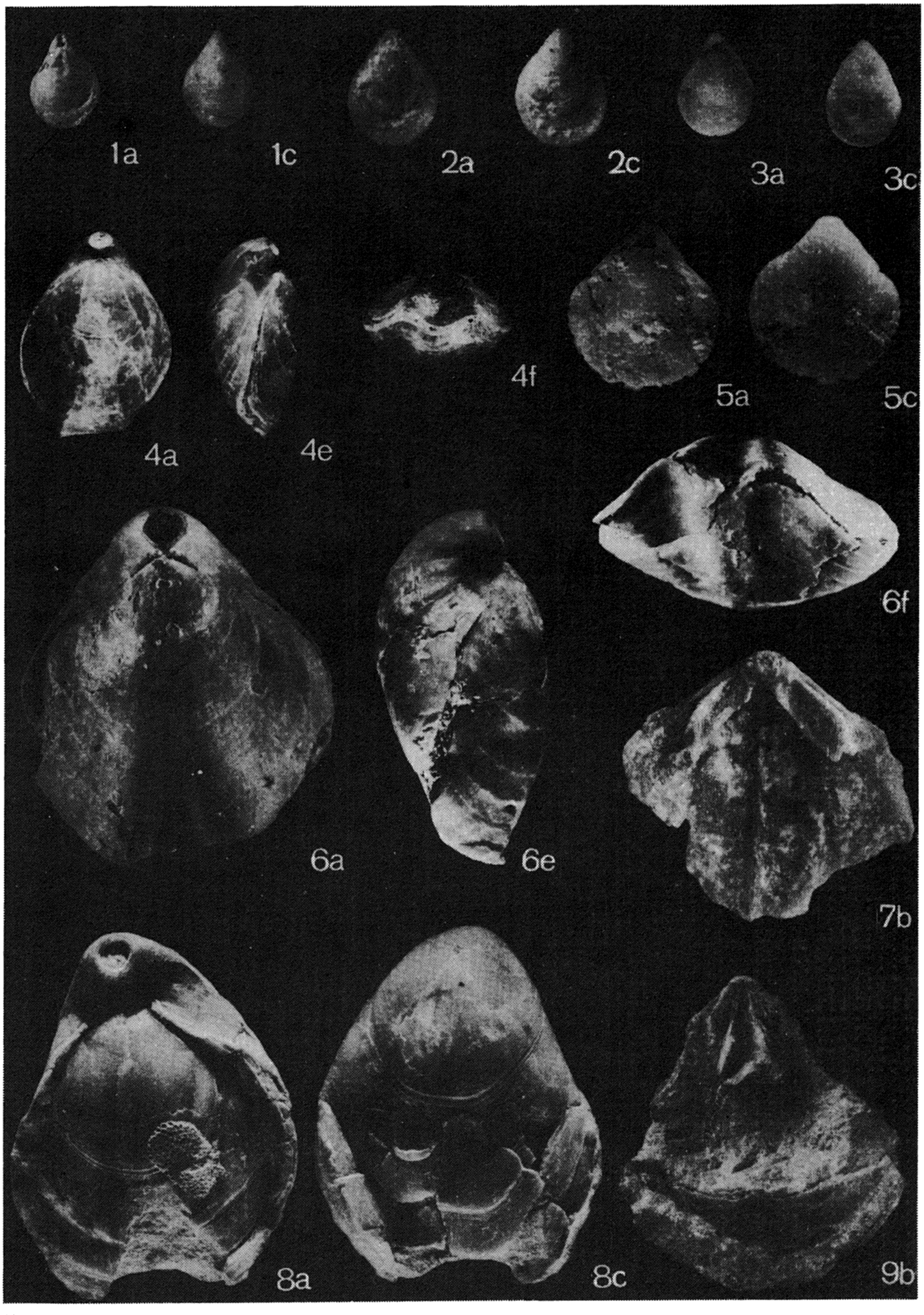
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1c
2a
2c
3a
3c
4a
4e
4f
5a
5c
6a
6e
6f
7b
8a
8c
9b

Table 1

Loop statistics in selected specimens of *Terebratula styriaca* DREGER

No	Locality	L	W	T	Wl/WD	Ll/LD	Wl/Ll
1.	Pińczów	14.7	11.1	7.0	0.31	0.36	0.65
2.	Busko	16.6	14.1	8.8	0.33	0.34	0.89
3.	Busko	17.8	14.4	8.0	0.30	0.34	0.71
4.	Szczaworyż	22.3	15.3	10.2	0.36	0.37	0.74
5.	Pińczów	22.4	16.5	10.2	0.31	0.30	0.72
6.	Busko	25.7	19.2	12.1	0.34	0.34	0.65

L — shell length, **W** — shell width, **T** — shell thickness, **Wl** — loop width, **Ll** — loop length, **WD** — brachial valve width, **LD** — brachial valve length

The investigated specimens resemble in their shell outline and sulciplicate anterior commissure the species *Terebratula sinuosa* BROCCHI from the Miocene of Italy (*cf.* BONI 1935, Pls 7—14; COOPER 1983, Pl. 4, Figs 17—19) and *Maltaia maltensis* COOPER (*cf.* COOPER 1983, Pl. 6, Figs 15—28). The relations between *T. styriaca* and *T. dregeri* have been discussed by DREGER (1889, p. 187), SACCO (1902, p. 15), FRIEDBERG (1924, p. 563), BONI (1935, p. 254), and MEZNERICS (1943, p. 29). The differences consist in more pentagonal shell outline as well as in the presence of rudimentary inner hinge plates and more closely parallel loop arms in *T. styriaca* (Pl. 9, Fig. 3b), whereas *T. sinuosa* has widely gaping and divergent loop arms but no inner hinge plates (*cf.* COOPER 1983; Pl. 4, Figs 18—19).

The specimens assigned herein to *Terebratula styriaca* DREGER differ from those attributed to *Terebratula* cf. *maxima* FRIEDBERG in their pentagonal shell outline, sigmoidal lateral commissure, and more distinct sulcation of the anterior commissure; moreover, their apical angle does not reach as large values as in *T.* cf. *maxima.* The two forms differ also in their inner hinge plates and muscle scar pattern.

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), Hungary (MEZNERICS 1943), and the Korynica Basin in Poland (BARCZYK & POPIEL-BARCZYK 1977).

Terebratula cf. *maxima* FRIEDBERG, 1924
(Pl. 4, Figs 5—9)

1924. *Terebratula maxima* FRIEDB.; W. FRIEDBERG, p. 563, Pl. 1, Fig. 6.

MATERIAL: 2 crushed specimens from Pińczów, 1 incomplete specimen from Świniary, 5 from Nadole by Busko, and 1 from Krzyżanowice.

REMARKS: FRIEDBERG (1924) erected his species on the basis of a single specimen from the KOWALEWSKI collection housed at the State Geological Institute; this specimen, however, cannot be located anymore. MUIR-WOOD (1938, p. 160) strongly denies the identity of *Terebratula maxima*

PLATE 3

1-9 — *Terebratulina styriaca* DREGER: *1, 2* juvenile specimens from Pińczów, (specimens No. Bra-1577a), *1* × 3; *2* × 7; *3, 5* juvenile specimens from Mogiła (specimens No. Bra-1590), × 7; *4* adult specimen from Łysa Góra near Skotniki (specimen No. Bra-1579a), nat. size; *6, 7, 9* adult specimens from Pińczów (specimens No. Bra-1577), *6* × 2; *7, 9* × 3; *8* adult specimen from Busko (specimen No. Bra-1578), × 2

In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view, **d** — interior of pedicle valve, **e** — lateral view, **f** — anterior view

FRIEDBERG and *Terebratula maxima* CHARLESWORTH, the latter species including specimens from the Pliocene of England. In fact, *T. maxima* CHARLESWORTH has been recently established (COOPER 1983) as the type species of the genus *Apletosia* COOPER. On the other hand, the shell characteristics of the species *"maxima"* of FRIEDBERG substantiate its attribution to the genus *Terebratula* O. F. MÜLLER. In the investigated specimens, apical angle is wide, approximately 140°, as it is typical of FRIEDBERG's species (*cf.* FRIEDBERG 1924, p. 563).

The investigated specimens bear euseptum in their brachial valve, which makes them similar to *Terebratula styriaca* DREGER and to the specimens from the Miocene of Podolia described by KUDRIN (1961; Pl. 3, Figs 1—3) under the name of *Terebratula grandis* BLUMENBACH. Both the latter forms, however, have a considerably narrower apical angle.

OCCURRENCE: Miocene of Nadole by Busko in Poland (FRIEDBERG 1924, KOWALEWSKI 1957).

Genus *Pliothyrina* ROY, 1980

Pliothyrina grandis (BLUMENBACH, 1803)
(Pl. 4, Figs 1—4 and 10)

1870. *Terebratula grandis* BLUMENB.; F. ROEMER, p. 376, Pl. 44, Fig. 1.
1882. *Terebratula*, forma *indeterminata;* V. HILBER, p. 33, Pl. 4, Figs 14—16.
1921. *Terebratula* cf. *grandis* BLUM.; W. FRIEDBERG, p. 7, Pl. 1, Figs 3—10.
1961. *Terebratula grandis* BLUMENBACH, 1803; L. N. KUDRIN, p. 51, Pl. 1, Figs 1—14 and Pl. 3, Figs 1—4.
1978. *Terebratula grandis* BLUMENBACH, 1803; S. CALZADA BADIA, p. 352, Figs 2—4 (a—c) and 5 (2—5).
1983. *Pliothyrina grandis* (BLUMENBACH); G. A. COOPER, p. 238, Pl. 5, Figs 5—6.

