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New Middle Miocene *Argyrotheca* (Brachiopoda; Megathyrididae) species from the Central Paratethys

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Új középső-miocén Argyrotheca (Brachiopoda; Megathyrididae) faj a Középső-Paratethysből

Összefoglalás

A Középső-Paratethys miocén bentosz együtteseiben a brachiopodák általában alárendelt szerepet játszanak. A nagyméretű, szabad szemmel is jól látható rhynchonellidák és terebratulidák elvétve fordulnak elő egy-egy lelőhelyen. A kisméretű, ún. mikromorf brachiopodák azonban helyenként feldúsulhatnak az iszapolási maradékokban. A Középső-Paratethys sekélytengeri mikromorf brachiopoda faunáiban uralkodó szerepet játszanak a Megathyrididae családba tartozó nemzetségek (*Megathiris, Argyrotheca, Joania*). Számos lelőhelyről ismerünk olyan brachiopoda együtteseket, ahol az *Argyrotheca* (illetve a belőle elkülönített *Joania*) a domináns elem. A korábbi őslénytani irodalomban számos fajnévvel illették ezeket az alakokat, az utóbbi évtizedekben végzett revíziók eredményeképpen azonban többnyire csak két faj jelenlétét erősítették meg (*A. cuneata* és *A. cordata*; ez utóbbi lett a közelmúltban leírt *Joania* nemzetség típusfaja).

A lengyelországi Szent Kereszt-hegység déli előterében, a Szydłów község mellett kibukkanó alsó-badeni heterosteginás homokból 2006-ban gyűjtött minták a kis mennyiségben előforduló *Joania cordata, Megathiris detruncata, Platidia anomioides* és *Discinisca* sp. fajok mellett igen nagy számban tartalmazták egy új fajba sorolható *Argyrotheca* példányait. Nem sokkal később ugyanez a faj került elő a leideni Naturalis Biodiverzitás Központ középső-paratethysi miocén anyagában. Az irodalom tanulmányozása során kiderült, hogy lengyel szerzők már többször is ábrázolták ezt a formát, tévesen azonosítva a recens földközi-tengeri *Argyrotheca cistellula* fajjal. Jelen cikk a saját gyűjtésű szydłówi, valamint a leideni NCB Naturalis és a varsói Muzeum Ziemi gyűjteményi anyagainak vizsgálata alapján új fajként írja le az *Argyrotheca bitnerae* n. sp. fajt. Az eddig rendelkezésre álló adatok alapján elterjedése a Középső-Paratethys északi részére korlátozódott.

Tárgyszavak: Brachiopoda, Argyrotheca, új faj, középső-miocén, badeni, Középső-Paratethys, Lengyelország

Abstract

The shallow water micromorphic brachiopod assemblages of the Central Paratethys are generally dominated by members of the family Megathyrididae (*Megathiris, Argyrotheca, Joania*). Several localities are recorded in the literature which are characterized by the dominance of *Argyrotheca* (and also of *Joania*, which has recently been differentiated from *Argyrotheca*). In earlier papers published in Central Europe, several names were used for these forms. However, after careful revisions over recent decades, only two species have been confirmed in the Badenian (Middle Miocene) of the Central Paratethys: *A. cuneata* and *A. cordata*; the latter is now regarded as the type-species of the recently recognised *Joania*.

Some samples collected in 2006 from the Lower Badenian Heterostegina Sand on the southern slopes of the Holy Cross Mts (near Szydłów, Poland) yielded an abundant and new *Argyrotheca* species (together with some *Joania cordata, Megathiris detruncata, Platidia anomioides* and *Discinisca* sp.). Later, some specimens of the same form were found in the Middle Miocene Central Paratethyan samples of the Netherlands Centre for Biodiversity (NCB) Naturalis in Leiden (the Netherlands). This form had already been illustrated in earlier papers by some Polish authors. However, it was erroneously confused with the Recent Mediterranean *Argyrotheca cistellula.* In this paper *Argyrotheca bitnerae* n. sp. is described on the basis of the newly collected Szydłów assemblage, the limited material of the NCB Naturalis, as well as the revision of some larger collections in the Muzeum Ziemi (Warsaw), which were described by the late Ewa POPIEL-BARCZYK. According to the known data, palaeogeographic distribution of *Argyrotheca bitnerae* n. sp. is limited to the northern part of the Central Paratethys.

Keywords: Brachiopoda, Argyrotheca, new species, Middle Miocene, Badenian, Central Paratethys, Poland

Introduction

The Paratethys was an epicontinental sea that developed as a relict of the ancient Tethys Ocean. It consisted of a series of basins, which were intermittently connected to the Mediterranean and the Indo-Pacific (Rögl 1998, Meulenkamp & Sissingh 2003). The area ranging from the present-day Austria to Poland and Romania is called the Central Paratethys. The Badenian is a regional stage used as a reference in the Central Paratethys for part of the Middle Miocene (Langhian to Middle Serravallian) (Papp et al. 1978, Nagymarosy & Müller 1988). The Badenian sedimentation of the Central Paratethys comprises a mixed siliciclastic-carbonate type. Most of the surface outcrops represent shallow water deposits, while deeper water formations are known mainly from drill cores.

