acta
geologica
polonica

Vol. 43, No. 1-2 Warszawa 1993

MARIA ALEKSANDRA BITNER

Middle Miocene (Badenian) brachiopods from coral reefs of north-western Bulgaria

ABSTRACT: The brachiopod assemblage from the Middle Miocene (Badenian) coral reefs of north-western Bulgaria comprises five species, viz. *Ancistrocrania abnormis* (DEFRANCE), *Argyrotheca cuneata* (RISSO), *A. cordata* (RISSO), *Platidia* sp., and *Thecidellina* sp., all of which are reported for the first time from the Miocene of Bulgaria, and *Thecidellina* being first noted from the Paratethys. The composition of the brachiopod fauna from Bulgaria displays the resemblance to other brachiopod assemblages of the Paratethys.

INTRODUCTION

The Miocene deposits from Bulgaria and their fauna, particularly the mollusks, were described several times (KOJUMDGIEVA 1960, 1976a, b, 1977; KOJUMDGIEVA & POPOV 1988). The brachiopods, however, were rather neglected and only the presence of the species *Megerlia truncata* (LINNAEUS) was mentioned by KOJUMDGIEVA (1960). Five brachiopod species belonging to 4 genera described in the present paper are reported for the first time from the Miocene deposits of Bulgaria. The commonest species are *Argyrotheca cordata* (RISSO) and *A. cuneata* (RISSO). The others, i.e. *Ancistrocrania abnormis* (DEFRANCE), *Platidia* sp., and *Thecidellina* sp., are very rare. The brachiopod fauna was collected in two localities, Bivolare and Ohrid (see Text-fig. 1), from the coral reefs occurring along the southern frame of the Paratethys. Totally 664 (106 from Bivolare and 558 from Ohrid) specimens of varying state of preservation have been recorded. At Bivolare, the reef deposits of Lower Badenian age are preserved as coral-algal rubble (PISERA 1993) with diversified corals representing nine genera (KOJUMDGIEVA 1960, 1978). At Ohrid, the reef of Upper Badenian age, is composed of large branching colonies of one species, *Tarbellastraea conoidea* (REUSS), attaining the height of up to 2 m (*see* PISERA 1993).

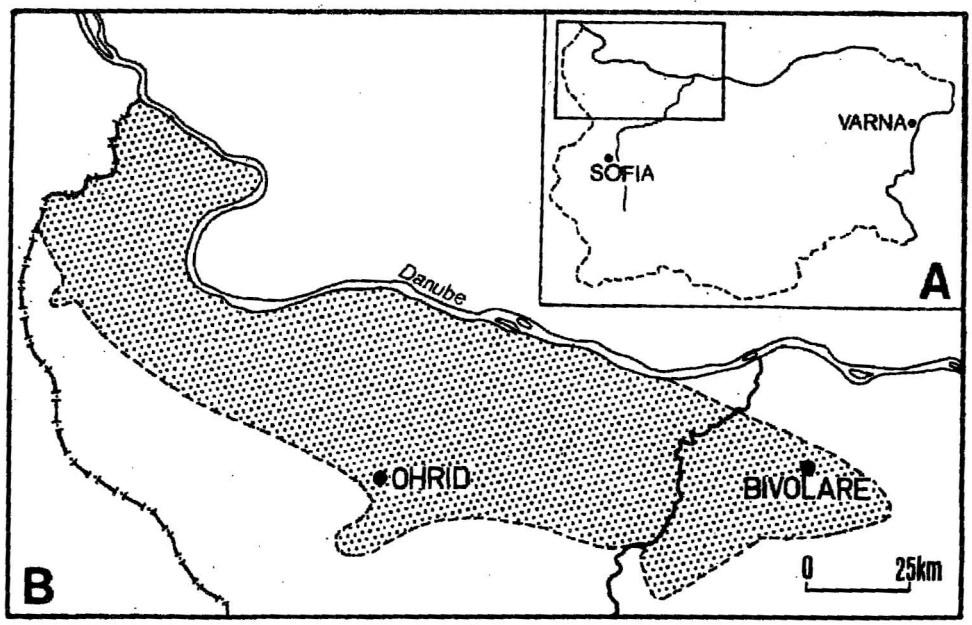


Fig. 1

A – General map of Bulgaria (rectangled is the area presented in Fig. B)
B – Extent of the Miocene deposits in north-western Bulgaria with the sampling sites (*after* KOJUMDGIEVA 1960; *simplified*)