MATERIAL: 9 shells and 1 pedicle valve from Pińczów, 3 shells and 6 pedicle valves from Świniary; most of the specimens incomplete, those from Pińczów compacted but some of those from Świniary intact.

REMARKS: The investigated specimens are entirely consistent in their outer characteristics with those referred to in the synonymy. The inner features are poorly visible because of the preservation state. The only specimen with at least partly preserved loop, a juvenile (Pl. 4, Fig. 1b), has loop statistics consistent with those given for the genus by COOPER (1983, p. 238), namely: Wl/WD = 0.30, Ll/LD = 0.31, and Wl/Ll = 0.80. Neither this specimen, nor another one which includes the hinge part of the brachial valve (Pl. 4, Fig. 3b) bears inner hinge plates, while the genus *Pliothyrina* ROY is generally characterized by small to prominent inner hinge plates (COOPER 1983, p. 238). On the other hand, muscle scar patterns agree with *Pliothyrina sowerbyana* (NYST) from the Upper Miocene to Lower Pliocene of Belgium (ROY 1980; Pl. 1, Figs 4 and 7) as well as with *P. grandis* (BLUMENBACH) from the Miocene of Podolia (KUDRIN 1961, Pl. 3, Figs 1—3) and Spain (CALZADA BADIA 1978, Fig. 5 (4)). The brachial valve bears a poorly developed euseptum.

One of the incomplete adult specimens contains a muscle field surrounded by triangular swellings in its beak area (Pl. 4, Fig. 4d), which resembles the species *Terebratula makridini* KUDRIN from the Miocene of Podolia (*cf.* KUDRIN 1961; p. 57, Pl. 2, Figs 1—16). The anterior commissure of the investigated specimen is too poorly preserved to allow for its analysis, while this character makes difference between the species *Pliothyrina grandis* (BLUMENBACH) and *Terebratula makridini* KUDRIN (*cf.* KUDRIN 1961, GURIDOV 1961). The investigated specimen is here regarded as a gerontic representative of the former species.

The Miocene terebratulids from the southern slopes of the Holy Cross Mountains evidently represent a group intermediary between two species groups (*cf.* COOPER 1983, p. 244). One of these are the genera *Apletosia* COOPER and *Pliothyrina* ROY from northern Europe and England, which bear inner hinge plates. The other are the genera *Terebratula* O. F. MÜLLER and (most likely) *Maltaia* COOPER from southern Europe and the Mediterranean Sea, which have no more than poorly developed inner hinge plates. The investigated representatives of *Terebratula styriaca* DREGER and *Terebratula* cf. *maxima* FRIEDBERG show features (*viz.* shell outline, loop statistics, presence of euseptum, poor development to absence of inner hinge plates) close to *Terebratula sinuosa* BROCCHI and *Maltaia maltensis* COOPER, typical of the southeuropean terebratulids. In turn, the investigated representatives of *Pliothyrina grandis* (BLUMENBACH) resemble in their shell outline, muscle scar patterns, and loop statistics the northeuropean terebratulids. In the investigated material, however, the inner hinge plate development is not a good diagnostic feature of the two species groups. This remark seems to be valid also for the Miocene terebratulids of the Vienna Basin, Hungary, and Podolia, described by the former authors (DREGER 1889, FRIEDBERG 1921, MEZNERICS 1943, GURIDOV 1961, KUDRIN 1961).

OCCURRENCE: Upper Oligocene of Westphalia (COOPER 1983), Miocene of Podolia (HILBER 1882, FRIEDBERG 1921, GURIDOV 1961, KUDRIN 1961), southern Spain (CALZADA BADIA 1978); Upper Silesia (ROEMER 1870) and southern slopes of the Holy Cross Mountains (KOWALEWSKI 1957, 1959; PRZYBYSZEWSKI 1975) in Poland.

Family **Platidiidae** THOMSON, 1927
Genus *Platidia* da COSTA, 1852
Platidia anomioides (SCACCHI & PHILIPPI, 1844)
(Text-fig. 7; Pl. 2, Figs 1—3)

1889. *Platidia anomioides* SCACCHI; J. DREGER, p. 192, Pl. 6 (II), Figs 10—11.
1902. *P. anomioides* var. *rotundella* SACC.; F. SACCO, p. 29, Pl. 6, Figs 1—3.
1927. *Platidia anomioides;* J. A. THOMSON, p. 218, Fig. 65a—c.
1943. *Platidia anomioides* (SCACCHI et PHILIPPI 1844); I. MEZNERICS, pp. 42, 60.
1973. *Platidia anomioides* (SCACCHI and PHILIPPI); G. A. COOPER, p. 21, Pl. 9, Figs 49—52.
1979. *Platidia anomioides* (SCACCHI & PHILIPPI); A. LOGAN, p. 60, Text-fig. 17, Pl. 7, Figs 1—11.

MATERIAL: 63 well preserved specimens from Pińczów and 20 from Busko.

DESCRIPTION: Shell small-sized (1.0 to 4.0 mm in length, 0.8 to 3.8 mm in width), flat to Ma bit convex in the hinge part (0.5 to 1.0 mm in thickness), subcircular (specimens > 3 mm in length) to elongate oval in outline (specimens < 3 mm in length). Shell surface with a characteristic

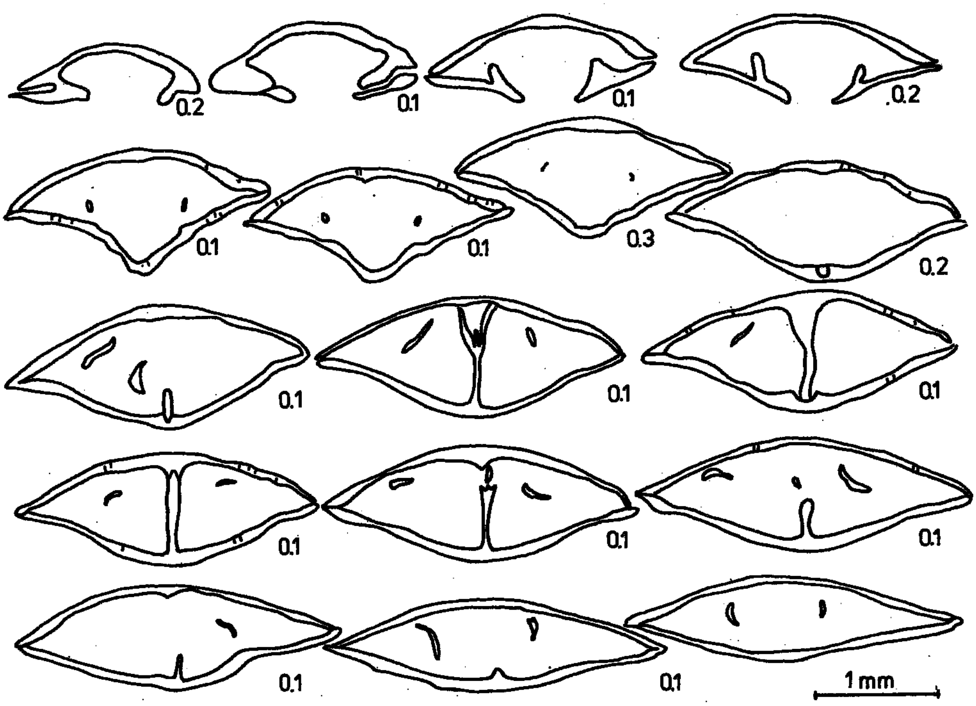


Fig. 7. Serial transverse sections of *Platidia anomioides* (SCACCHI & PHILIPPI) from Pińczów, to show internal features (specimen No. Bra-1565; L—3.0, W—2.8, T—1.0 mm)

microornamentation, and with a distinct cluster of growth lines close to the anterior margin. Large amphithyridid foramen surrounded by thick integument, which may represent, in its anterior part, a relic after narrow deltidial plates. [The presence of deltidial plates in the genus *Platidia* da COSTA has been recently questioned (LOGAN 1979), though older authors regard it as characteristic of the genus (DAVIDSON 1887, THOMSON 1927, ATKINS 1959, MUIR-WOOD 1965).] Median septum poorly visible in the brachial valve, but quite distinct in serial sections (Text-fig. 7).

REMARKS: Among the investigated specimens, those small-sized resemble in outline *Platidia anomioides* from Podolia (*cf.* DREGER 1889), while those larger-sized are consistent in their subcircular outline with *P. anomioides* var. *rotundella* from the Miocene of Italy (SACCO 1902).

Thus far, two species of the genus *Platidia* da COSTA have been reported from the fossil record (ZEZINA 1985), namely *P. anomioides* (SCACCHI & PHILIPPI) and *P. davidsoni* (DESLONGCHAMPS). They differ from each other in shell size and outline, as well as in brachidium which includes fully developed descending branches of the loop in *P. anomioides* (cf. LOGAN 1979). The latter feature allows for attribution of the investigated specimens (*cf.* Text-fig. 7).