Brachiopods are minor components of the Central Paratethyan Badenian benthic assemblages. Large-sized terebratulides and rhynchonellides are generally rare, but the small-sized, so-called micromorphic forms are sometimes more common in the washed residues. Members of the family Megathyrididae (*Megathiris*, *Argyrotheca*, *Joania*) are generally dominant in the Miocene shallow water brachiopod faunas, similarly to Recent Mediterranean assemblages (Logan 1979; Logan et al. 2004). *Megathiris* and *Argyrotheca* are two "old" genera of the family; *Joania* was proposed recently by Alvarez et al. (2008b) for those *Argyrotheca*, which differ in their adult crural development, narrow hinge line, prominent cardinal process, characteristic dorsal median septum and their tuberculate radial ridges (which terminate anteriorly in tubercles).

The micromorphic megathyrid brachiopod genera *Argyrotheca* and *Joania* are nowadays recognized as having a worldwide distribution with 26 living species (Hiller et al. 2008, Simon 2010). The highest diversity can be observed in the Caribbean and European seas (Cooper 1977, Logan 2007). These genera have also been discovered in the tropical areas of the Atlantic, the Pacific and Indian Oceans; however, they seem to be missing in Arctic and Antarctic waters (Hiller et al. 2008, Fig. 1). Fossil *Argyrotheca* species are known from the Late Cretaceous (Lee et al. 2006) and they also have a worldwide distribution. *Joania* is known to have been present since the Eocene (Simon 2010). According to Hiller et al. (2008), until now, more than 45 fossil *Argyrotheca* (and *Joania*) species have been described from different palaeogeographic realms and different stratigraphic levels.

Bulk samples of shallow water Central Paratethyan sediments yielded rich *Argyrotheca* (and *Joania*) assemblages at several localities. In the earlier papers the names of several species were used for these forms. Matyasovszky (1880) described four new *Argiope* species from southern Hungary (*A. baanensis*, *A. hofmanni*, *A. baranyaense*, *A. boeckhi*) but later these were neglected by subsequent authors. Unfortunately, this material was not found in the collection of the Hungarian Geological Institute. However, on the basis of the descriptions and the figures, they are identical with *Joania cordata* (Risso), *Argyrotheca cuneata* (Risso) and *Megathiris detruncata* (Gmelin). Dreger (1889) mentioned *A. neapolitana* (Scacchi), *A. squamata* (Eichwald) and *A. interponens* (Dreger) from the Miocene of the Vienna Basin. Friedberg (1921) described *A. squamata*, *A. neapolitana*, *A. dertomutinensis* (Sacco) and *A. zboroviensis* (Friedberg) from the Ukrainian Miocene. Meznerics (1944) found *A. neopolitana*, *A. subcordata* (Boettger), *A. subcuneata* (Boettger), *A. squamata* and *A. cistellula* (Wood) in the Hungarian Miocene (including Transylvanian localities). Barczyk & Popiel-Barczyk (1977) identified four *Argyrotheca* species in the Middle Miocene of the Korytnica Basin (*A. cistellula*, *A. subcordata*, *A.*? *squamata* and *A.* sp.). The Miocene brachiopod fauna of Romania was summarized by Bărbulescu & Rado (1984) and they illustrated *A. cistellula*, *A. squamata*, *A. subcordata* and *A. subcuneata* from different localities.

However, on the basis of careful revisions during the last two decades, only two *Argyrotheca* species were confirmed in the Miocene deposits of the Central Paratethys (*A. cuneata* and *A. cordata*). These were found in the silty facies of the Nowy Sącz Basin (Bitner & Kaim 2004). The same two species are dominant in Łychów, Radmanówka and Zdziechowice (Roztocze Hills, Poland; Bitner 1990), in Niechobrz (south-eastern Poland; Bitner & Pisera 2000), in Bivolare and Ohrid (Bulgaria; Bitner 1993), as well as in Bánd (Bakony Mts, Hungary; Dulai 2007).

Localities and the studied material

1. Szydłów (new collection, deposited in the Hungarian Natural History Museum, Budapest)

Middle Miocene sediments can be found between Szydłów and Brzeziny (on the southern slopes of the Holy Cross Mountains, Poland) (Stachacz 2007). In the studied outcrop (*Figure 1*) the Pińczów Beds are developed as

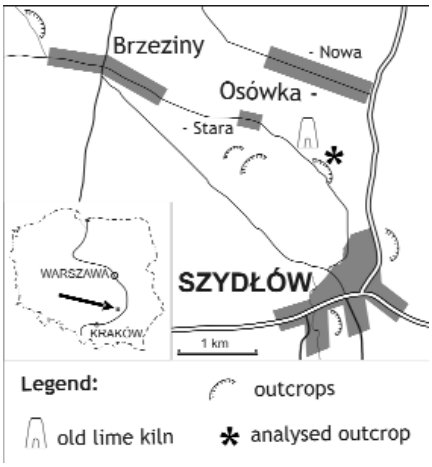


Figure 1. Location of the Szydłów locality along the southern slopes of the Holy Cross Mts (modified after Stachacz 2007)