The investigated material is housed in the Institute of Paleobiology of the Polish Academy of Sciences (Warsaw) under the collection numbers *ZPAL Bp.XXXVI/1-664*.

SYSTEMATIC ACCOUNT

Family **Craniidae** MENKE, 1828
Genus *Ancistrocrania* DALL, 1877

Ancistrocrania abnormis (DEFRANCE *in* HOENINGHAUS, 1828)
(Pl. 1, Figs 1–5)

1990. *Ancistrocrania abnormis* (DEFRANCE *in* HOENINGHAUS); M.A. BITNER, p. 133, Pl. 1, Figs 1–5 [*cum syn.*].

MATERIAL: 29 brachial valves.

DIMENSIONS: Max. length 3.7 mm, width 4.1 mm.

REMARKS: The external and internal characters of the investigated specimens are consistent with those hitherto described (HOENINGHAUS 1828, DAVIDSON 1870, SACCO 1902, JULIEN 1940, PAJAUD 1977, BITNER 1990), being in size, however, the most similar to the specimens from the Roztocze Hills in south-eastern Poland (BITNER 1990).

On the shell surface visible are irregular growth lines. In some specimens muscle scars are indistinct, but one can see pairs of subcircular posterior and elongated anterior adductor muscle scars, protractor muscle scars in the central part, and a low median septum (*see* Pl. 1, Fig. 1b).

The specimens described and illustrated as *Crania badensis* MICHALIK & ZÁGORŠEK from the Miocene of Szczaworyż in Poland by POPIEL-BARCZYK & BARCZYK (1990) show a great similarity to the investigated specimens as well as to those from the Roztocze Hills (BITNER 1990). They have the same size and internal sculpture (*compare* Pl. 1, Fig. 1b and Pl. 1, Fig. 3b *in* POPIEL-BARCZYK & BARCZYK 1990). On the other hand, the specimens of *C. badensis* from Slovakia representing the type material are much larger, exceeding more than 17 mm in width (*cf.* MICHALIK & ZÁGORŠEK 1986).

The species *Neocrania anomala* (O.F. MÜLLER) is also much larger, exceeding 15 mm in width. It differs from *Ancistrocrania abnormis* in lacking the median septum and in having different shape of the brachial protractor muscle scars (LOGAN 1979, LEE & BRUNTON 1986; *see also* Fig. 4 *in* POPIEL-BARCZYK & BARCZYK 1990).

OCCURRENCE: Miocene of Bulgaria—Bivolare, Ohrid (samples *1* and *2*); *see also* BITNER (1990, p. 133).

Family **Megathyrididae** DALL, 1870
Genus *Argyrotheca* DALL, 1900

Argyrotheca cuneata (RISSO, 1826)
(Pl. 2, Figs 1—6 and Pl. 3, Figs 1—6)

1983. *Argyrotheca cuneata* (RISSO); A. LOGAN, pp. 173—174.
1983. *Argyrotheca cuneata* (RISSO); A. LOGAN & J.P.A. NOBLE, p. 38, Pl. 2, Figs 6—10.
1988. *Argyrotheca cuneata* (RISSO); A. LOGAN, p. 66.
1990. *Argyrotheca cuneata* (RISSO); M.A. BITNER, pp. 138—140, Text-figs 5—6; Pl. 4, Figs 1—9 [*cum syn.*].
1990. *Argyrotheca costulata* (SEGUENZA); E. POPIEL-BARCZYK & BARCZYK, pp. 173—175, Text-fig. 9; Pl. 2, Figs 14—18 and 20.