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), northwest Italy (SACCO 1902), Podolia (DREGER 1889, THOMSON 1927), and the Korytnica Basin in Poland (BARCZYK & POPIEL-BARCZYK 1977), as well as the Upper Miocene of the entire Mediterranean area (MEZNERICS 1943, ZEZINA 1985). Recent representatives of this species occur at 150—400 m in the Mediterranean Sea (LOGAN 1979) and southwest Africa (COOPER 1973), but they have also been reported at greater depths (THOMSON 1927, ZEZINA 1985).

Family **Kraussinidae** DALL, 1870

Genus *Megerlia* KING, 1850

Megerlia truncata (LINNAEUS, 1767)

(Text-fig. 8; Pl. 3, Figs 1—7)

1888. *Megerlia truncata*, LINNE, sp.; T. DAVIDSON, p. 103, Pl. 19, Figs 11—20.
1889. *Megerlia oblita*, MICH.; J. DREGER, p. 190, Pl. 6 (II), Figs 6 and 8—9 (*non* Fig. 7).
1902. *Muhlfeldtia truncata* (L.); F. SACCO, p. 27, Pl. 5, Figs 38—43.
1902. *Muhlfeldtia truncata* var. *oblita* (MICHT.); F. SACCO, p. 28, Pl. 5, Figs 54—60.
1921. *Muhlfeldtia truncata* L.; W. FRIEDBERG, p. 10, Pl. 2, Figs 3—10.
1921. *Muhlfeldtia truncata* L. var. *oblita* MICHT.; W. FRIEDBERG, p. 12, Pl. 2, Figs 8—9.
1943. *Muhlfeldtia oblita* (MICHELOTTI, 1838); I. MEZNERICS, p. 43, Pl. 2, Figs 6 and 9.
? 1943. *Muhlfeldtia marginata* n. sp.; I. MEZNERICS, p. 44, Pl. 2, Figs 13—14.
1950. *Muhlfeldtia truncata* L.; W. KRACH, p. 294, Pl. 1, Fig. 29a—b.
1967. *A. truncata;* C. H. BRUNTON & *al.*, p. 177, Pl. 4, Figs 14—25.
1979. *Megerlia truncata* LINNAEUS, 1767); A. LOGAN, p. 68, Pl. 9, Figs 1—19 (*non* Figs 20—23).
1981. *Megerlia truncata* (LINNE); G. A. COOPER, p. 16, Pl. 3, Figs 5—11.
1982. *Megerlia truncata* (LINNE, 1767); C. LLOMPART & S. CALZADA, p. 195, Fig. 3.
1985. *Megerlia truncata* (LINNEO, 1767); M. GAETANI & D. SACCA, p. 16, Pl. 10, Fig. 10 and Pl. 11, Figs 1—5.

MATERIAL: 13 specimens from Pińczów, 25, from Busko, 897 from Szczaworyż, 4 from Kików, and 1 from Grzybów; preservation state variable, with larger shells commonly deformed, disarticulated, and drilled by boring organisms.

REMARKS: Shells biconvex, transversally oval in outline, with submesothyrid foramen fully consistent with specimens from the Miocene of Italy (SACCO 1902), Spain (LLOMPART & CALZADA 1982), Hungary (MEZNERICS 1943), and Podolia (FRIEDBERG 1921), as well as with extant ones from the Mediterranean Sea (LOGAN 1979) and Atlantic Ocean (COOPER 1981). Their inner structure (Text-fig. 8) does also fully agree with the descriptions given by LOGAN (1979) and COOPER (1981). Shell ornamentation was previously regarded as diagnostic of the fossil species *Megerlia oblita* MICHELOTTI and *Megerlia marginata* (MEZNERICS), which are here included to the species *Megerlia truncata* (LINNAEUS) because the ornamentation seems to depend on individual age and substrate nature. Juvenile specimens bear quite distinct tuberculate ribs at both the valves.

In the investigated material, shell ornamentation and mesothyrid foramen differ the species *Megerlia truncata* from the associated representatives of the genus *Pantellaria* DALL, whose validity the authors accept following the opinions expressed by THOMSON (1927), MUIR-WOOD (1965), COOPER (1981), DOESCHER (1981), and ZEZINA (1985).

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), north Italy (DAVIDSON 1888, SACCO 1902, THOMSON 1927), SPAIN (LLOMPART & CALZADA 1982), Hungary (MEZNERICS 1943), Podolia (FRIEDBERG 1921), as well as Upper Silesia (ROEMER 1870), Roztocze (JAKUBOWSKI & MUSIAŁ 1979b), Lublin area (KRACH 1950), and Busko (RADWAŃSKI 1969) in Poland; Pliocene of the Mediterranean area (LLOMPART & CALZADA 1982). Recent representatives of *M. truncata* are known from variable depths of the Mediterranean Sea (COOPER 1981, LOGAN 1979) and Atlantic Ocean (ATKINS 1961b, COOPER 1981, ZEZINA 1985). REVERT (1985) suggests a change in habitat bathymetry of this species in western Mediterranean Sea, from 50—95 m in the Miocene to some 150 m today.

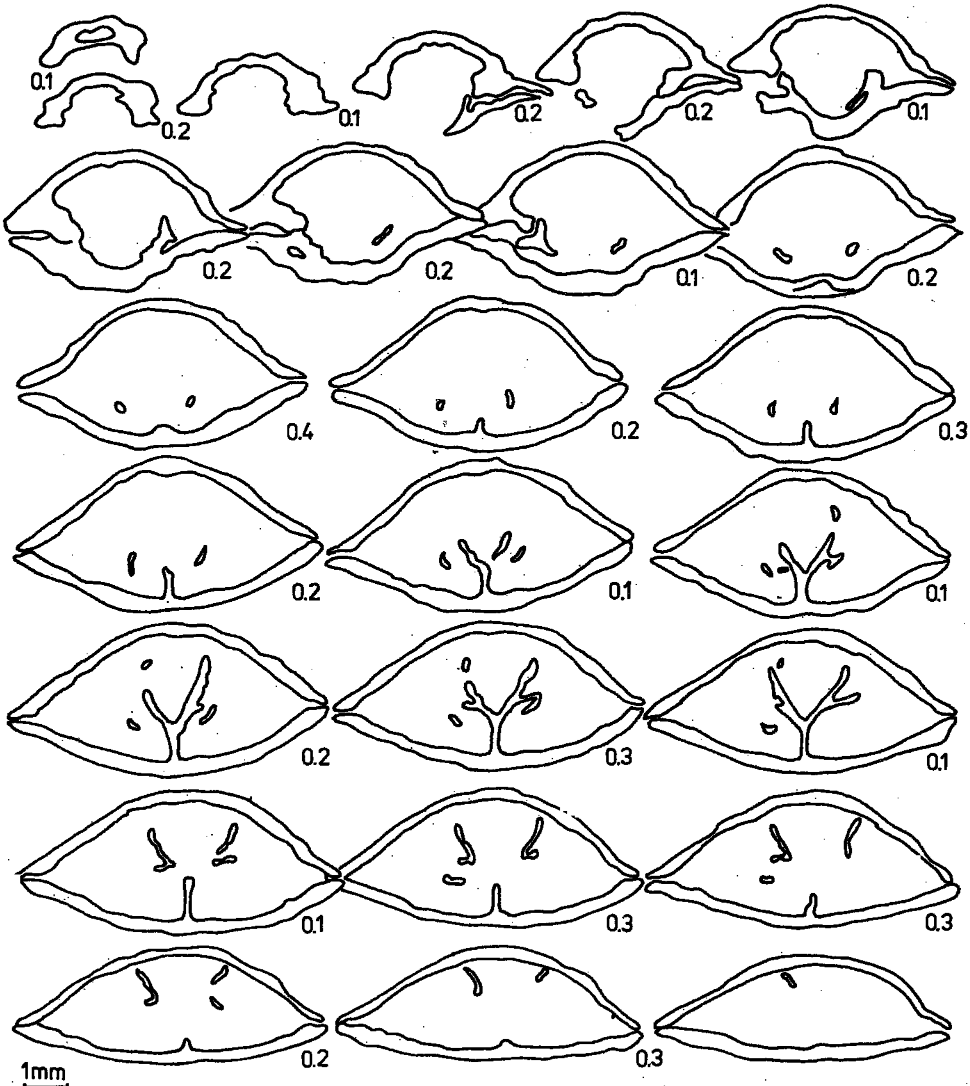


Fig. 8. Serial transverse sections of *Megerlia truncata* (LINNAEUS) from Szczaworyż, to show internal features (specimen No. Bra-1567: L—8.2, W—8.8, T—4.2 mm)

Genus *Pantellaria* DALL, 1919

Pantellaria monstruosa (SCACCHI, 1838)
(Pl. 6, Figs 1—5)

1888. *Megerlia truncata*, var. *monstruosa*, SCACCHI; T. DAVIDSON, p. 108, Pl. 19, Figs 21 and 22a.
1889. *Megerlia oblita* MICH.; J. DREGER, p. 190, Pl. 6 (II), Fig. 7 (*only*).
1921. *Muhlfeldtia truncata* L.; W. FRIEDBERG, p. 10, Pl. 2, Fig. 10 (*only*).
1927. *Pantellaria monstruosa* SCACCHI; A. THOMSON, p. 229, Fig. 70a—c.
1979. *Megerlia truncata* (LINNAEUS, 1767); A. LOGAN, p. 68, Pl. 9, Figs 20—23 (*only*).
1981. *Pantellaria monstruosa* (SCACCHI); G. A. COOPER, p. 17, Pl. 3, Figs 16—18.
1982. *Pantellaria monstruosa* SCACCHI); G. A. COOPER, p. 15, Pl. 5, Figs 1—6.