1. ábra. *A Szent Kereszt-hegység déli lejtőjén lévő Szydłów lelőhely helyzete (módosítva Stachacz 2007 nyomán)*

Heterostegina sands with intercalations of red algal limestones. These sediments contain numerous fossils of foraminifers, bryozoans, bivalves, ostracods, echinoids, crustaceans and corallinacean red algae. Foraminifers (*Amphistegina*, *Heterostegina*, *Orbulina suturalis*) suggest an Early Badenian age for the Pińczów Beds. STACHACZ (2005a, b) also mentioned the presence of some brachiopods in this locality in his MSc thesis (*Terebratula styriaca*, *Argyrotheca subcordata*). In September 2006 the authors went to visit the outcrop and four samples (1.5-1.5 kg each) were collected; the washed residues were checked to see if any micromorphic brachiopods were present (*Figure 2*). These samples yielded the following brachiopod

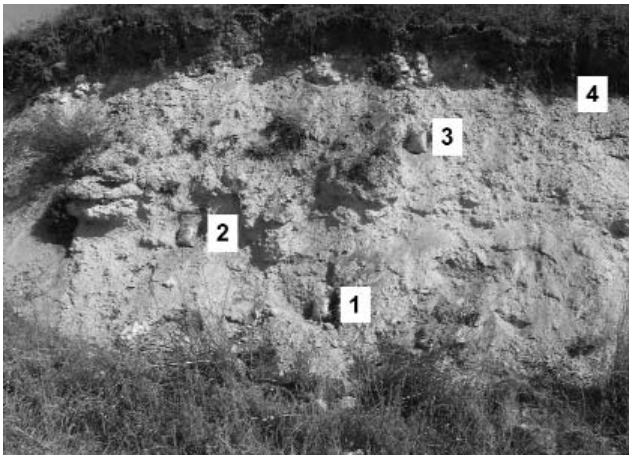


Figure 2. Section of the Lower Badenian *Heterostegina* Sand with algal limestone intercalations at Szydłów. Numbers indicate the location of washed and studied samples

2. ábra. *Az alsó-badeni heterosteginás homok szelvénye algás mészkő betelepüléssel Szydłównál. A számok jelzik a begyűjtött és leiszapolt minták helyzetét*

fauna (numbers of specimens; abbreviations: fr = fragments, C = complete specimens, V = ventral valves, D = dorsal valves):

Sample 1 (lower part of the section)
Discinisca sp. (1fr)
Joania cordata (RISSO) (16C, 3V, 2D)
Argyrotheca bitnerae n. sp. (120C, 18V, 11D)
Sample 2 (below the limestone intercalation)
Discinisca sp. (3fr)
Joania cordata (RISSO) (23C, 8V, 3D)
Argyrotheca bitnerae n. sp. (198C, 34V, 31D)
Sample 3 (above the limestone intercalation)
Discinisca sp. (9fr)
Megathiris detruncata (GMELIN) (3C)
Platidia anomioides (SCACCHI & PHILIPPI) juv. (3C)
Joania cordata (RISSO) (49C, 5V, 12D)
Argyrotheca bitnerae n. sp. (520C, 42V, 39D)
Sample 4 (upper part, just below the soil level)
Discinisca sp. (1fr)
Joania cordata (RISSO) (7C)
Argyrotheca bitnerae n. sp. (140C, 9V, 13D)

2. Korytnica and Węglin, Netherlands Centre for Biodiversity Naturalis, Leiden (the Netherlands)

Alfréd Dulai visited the NCB Naturalis in February 2008 within the framework of a European Union's Synthesys project to check the Neogene brachiopods in the Leiden collections. Among many other brachiopods, a rich fauna was found from the Middle Miocene of the Central Paratethys, collected by Arie W. JANSSEN, former curator of the NCB Naturalis. There were more than 1400 (partly fragmentary) brachiopod specimens representing 9 species of 7 genera (DULAI submitted). Within this material the new *Argyrotheca* species was also found from two Polish localities:

Korytnica: *Argyrotheca bitnerae* n. sp. (5C)
Węglin: *Argyrotheca bitnerae* n. sp. (2D)

3. Different localities, Museum of the Earth of the Polish Academy of Sciences (Muzeum Ziemi, PAN), Warsaw (Poland)

During the course of checking carefully earlier papers on the subject of brachiopods it became clear that the same form had already been written about in Poland by BARCZYK & POPIEL-BARCZYK (1977), JAKUBOWSKI & MUSIAŁ (1979), POPIEL-BARCZYK & BARCZYK (1990) and POPIEL-BARCZYK (1996); however, they erroneously identified this form as *Argyrotheca cistellula*. The bilateral cooperation between the Hungarian Academy of Sciences and the Polish Academy of Sciences made it possible for Alfréd DULAI to study the late Ewa POPIEL-BARCZYK's materials in the Muzeum Ziemi. Within this collection the new *Argyrotheca* species was identified from the following localities:

Korytnica: *Argyrotheca bitnerae* n. sp. (2C, 8V, 6D)
Mogiła: *Argyrotheca bitnerae* n. sp. (2C)
Celiny: *Argyrotheca bitnerae* n. sp. (10C, 3V, 5D)
Szczaworyż: *Argyrotheca bitnerae* n. sp. (128C, 2V, 4D)
Busko-Wełecz: *Argyrotheca bitnerae* n. sp. (20C, 2V, 2D)
Pińczów: *Argyrotheca bitnerae* n. sp. (454C, 13V, 10D)

Systematic palaeontology (A. DULAI)

Phylum Brachiopoda DUMÉRIL, 1806
Subphylum Rhynchonelliformea WILLIAMS, CARLSON, BRUNTON, HOLMER & POPOV, 1996
Class Rhynchonellata WILLIAMS, CARLSON, BRUNTON, HOLMER, & POPOV, 1996
Order Terebratulida WAAGEN, 1883
Suborder Terebratellidina MUIR-WOOD, 1955
Superfamily Megathyridoidea DALL, 1870
Family Megathyrididae DALL, 1870
Genus *Argyrotheca* DALL, 1900

***Argyrotheca bitnerae* n. sp.**

(*Figure 3: 1–11, Figure 4: 1–6*)

1977 *Argyrotheca cistellula* (S. WOOD, 1841) – BARCZYK & POPIEL-BARCZYK, pp. 161–162, Pl. 1, Figs 1–3.

1979 *Argyrotheca* cf. *cistellula* (S. Wood, 1841) – Jakubowski & Musiał, p. 50, pl. 1, Figs 10–13.
1990 *Argyrotheca cistellula* (S. Wood, 1841) – Popiel-Barczyk & Barczyk, pp. 172–173, Pl. 2, figs 11, 13.
1996 *Argyrotheca cistellula* (S. Wood, 1841) – Popiel-Barczyk, p. 659, pl. 158, figs 1–3.

Holotype: PAL 2011.1.1. (Hungarian Natural History Museum, Budapest [HNHM]) (*Figure 3:1*)

Paratypes: PAL 2011.2.1. – PAL 2011.3.1 (HNHM, Budapest); RGM 607.738 - RGM 607.741 (Netherlands Centre for Biodiversity Naturalis, Leiden); MZ Bra-1601, 1603a, 1604a, 1208/4, 1208/7 (Muzeum Ziemi, Warsaw [MZ]) (*Figure 3: 2–11, Figure 4: 1–6)*.

Type horizon: Lower Badenian sands and clays (Heterostegina Sand, Korytnica Clay).

Type locality: Szydłów, Poland.

Etymology: in honour of dr Maria Aleksandra Bitner, Polish brachiopod specialist.

Diagnosis: Argyrotheca of very small size, subtriangular in outline. Prominent, high and acute beak. Short and slightly arched hinge line and large subtrigonal hypothyrid foramen. Thin, disjunct deltidial plates and narrow interareas. Dorsibiconvex, smooth and punctate shells. Rectimarginate anterior commissure. Short but wide subtrapezoidal oblique teeth. Wide and tall pedicle collar. Short and deep oblique sockets and slender socket ridges. Very high dorsal median septum, triangular in profile with 2–3 slight serrations.

Material: Szydłów (978C, 103V, 94D; HNHM); Korytnica (5C, NCB Naturalis; 7C, 8V, 6D, MZ), Węglin (2D, NCB Naturalis); Mogiła (2C, MZ); Celiny (10C, 3V, 5D, MZ); Szczaworyż (128C, 2V, 4D, MZ); Busko-Wełecz