MATERIAL: 56 specimens from Szczaworyż, 6 from Mogiła, 3 from Kików, and 1 from Skowronno; preservation state variable, some specimens crushed.

REMARKS: Although ATKINS (1961a) and LOGAN (1979) express doubts concerning generic distinctness of *Pantellaria* DALL, the authors follow the opinions of THOMSON (1927), MUIR-WOOD (1965), COOPER (1981, 1982), DOESCHER (1981) and ZEZINA (1985) because the amphithyridid foramen makes a clear difference regardless of its origin. The presence of such a foramen in specimens no more than 2 mm in length clearly indicates it developes early in ontogeny.

The convex ventral valve bears wide and sometimes strongly bent beak (Pl. 6, Fig. 4). Ventral valve ornamented with delicate radial ribs with nodulose crests; brachial valve bearing no ribs but only distinct growth lines, often in clusters. Ventral valve bears inside a narrow pedicle collar and poorly developed teeth without dental plates; brachial valve has a median septum, sometimes preserved jointly with its link with descending branches of the loop which resembles *Megerlia truncata* (LINNAEUS).

Representatives of the genera *Pantellaria* DALL and *Megerlia* KING often occur in the same habitats, both presently (DAVIDSON 1888, LOGAN 1979) and in the geological past (THOMSON 1927, COOPER 1981), though they occur sometimes also in isolation (*see* COOPER 1981).

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889) and Podolia (FRIEDGERG 1921); Pleistocene of south Italy and Sicilia (THOMSON 1927, COOPER 1981). Extant representatives known from depths of 35 to 550—580 m in the Mediterranean Sea and Atlantic (COOPER 1981, 1982), though the species may also occur at greater depths (ZEZINA 1985).

Family **Megathyrididae** DALL, 1870

Genus *Argyrotheca* DALL, 1870

Argyrotheca cistellula (S. WOOD, 1841)
(Pl. 2, Figs 11 and 13)

1977. *Argyrotheca cistellula* (S. WOOD, 1841); W. BARCZYK & E. POPIEL-BARCZYK, p. 161, Pl. 1, Figs 1—3 (*cum syn.*).
1979. *Argyrotheca cistellula* (SEARLES-WOOD, 1841); A. LOGAN, p. 41, Text-figs 9—10 and Pl. 1, Figs 11—19.
1979a. *Argyrotheca* cf. *cistellula* (S. WOOD, 1841); G. JAKUBOWSKI & T. MUSIAŁ, p. 50, Pl. 1, Figs 10—13.

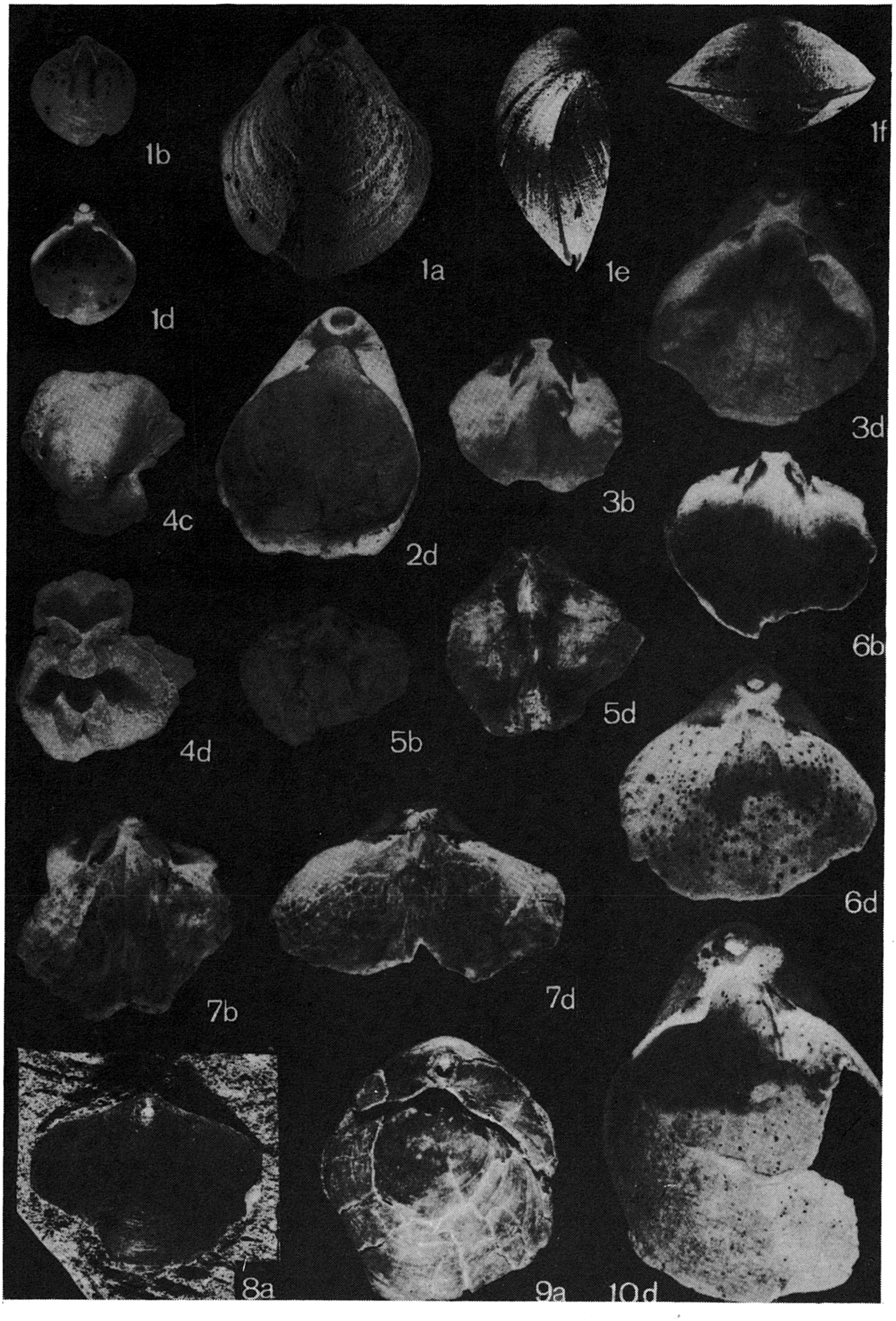
PLATE 4

1-4, 10 — *Pliothyrina grandis* (BLUMENBACH): *1, 3, 10* from Świniary (specimens No. Bra-1626), *1b, 1d, 3, 10d* — nat. size, *1a, 1e, 1f* × 3; *2, 4* from Pińczów (specimens No. Bra-1627, Bra-1628), nat size

6, 9 — *Terebratula* cf. *maxima* FRIEDBERG: *6* from Świniary (specimen No. Bra-1630), *9* from Pińczów (specimen No. Bra-1629); nat. size

5, 7-8 — *Terebratula maxima* FRIEDBERG: *5, 8* from Busko (Nadole) (specimens No. I. G. 32 II 87, I. G. 32 II 84), 7 from Krzyżanowice (specimen No. I. G. 32 II 104); nat. size

In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view, **d** — interior of pedicle valve, **e** — lateral view, **f** — anterior view