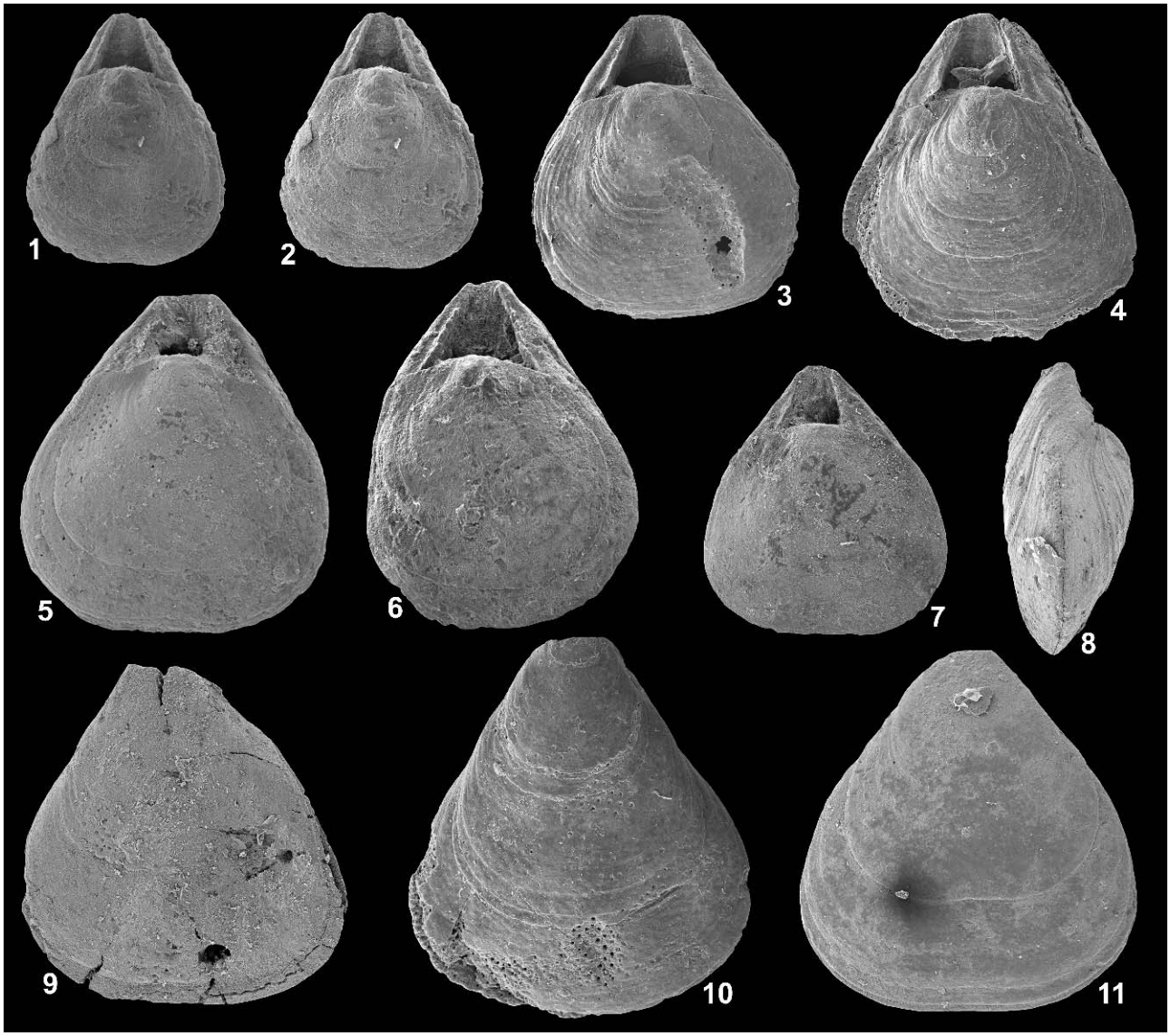


Figure 3. *Argyrotheca bitnerae* n. sp. Outer morphological characters
1 – Dorsal view, Szydłów, HNHM, Budapest, holotype (PAL 2011.1.1.), ×20; 2 – Dorsal view, Szydłów, HNHM, Budapest, paratype (PAL 2011.2.1.), ×20; 3 – Dorsal view, Korytnica5, NCB Naturalis, Leiden, paratype (RGM 607.738), ×20; 4 – Dorsal view, Korytnica5, NCB Naturalis, Leiden, paratype (RGM 607.739), ×20; 5 – Dorsal view, Busko, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1603a), ×20; 6 – Dorsal view, Szydłów, HNHM, Budapest, paratype (PAL 2011.3.1.), ×20; 7 – Dorsal view, Busko, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1603a), ×20; 8 – Lateral view, Szczaworyż, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1604a), ×20; 9 – Ventral view, Szczaworyż, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1604a), ×20; 10 – Ventral view, Korytnica5, NCB Naturalis, Leiden, paratype (RGM 607.740), ×20; 11 – Ventral view, Szczaworyż, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1604a), ×20

(20C, 2V, 2D, MZ); Pińczów (454C, 13V, 10D, MZ) (altogether 1853 specimens).

Size (mm; 50 randomly selected specimens from Szczaworyż, Muzeum Ziemi, Bra-1604/a):

Length	Width	Length	Width	Length	Width	Length	Width	Length	Width
2.4	2.3	1.9	1.6	1.4	1.2	2.1	1.9	2.0	1.7
2.5	2.3	2.0	1.9	2.1	1.7	1.8	1.5	1.6	1.4
2.4	2.0	1.8	1.7	2.0	1.8	1.7	1.4	1.7	1.5
1.4	1.3	1.6	1.5	1.8	1.5	2.1	1.8	1.9	1.7
1.2	1.1	1.8	1.6	1.8	1.4	2.2	2.0	1.5	1.4
2.8	2.0	1.4	1.2	1.8	1.5	2.2	1.8	1.5	1.2
2.0	1.8	2.1	2.0	1.9	1.6	1.5	1.3	1.2	1.0
2.2	2.0	2.0	1.8	1.6	1.3	2.1	2.0	1.3	1.1
2.2	2.1	2.0	1.9	1.8	1.7	1.7	1.4	1.1	1.0

Description: External characters: Small and thin shells (maximum observed length is 2.9 mm), both valves densely punctate (*Figure 4: 1c*). Dorsibiconvex, with the subpentagonal dorsal valve slightly inflated (*Figure 3: 8*). Outline is dominantly subtriangular, rarely subcircular (*Figure 3: 5*) but always longer than the width. Maximum width is at the anterior third, while maximum thickness is at the mid-length to posterior third. The angle between the beak ridges is about 70–80°. Prominent, high and acute beak truncated by large and wide subtriangular hypothyrid foramen flanked by very thin, disjunct deltidial plates and narrow interareas. Hinge line widely angled and slightly arched; its length is about two-thirds of the shell width. Shell surface smooth, ornamented only by some weaker or stronger growth lines. Anterior commissure is rectimarginate; the lateral commissures are straight.

Internal characters: Ventral valve interior with short but wide oblique teeth, subtrapezoidal in outline (*Figures 4: 1a–b*). Dental plates are lacking. Pedicle collar wide and rather tall with transverse growth lines (*Figure 4: 1b*), supported by a low but long ventral median septum that extends to three-quarters of the shell length. Dorsal valve interior with short and deep oblique sockets and slender socket ridges (*Figures 4: 4 and 5b*). Median septum very low posteriorly, becoming high at the mid-valve; subtriangular in profile; and the anterior side has 2–3 sligtht serrations (*Figures 4: 6a–b*). Anterior ends of descending branches join to the median septum (*Figures 4: 5a, d*).

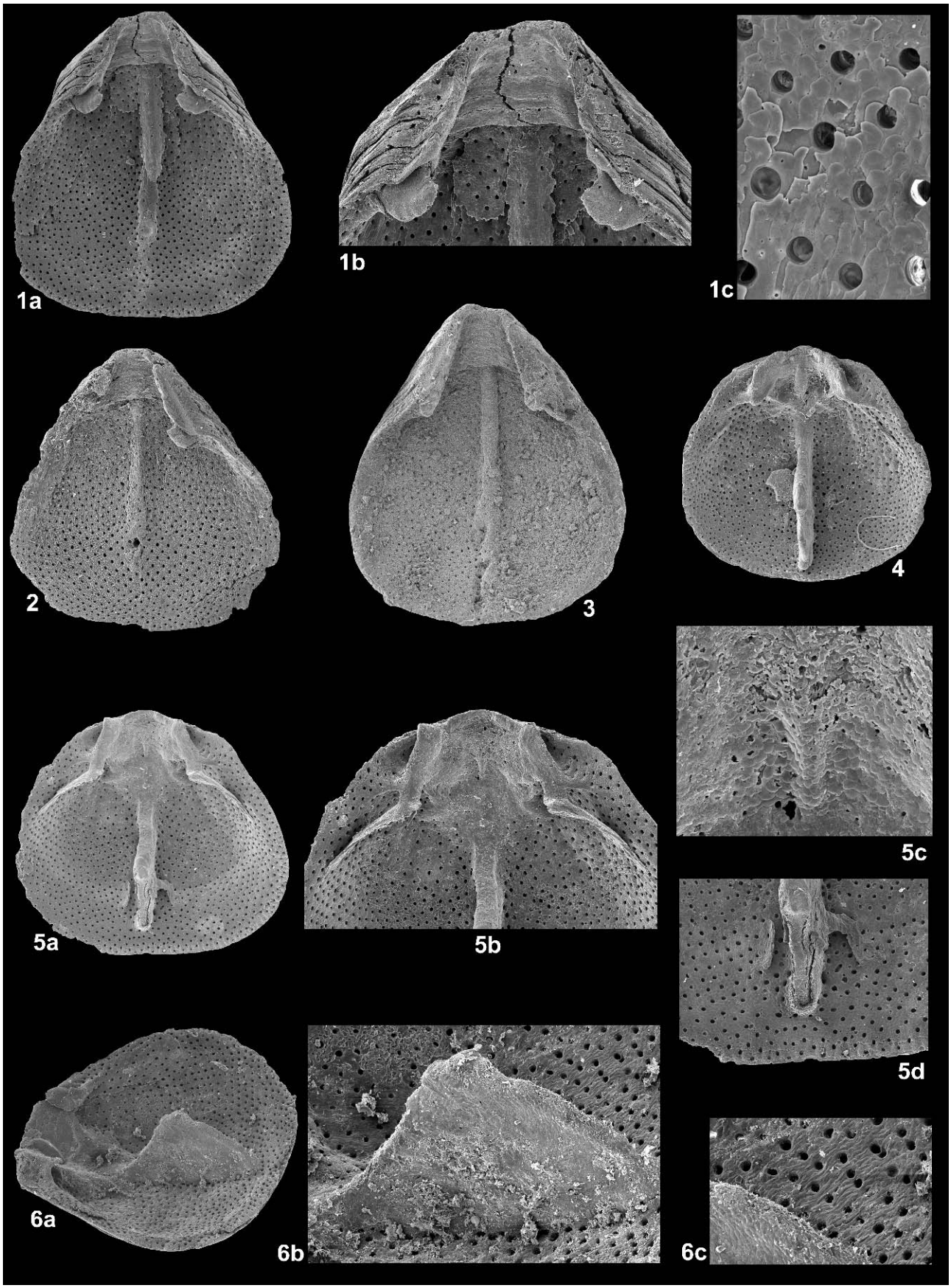
Notes: Argyrotheca is a common member of the shallow water brachiopod assemblages and accordingly several dozens of the species were described both in fossil and Recent faunas (26 living, and more than 45 fossil species according to Hiller et al. 2008 and Simon 2010). With respect to the Central Paratethyan Miocene Megathyrididae brachiopods, *Argyrotheca bitnerae* n. sp. is externally slightly similar to *Joania cordata*; however it differs due to its subtrigonal outline, its very high beak, the absence of a median sulcus on the dorsal valve and the lack of tubercles on the internal margin of both valves. Even the smallest *J. cordata* have four tubercles situated at the internal anterior margin (Bitner 1990). *Argyrotheca cuneata* can be clearly distinguished from *A. bitnerae* n. sp. by its ribbed surface and its pentagonal outline.