1b
1a
1e
1f
1d
3d
4c
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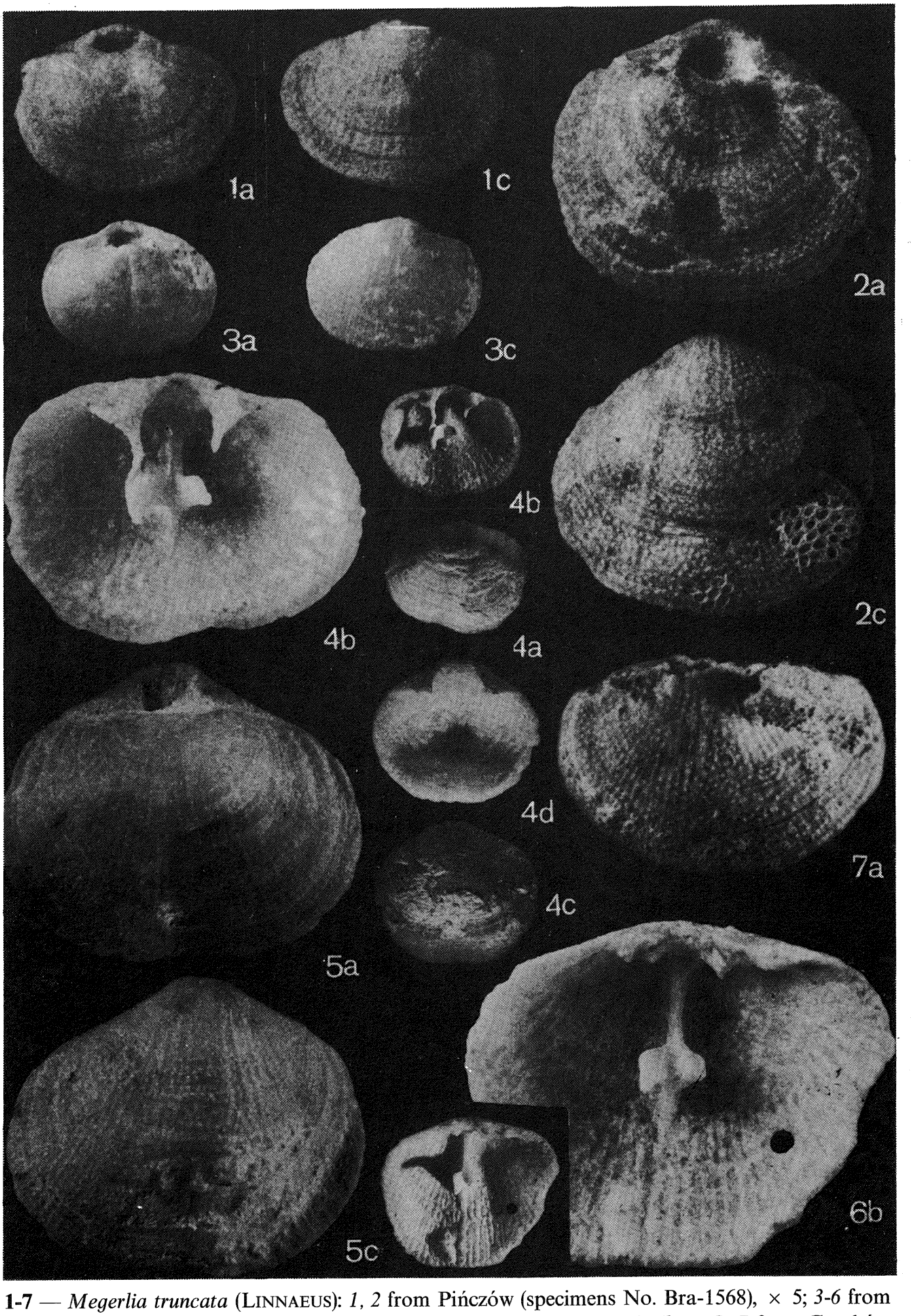
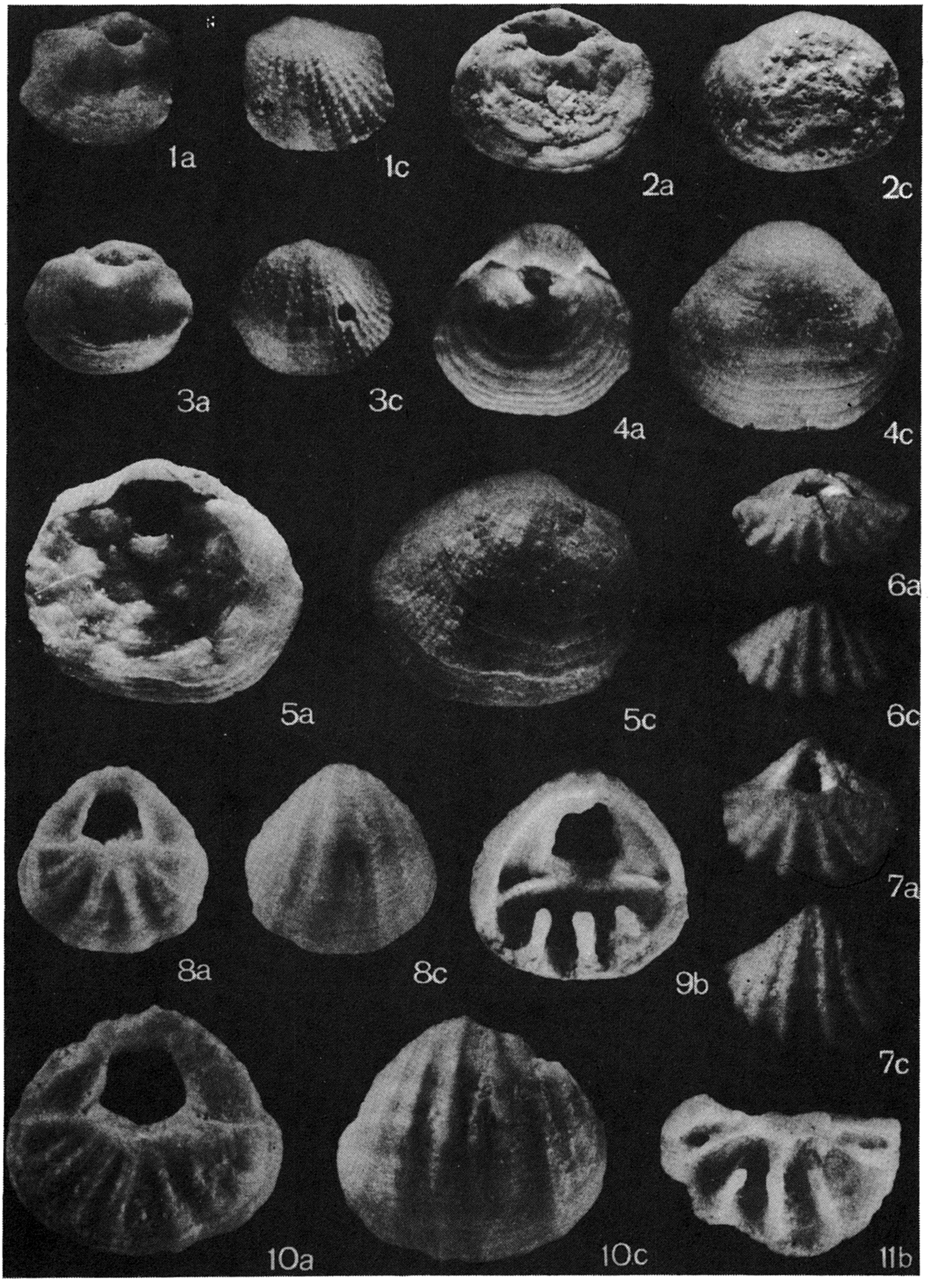


1-7 — *Megerlia truncata* (LINNAEUS): *1, 2* from Pińczów (specimens No. Bra-1568), × 5; *3-6* from Szczaworyż (specimens No. Bra-1567), **3, 4** × 2; *4b, 5, 6* × 5; *6b* × 2; *7* from Grzybów (specimen No. Bra-1600), × 5

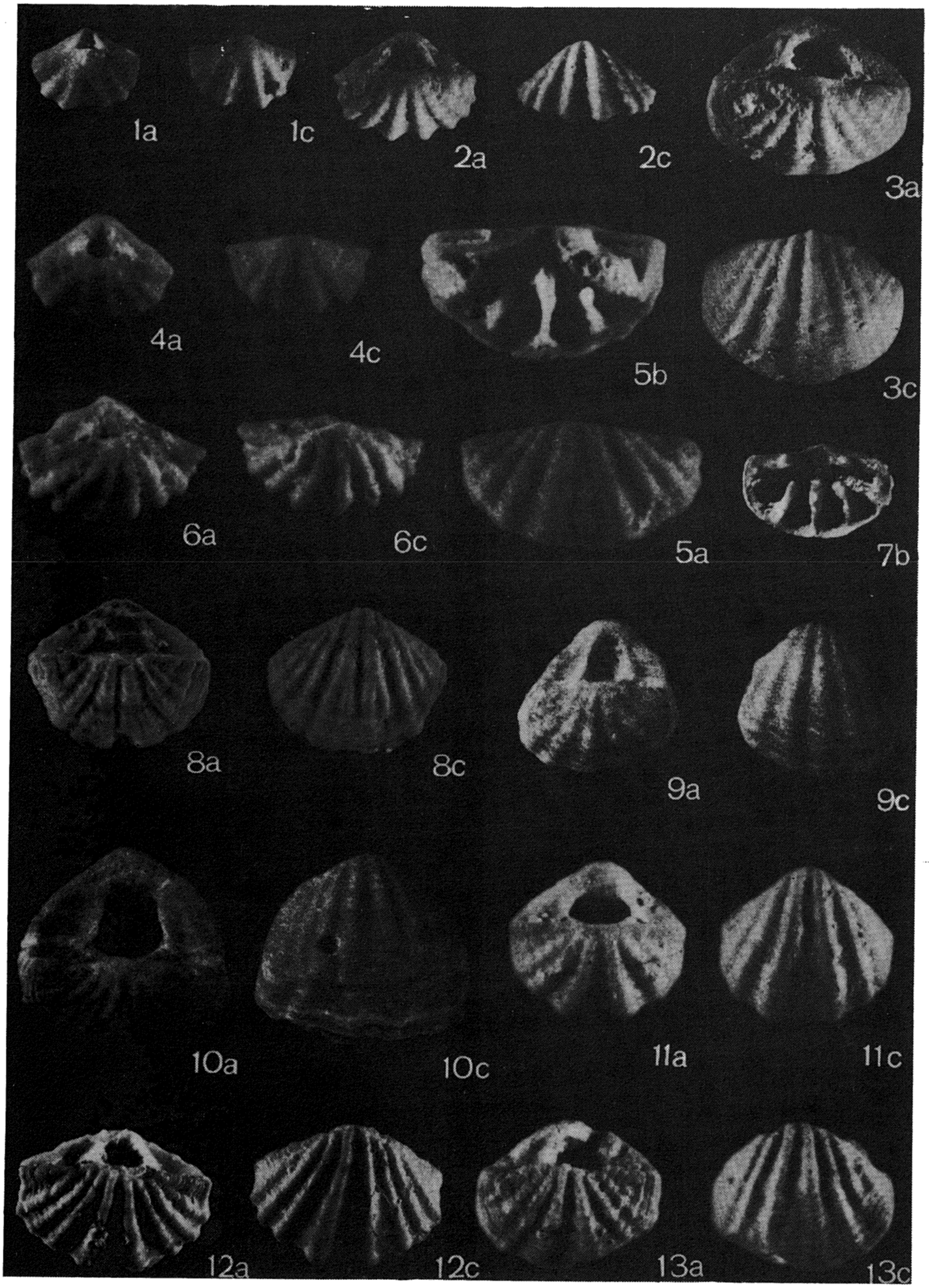
In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view, **d** — interior of pedicle valve