The Recent Mediterranean *Argyrotheca cistellula* (which has been mentioned from the Central Paratethys by some authors) has no tubercles on its internal margins. However, it is smaller, transversely subrectangular or ovoid in outline with a short beak and straight hinge line. Its relatively short dorsal median septum also has a different shape without serrations (see Logan 1979, Brunton & Curry 1979, Alvarez et al. 2008a). On the basis of the illustrated specimens, it is obvious that Barczyk & Popiel-Barczyk (1977), Jakubowski & Musiał (1979), Popiel-Barczyk & Barczyk (1990) and Popiel-Barczyk (1996) erroneously identified the Polish *A. bitnerae* n. sp. specimens as *A. cistellula*. At the same time Bărbulescu & Rado (1984) used the species name *cistellula* for a different form in Romania, which seems to be more similar to *J. cordata*.

Based on an analysis of all the other fossil and Recent *Argyrotheca* species, most of the described species can be excluded, given that their respective surfaces are more or less covered by weaker or stronger ribs. Therefore, in the following discussion only the smooth *Argyrotheca* species will be mentioned. The very small-sized, Late Cretaceous *A. popielae* described by Simon (1992) from Belgium, is smooth and subcircular to subtriangular, without any sulcus; in this way, externally it is similar to *A. bitnerae* n. sp. However, its outline is closer to subcircular and the punctation seems to be larger, while internally the triangular dorsal median septum has a double-peaked appearence, and the teeth are strongly recurved and significantly higher. Although Johansen (1987) described eleven *Argyrotheca* species, including smooth forms from the Danish Maastrichtian–Danian boundary section, all of these species are significantly different from *A. bitnerae* n. sp., in outline and partly also in shell surface ornamentation.

A. altavillensis described by de Morgan (1883) from the Eocene of France, is a relatively large-sized, smooth and elongated triangular species, which possesses a small sulcus on both valves. The equibiconvex valves are flat, without dorsal inflation. The dorsal median septum is very long, reaching the anterior margin. *A. puncticulata* described by Deshayes (1861) from the Eocene of the Paris Basin, and later also recognized in the Belgian Eocene by Vincent (1893) is a smooth and equibiconvex species, with a subcircular to subtrigonal outline. Compared with *A. bitnerae* n. sp., its beak is not so high, the foramen is smaller and the interareas are wider. According to Vincent (1893) *A. puncticulata* is synonymous with *A. parisiensis* described by de Morgan (1883).

A. saltmountainensis described by Toulmin (1940) from the Early Eocene of Alabama is small and smooth to poorly costate. However, its outline is quadrate to subcircular, the dorsal valve is semicircular, and the hinge is nearly equal to its maximum width. In contrast to *A. bitnerae* n. sp., its interareas are wider than the foramen. *A. akymatophora* from the Middle Eocene of Texas is much larger, differently shaped with strong growth lines, and it has a well-developed


1a
1b
1c
2
3
4
5a
5b
5c
5d
6a
6b
6c

←**Figure 4.** *Argyrotheca bitnerae* n. sp. inner morphological characters
1 – Pedicle valve, inner view, Korytnica, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1208/4), 1a: ×20, 1b: ×40, 1c: ×200; 2 – Pedicle valve, inner view, Celiny, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1601), ×20; 3 – Pedicle valve, inner view, Szczaworyż, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1604a), ×20; 4 – Brachial valve, inner view, Korytnica5, NCB Naturalis, Leiden, paratype (RGM 607.741), ×20; 5 – Brachial valve, inner view, Korytnica, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1208/4), 5a: ×20, 5b: ×30, 5c: ×150, 5d: ×40; 6 – Brachial valve, oblique lateral view, Korytnica, Muzeum Ziemi, Warsaw, paratype (MZ Bra-1208/7), 6a: ×20, 6b: ×50, 6c: ×80

notothyrial chamber (STENZEL 1940). *Argyrotheca robinsoni* described by DONOVAN et al. (1993) from the Middle Eocene of Jamaica is smooth and punctated but subpentagonal to subcircular in outline and the less inflated dorsal valve possesses a narrow sulcus. It has robust socket ridges and large triangular teeth. A small and smooth subtriangular species was described by COOPER (1971) from the Eocene of Tonga; however, *A. anomala* has a shallow sulcus on each valve and therefore presents a heart-shaped outline. The dorsal median septum is also different, with a concave and strongly serrate anterior slope. Recently, an indeterminable Terebratulidae (Terebratulida gen. indet. B.) was described by DULAI (2011) from the Late Eocene of Austria, and externally this seems to be slightly similar to *A. bitnerae* n. sp. However, its internal morphology is unknown; therefore the generic identification is impossible. Anyway, the two forms are definitely different even on the basis of the external characters: although the indeterminable form is also subtriangular but not so long, its beak is less prominent and high, and the foramen is also lower and wider. *A. oamarutica* (HILLER et al. 2008) from the Late Eocene and Early Oligocene of New Zealand is very small and smooth, but the outline is subcircular to subpentagonal, and the dorsal valve sometimes has a small sulcus. Its dorsal median septum has a single high and flat peak. Some other indeterminable smooth *Argyrotheca* species were mentioned from the Eocene of New Zealand by HILLER et al. (2008), but compared with *A. bitnerae* n. sp., all of them have a different outline. *Argyrotheca laevis* described by COOPER (1988) from the Oligocene of South Carolina is small, smooth, but subpentagonal in outline, with a long straight hinge line.

DE MORGAN (1915) described some smooth or very weakly ribbed *Cistella* (=*Argyrotheca*) species from the French Miocene. *C. eugenii* (DE MORGAN) is obscurely costate throughout its oval shell and the interior of the ventral valve shows a marginal row of tubercles, thus connecting it with the genus *Joania*. *C. laevigata* (DE MORGAN) has a slightly similar outline to *A. bitnerae* n. sp., but it is more subcircular than subtrigonal, with a much lower and more rounded beak, furthermore the marginal row of tubercles in the interior of the valves suggest a possible assignation to *Joania*. *C. laevigata*, and *C. mariae* was synonymized with *J. cordata* by BITNER (1990). *C.*? *transversa* (DOLLFUS & DAUTZENBERG, 1886) has a widely oval outline, as is the case with *C. falunica* (DE MORGAN), where the elongated oval outline is accompanied by strong growth lines (lamellae). It also has a characteristic marginal row of tubercles (*Joania*? *falunica*, see also DULAI 2010). *Argyrotheca* sp. 1. described by COOPER (1978) from central Java is large and nearly smooth; however it has a subquadrate outline and a relatively large sulcus. The Early Miocene *A. kupei* (HILLER et al., 2008) is closest to the Recent *A. mayi*: namely, smooth and subtriangular in outline. However, its beak is not so high and prominent and the foramen is also smaller and narrower. Its dorsal median septum is relatively low with an irregular profile.

Concerning Recent *Argyrotheca* species, the mostly smooth *A. arguta* from the Marshall Islands (GRANT 1983) has a subpentagonal or heart-shaped outline, a wide hinge line, and 5–7 tubercles around the internal margins; this suggests a possible attribution to *Joania*. *A. mayi* described by BLOCHMANN (1913) from Tasmania is longer than its width and its inner margins have no tubercles. The outline varies among studied localities, between elongate triangular and subpentagonal (HILLER et al. 2008). A shallow sulcus is sometimes present on the dorsal valve, and the elongated triangular specimens show a slight depression along the lateral margin. Its teeth and their sockets are widely spaced compared with *A. bitnerae* n. sp. Recently, BITNER (2008) mentioned an indeterminable *Argyrotheca* sp. from Fiji. This is small and smooth, but its outline is subquadrate, and its internal margin possesses tubercles (suggesting *Joania*).

Distribution: Up until the present, *Argyrotheca bitnerae* n. sp. has only been found in the northern part of the Central Paratethys (Carpathian Foredeep, present-day Poland) (*Figure 5*).

Figure 5. Known occurrence of *Argyrotheca bitnerae* n. sp. in the Carpathian Foredeep. (Distribution of the Miocene deposits of the Carpathian Foredeep after RADWAŃSKI 1973)

5. ábra. *Az Argyrotheca bitnerae n. sp. jelenleg ismert előfordulási pontjai a Kárpáti-előmélyedésben. (A miocén üledékek elterjedése a Kárpáti-előmélyedésben RADWAŃSKI 1973) nyomán)*

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