1-5 — *Pantellaria monstruosa* (SCACCHI): *1, 3* from Mogiła (specimens No. Bra-1624), × 5; *2* from Kików (specimen No. Bra-1608), × 5; *4-5* from Szczaworyż (specimens No. Bra-1607), × 5

6-11 — *Megathiris detruncata* (GMELIN) from Szczaworyż (specimens No. Bra-1569): *6, 7* × 7; *8-11* × 10

In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view



1-13 — *Megathiris detruncata* (GMELIN): *1-3* from Mogiła (specimens No. Bra-1586), *1* juvenile specimen × 10; *2-3* × 6; *4-10* from Pińczów (specimens No. Bra-1570), *4* juvenile specimen × 6; *6* × 7; *5, 8-10* × 5; *7b* × 3; *11-13* form Grzybów (specimens No. Bra-1595), × 5
In all figures: **a** — brachial valve view, **b** — interior of brachial valve, **c** — pedicle valve view

MATERIAL: 634 well preserved specimens from Pińczów, 4 from Busko, 133 from Szczaworyż, 2 from Mogiła, and 16 from Celiny.

REMARKS: The investigated material includes juveniles as well as adults and allows for corroboration of the information given by BARCZYK & POPIEL-BARCZYK (1977) for the material from the Korytnica Basin. The adults resemble most closely those from the Pliocene of England (DAVIDSON 1852; Pl. 1, Fig. 13). They also superficially resemble *Cistella neapolitana* SCACCHI from the Miocene of the Vienna Basin (*cf.* DREGER 1889; p. 185, Pl. 5 (I), Figs 6—8), but the latter forms have three septa in ventral valve, whereas the investigated specimens bear only a single one; moreover, the Viennese forms are tuberculate at the inner surface, whereas the investigated specimens are not. Similar differences exist between the investigated material and *Cistella neapolitana* SCACCHI from the Miocene of Podolia (*cf.* BARCZYK & POPIEL-BARCZYK 1977, p. 163).

Smooth-shelled Miocene representatives of the genus *Argyrotheca* DALL include also *A. laevigata* de MORGAN from France and *A. pusilla* (EICHWALD) from Podolia. The former species, however, is tuberculate at the inner surface of valve margins (de MORGAN 1915; p. 263, Fig. 5), while the latter is a junior synonym of *Cistella neapolitana* SCACCHI (*cf.* DREGER 1889, FRIEDBERG 1921).

In turn, *A. cistellula* (S. WOOD) differs from *A. subcordata* (BOETTGER) and *A. costulata* (SEGUENZA) in its smooth shell surface which bears no ribs until the shell reaches some 3 mm in length.

Extant representatives of *A. cistellula* (S. WOOD) have a broader hinge margin (DAVIDSON 1852; Pl. 1, Fig. 12) and smaller size, generally no more than 1.5 mm in length (RIOULT 1972, LOGAN 1979), than the fossil ones.

OCCURRENCE: Miocene of the Korytnica Basin (BARCZYK & POPIEL-BARCZYK 1977) and Roztocze (JAKUBOWSKI & MUSIAŁ 1979a) in Poland; Pliocene of south England (DAVIDSON 1852, THOMSON 1927). Extant representatives of the species live in the Mediterranean Sea and Atlantic Ocean at depths of 3 to 85 m (RIOULT 1972, LOGAN 1979, ZEZINA 1985).

Argyrotheca costulata (SEGUENZA, 1866) (Text-fig. 9; Pl. 2, Figs 14—18 and 20)

1889. *Cistella squamata* EICHW.; J. DREGER, p. 186 (8), Pl. 1, Figs 12—14.
1902. *Cistella costulata* (SEGU.); F. SACCO, p. 32, Pl. 6, Fig. 34.
1943. *Argyrotheca squamata* (EICHWALD 1853); I. MEZNERICS, p. 37.
1977. *Argyrotheca? squamata* EICHWALD, 1830); W. BARCZYK & E. POPIEL-BARCZYK, p. 163, Pl. 2, Fig. 1.

MATERIAL: 590 specimens from Pińczów, 10 from Busko, 132 from Szczaworyż, 17 from Mogiła, and 48 from Grzybów; mostly well preserved.

REMARKS: The investigated material clearly demonstrates that the most characteristic feature of *Argyrotheca costulata* (SEGUENZA) is its radial ribbing. Ribs are usually 5 or 7 in number in adult specimens; they are non-dichotomous, high, and distinct. Inter-rib spaces are wide, increasing anteriorily. The median rib is shorter than the others and begins only in the mid-length; its two neighboring ribs are more conspicuous than the others. This ribbing pattern appears in specimens as small as 2 mm in length and makes a clear difference from the species *Argyrotheca subcordata* (BOETTGER), *A. cistellula* (S. WOOD) and juveniles of *Megathiris detruncata* (GMELIN).

The investigated specimens bear no tubercles inside the shell but they have 3—4 incisions at the terminal end of the septum (Text-fig. 9), similarly to those in the Viennese forms (*cf.* DREGER 1889; Pl. 5 (I), Fig. 13b). The adult specimens bear also a cardinal process (Pl. 2, Figs 16—17 and 20).

Superficially, the investigated specimens resemble two Neogene species from the Caribbean (COOPER 1979; Pl. 6, Figs 1—20), namely *Argyrotheca inconstans* COOPER and *A. sublamellosa* COOPER. The latter two species, however, are more densely ribbed.

In spite of the priority of the name "*squamata*" of EICHWALD, it cannot be applied for the investigated material. Moreover, the species "*squamata*" EICHWALD and "*costulata*" SEGUENZA cannot be synonimized with each other, as done by SACCO (1902) and MEZNERICS (1943), because the inner characteristics of the former species have not been described or illustrated and EICHWALD (1850, p. 45) himself suggested their similarity to "*T. detruncata* L.", which seems to imply attribution of his species to the genus *Megathiris* d'ORBIGNY. In fact, the Miocene specimens from Podolia described by FRIEDBERG (1921) as "*Cistela squamata* EICHW", should indeed be assigned to *Megathiris*.

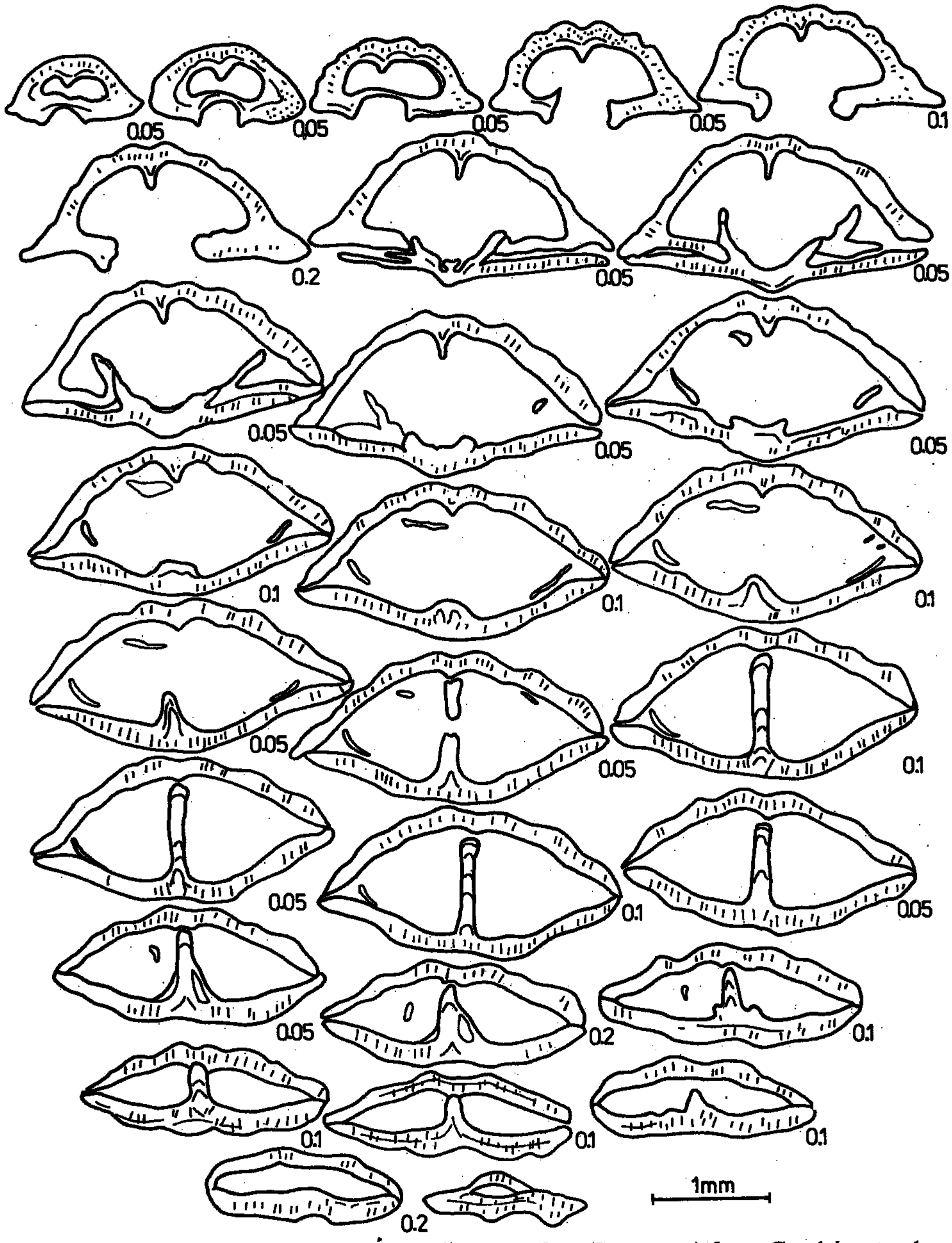


Fig. 9. Serial transverse sections of *Argyrotheca costulata* (SEGUENZA) from Grzybów, to show internal features (one septum) (specimen No. Bra-1589: L—2.3, W—2.6, T—1.4 mm)

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), north Italy (SACCO 1902), Rumania (MEZNERICS 1943), Hungary (VADASZ 1907), and the Korytnica Basin in Poland (BARCZYK & POPIEL-BARCZYK 1977).

Argyrotheca subcordata (BOETTGER, 1901)
(Pl. 2, Figs 9—10, 12, and 21)

1977. *Argyrotheca subcordata* (BOETTGER, 1901); W. BARCZYK & E. POPIEL-BARCZYK, p. 162, Pl. 2, Figs 2—9 (*cum syn.*).
1979a. *Argyrotheca* cf. *subcordata* (BOETTGER, 1901); G. JAKUBOWSKI & T. MUSIAŁ, p. 50, Pl. 1, Figs 14—17.

MATERIAL: 478 well preserved specimens from Pińczów, 14 from Busko, 179 from Szczaworyż, 12 from Mogiła, 28 from Grzybów, and 10 from Celiny.

REMARKS: The investigated material corroborates the observations made previously on the specimens from the Korytnica Basin (BARCZYK & POPIEL-BARCZYK 1977).

External differences between the Miocene species *Argyrotheca subcordata* (BOETTGER) and the living *A. cordata* (RISSO) have been summarized by MEZNERICS (1943, p. 37). Internally, the difference consists in that *A. subcordata* bears 3—4 incisions in the septum, while *A. cordata* has 5—7 such incisions (*cf.* LOGAN 1979; Pl. Figs. 8—9); the number of tubercles at the valve inner surface also is twice smaller in the former species (*cf.* LOGAN 1979). These differences strongly support specific distinctness of the two forms, although it should be noted that the investigated specimens of *A. subcordata* (BOETTGER) closely resemble externally the extant individuals of *A. cordata* (RISSO) living at small depths in caverns and the *„coralligene"* facies near Marseille (*cf.* LOGAN 1979; Pl. 5, Figs 1—2).

The species *A. subcordata* (BOETTGER) differs from both *A. cistellula* (S. WOOD) and *A. Acostulata* (SEGUENZA) in its external ribbing and internal tuberculation.

OCCURRENCE: Miocene of Rumania (BOETTGER 1901, ZILCH 1934, MEŽNERICS 1943), and the Korytnica Basin (BARCZYK & POPIEL-BARCZYK 1977), Roztocze (JAKUBOWSKI & MUSIAŁ 1979a), and Pińczów and Busko in Poland (STUDENCKI 1988).

Genus *Megathiris* d'ORBIGNY, 1847
Megathiris detruncata (GMELIN, 1790)
(Text-figs 10—11; Pl. 6, Figs 6—11 and Pl. 7, Figs 1—13)

1950. *Megathyris decollata* CHEMN.; W. KRACH, p. 294, Pl. 1, Fig. 25.
1977. *Megathiris detruncata* (GMELIN, 1790); W. BARCZYK & E. POPIEL-BARCZYK, p. 164, Pl. 1, Figs 4—5 (*cum syn.*).
1978. *Argiope decollata* (CHEMNITZ, 1785); S. CALZADA BADIA, p. 356, Fig. 5, No. 6.
1979. *Megathiris detruncata* (GMELIN, 1790); A. LOGAN, p. 55, Text-figs 15—16, Pl. 6, Figs 1—13.
1979a. *Megathiris detruncata* (GMELIN, 1790); G. JAKUBOWSKI & T. MUSIAŁ, p. 50, Pl. 1, Figs 6—9.
1979b. *Megathiris detruncata* (GMELIN, 1790) G. JAKUBOWSKI & T. MUSIAŁ, p. 82, Pl. 2, Figs 8—10.
1982. *Megathiris detruncata* (GMELIN, 1792); C. LLOMPART & S. CALZADA, p. 195, Pl. 1, Figs 5—9.
1985. *Megathiris detruncata* GMELIN, 1790; M. GAETANI & D. SACCA, p. 17, Pl. 9, Figs 10—12 and Pl. 10, Figs 11—24.

MATERIAL: 750 well preserved specimens from Pińczów, 66 from Busko, 2300 from Szczaworyż, 55 from Mogiła, 25 from Kików, 100 from Grzybów, and 12 from Celiny.

REMARKS: The investigated material strongly supports the opinions concerning a wide intraspecific variation in external characteristics of the species *Megathiris detruncata* (GMELIN) (*cf.* SACCO 1902, FRIEDBERG 1921, THOMSON 1927, ATKINS 1960, BARCZYK & POPIEL-BARCZYK 1977, LOGAN 1979). This variation is related to individual ontogeny as well as the way of attachment to the substrate (*cf.* Pl. 6, Figs 3a, 6a, 10a). Some of the external features, however, allow for identification of adults as well as juveniles of *M. detruncata* among the associated representatives of the genus *Argyrotheca* DALL. These features include: shell width exceeding shell length and reaching its maximum at the hinge margin; even number of singular ribs, only rarely associated in gerontic specimens with intercalatory or dichotomous ones. Generally, rib number increases with shell size (Pl. 7, Figs 5a and 8), but ribs begin to fade away in the largest specimens (Pl. 6, Fig. 10c and Pl. 7, Figs 3, 10, and 13c).

As observed in serial sections (Text-figs 10—11) as well as in disarticulated specimens (Pl. 6, Figs 9b and Pl. 7, Figs 5b, 7b), there are three well developed septa in brachial valve and one weaker septum in ventral valve, which appear in ontogeny as early as in specimens of no more than 2.5 mm in length (Text-fig. 10 and Pl. 6, Fig. 1). Some of the investigated specimens show loop fragments attached to the shell in interseptal spaces (Text-fig. 11), evidence of cardinal process and pedicle collar.

A number of morphotypes can be distinguished in the investigated material which differ from one another in beak development in the ventral valve and in hinge margin width and ribbing in the brachial valve. These differences are most likely related to the ways of shell attachment to the substrate.

Transversally oval to semicircular juveniles with spiriferlike shell outline (*cf.* PEDLEY 1976, p. 228), wide hinge margin, and 4 or 6 ribs (Pl. 6, Figs 6—7 and Pl. 7, Figs 1—2, 4, and 6) closely resemble representatives of the genus *Argyrotheca* DALL. In turn, transversally oval to pentagonal adults with 6 or 8 ribs (Pl. 6, Figs 8, 9b and Pl. 7, Figs 8, 11—12) closely resemble the specimens described from the Vienna Basin (DREGER 1889; Pl. 5 (I), Figs 1—5), Podolia (FRIEDBERG 1921; Pl. 2, Fig. 11 and Pl. 3, Figs 1—5), and Hungary (MEZNERICS 1943; Pl. 2, Figs 1, 5 and 8); they also resemble the forms *Megathyris decollata* var. *pertransversa* SACCO and *M. decollata* var. *eoinflata* SACCO distinguished by SACCO (1902; Pl. 4, Figs 14—15 and 27—28).

Subcircular gerontic specimens with dichotomous and intercalatory ribs as well as with stronger growth lines and fading away ribbing close to the anterior margin (Pl. 6, Fig. 10 and Pl. 7, Figs 10, 13) resemble the forms *Megathyris decollata* var. *magnicostata* SACCO and *M. decollata* var.

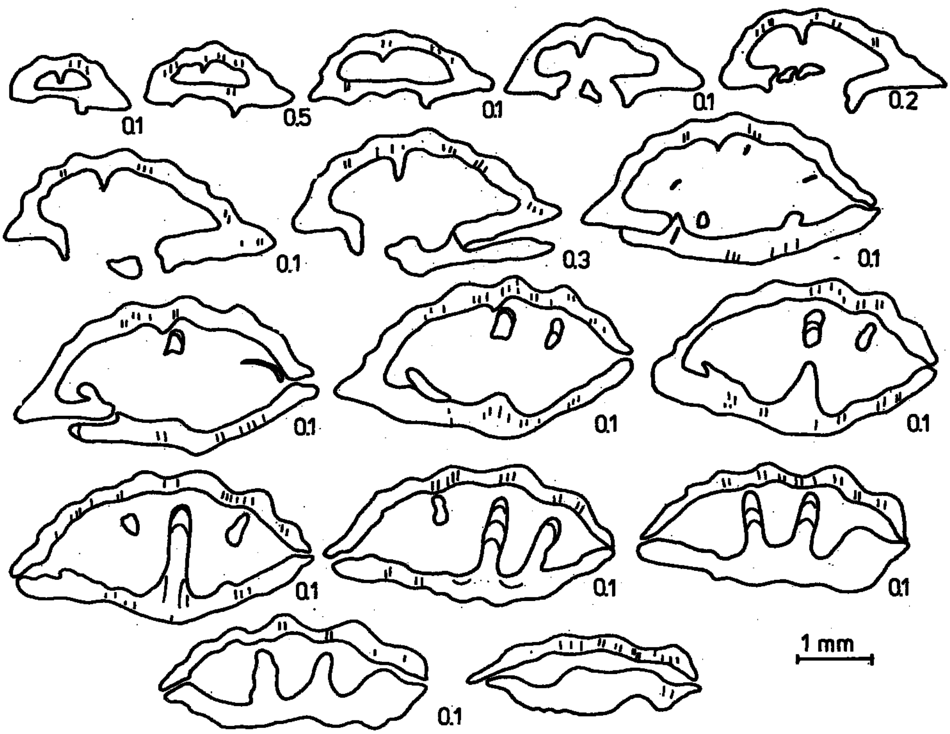


Fig. 10. Serial transverse sections of a juvenile specimen of *Megathiris detruncata* (GMELIN) from Grzybów, to show internal features (three septa) (specimen No. Bra-1595: L—2.2, W—3.7, T—1.8 mm)

mioglobosa SACCO distinguished by SACCO (1902; Pl. 6, Figs 23—26 and 29—33) and the specimens from the Miocene of Murcia, Spain, described by CALZADA BADIA (1978; Fig. 5, No. 6) as *Argiope decollata* (CHEMNITZ).

Some of the investigated adult specimens show external asymmetry (Pl. 7, Figs 9 and 13) which does not affect the inner structures, though (Pl. 6, Fig. 11b). These features may be due to overpopulation of the habitat (*cf.* POPIEL-BARCZYK & BARCZYK 1987).

OCCURRENCE: Miocene of the Vienna Basin (DREGER 1889), north Italy (SACCO 1902), Spain (CALZADA BADIA 1978, LLOMPART & CALZADA 1982), Hungary (MEZNERICS 1943), and Podolia (FRIEDBERG 1921), as well as the Lublin area (KRACH 1950), Busko (RADWAŃSKI 1969), the

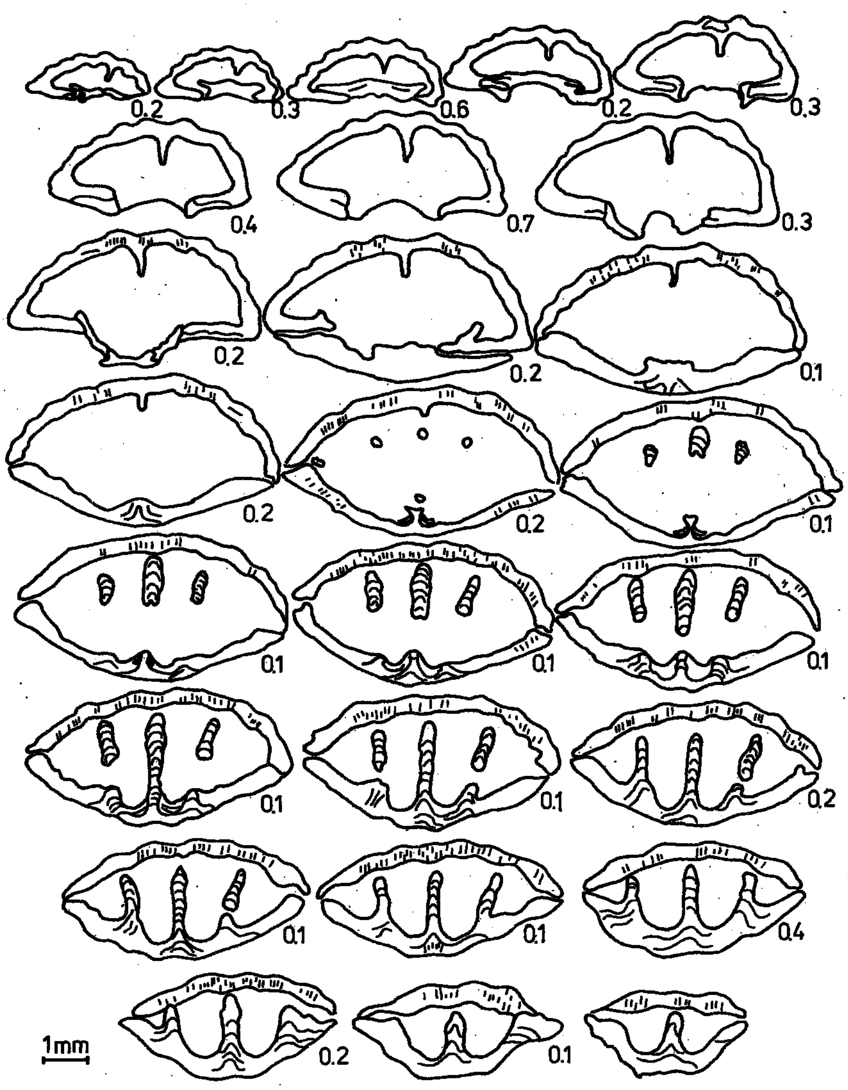


Fig. 11. Serial transverse sections of an adult specimen of *Megathiris detruncata* (GMELIN) from Pińczów, to show internal features (three septa) (specimen No. Bra-1570: L—5.1, W—6.0, T—3.1 mm)

Korytnica Basin (BARCZYK & POPIEL-BARCZYK 1977), Roztocze (JAKUBOWSKI & MUSIAŁ 1979a, b), and Pińczów (STUDENCKI 1988) in Poland. Extant representatives of *Megathiris detruncata* (GMELIN) are known from depths of 20 to 160 m in the Mediterranean Sea and Atlantic Ocean (LOGAN 1979, ZEZINA 1985).

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MIOCEŃSKIE RAMIENIONOGI Z POŁUDNIOWYCH STOKÓW GÓR ŚWIĘTOKRZYSKICH

(Streszczenie)

Przedmiotem pracy jest charakterystyka bogatego zespołu ramienionogów (6.500 okazów) występujących w osadach miocenu południowych stoków Gór Świętokrzyskich (*patrz* fig. 1). W zespole tym (*patrz* fig. 2– 11 oraz pl. 1– 7) stwierdzono obecność 17 gatunków należących do 14 rodzajów. Wśród Inarticulata są to: *Lingula dregeri* ANDREAE, *Crania badensis* MICHALIK & ZÁGORŠEK, *Neocrania anomala* (O. F. MÜLLER), oraz *Craniscus japonicus* (ADAMS), zaś wśród Articulata — *Notosaria* sp., *Cryptopora lovisati* (DREGER), *Terebratulina* sp., *Terebratula styriaca* DREGER, *T.* cf. *maxima* FRIEDBERG, *Pliothyrina grandis* (BLUMENBACH), *Platidia anomioides* (SCACCHI & PHILIPPI), *Megerlia truncata* (LINNAEUS), *Pantellaria monstruosa* (SCACCHI), *Argyrotheca cistellula* (S. WOOD), *A. costulata* (SEGUENZA), *A. subcordata* (BOETTGER), *Megathiris detruncata* (GMELIN).

W badanym zespole najliczniej są reprezentowane rodzaje *Megathiris* d'ORBIGNY oraz *Argyrotheca* DALL i *Megerlia* KING, które występują masowo w facjach margli i wapieni litotamniowych. Mniej liczne są rodzaje *Terebratula* O. F. MÜLLER i *Pliothyrina* ROY, spotykane również w facjach piaszczystych, oraz *Platidia* da COSTA, *Pantellaria* DALL, *Terebratulina* d'ORBIGNY, *Lingula* BRUGUIÈRE, *Crania* RETZIUS, *Neocrania* LEE & BRUNTON i *Craniscus* DALL. Do bardzo rzadkich należą przedstawiciele rynchonellidów z rodzajów *Cryptopora* JEFFREYS i *Notosaria* COOPER.

Prawie wszystkie rodzaje ramienionogów, stwierdzone w miocenie południowych stoków Gór Świętokrzyskich (z wyjątkiem rodzaju *Pliothyrina*) mają swoich przedstawicieli wśród gatunków żyjących współcześnie w wodach Morza Śródziemnego, Oeanów Atlantyckiego i Spokojnego, gdzie żyją na różnych głębokościach, w szerokim przedziale od 3 do 580 m.