MATERIAL: 90 complete specimens, 23 pedicle valves, 31 brachial valves.

DIMENSIONS: Maximum length 1.9 mm, width 2.2 mm, thickness 1.2 mm.

REMARKS: The species *Argyrotheca cuneata* (RISSO) is the second, after *A. cordata* (RISSO), of the most common species in the investigated material. In their shell ornamentation and internal features the studied specimens resemble closely those described from the Roztocze Hills (BITNER 1990) and the Recent ones from the Mediterranean (LOGAN 1979) being, however, smaller in size. The investigated specimens show considerable variability in shell outline (*compare* Pl. 2, Figs 3 and 5). The shell surface is ornamented with rounded ribs, varying from 2 to 7 in number. Some specimens have a shorter, median rib (*see* Pl. 2, Figs 3—4). Internally, on the brachial valve there are a high, triangular median septum and a simple loop attaching the septum.

The comparison of the investigated specimens *Argyrotheca cuneata* (RISSO) with the collection of those determined as *A. costulata* (SEGUENZA) by POPIEL-BARCZYK & BARCZYK (1990) shows that they are identical in morphology. However, POPIEL-BARCZYK & BARCZYK (1990) mentioned about 3-4 incisions in the septum of their specimens, while the studied specimens, similarly to the Recent ones and the Miocene ones from the Roztocze Hills, have a septum with only two serrations.

The species *A. cuneata* (RISSO) is easily distinguishable from *A. cordata* (RISSO) by its shell ornamentation and lacking of tubercles on the inner surface of both valves.

OCCURRENCE: Miocene of Bulgaria—Bivolare, Ohrid (samples *1* and *2*); Miocene of Poland—Wójcza-Pińczów Range (POPIEL-BARCZYK & BARCZYK 1990); *see also* BITNER (1990, p. 140).

Argyrotheca cordata (RISSO, 1826)
(Pl. 4, Figs 1—5 and Pl. 5, Figs 1—8)

1983. *Argyrotheca cordata* (RISSO); A. LOGAN, p. 174.
1983. *Argyrotheca cordata* (RISSO); A. LOGAN & J.P.A. NOBLE, p. 38, Pl. 2, Figs 1—5.
1985. *Argyrotheca cordata* (RISSO); E. TADDEI-RUGGIERO, pp. 371—372, Pl. 7, Figs 10—13.
1988. *Argyrotheca cordata* (RISSO); A. LOGAN, pp. 66—67.
1990. *Argyrotheca cordata* (RISSO); M.A. BITNER, pp. 140—143, Text-figs 7—8; Pl. 5, Figs 1—14; Pl. 7, Fig. 1 [*cum syn.*
1990. *Argyrotheca subcordata* (BOETTGER); E. POPIEL-BARCZYK & W. BARCZYK, p. 175, Pl. 2, Figs 9—10, 12 and 21.

MATERIAL: 310 complete specimens, 75 pedicle valves, 77 brachial valves.

DIMENSIONS: Maximum length 2.7 mm, width 2.8 mm, thickness 1.1 mm.

REMARKS: The species *Argyrotheca cordata* (RISSO) is the most common (more than 460 specimens) in the investigated material.

The studied specimens agree well in their morphology with those described earlier (LOGAN 1979, BITNER 1990, POPIEL-BARCZYK & BARCZYK 1990), although they are slightly smaller in size. Moreover, they show a great variability both in shell outline and ornamentation. They differ from the Recent specimens in the number of serrations on the brachial septum, being identical in this aspect with other Miocene specimens of this species.

The presence of tubercles on the inner surface of valve margins makes *A. cordata* (RISSO) clearly different from *A. cuneata* (RISSO).

OCCURRENCE: Miocene of Bulgaria—Bivolare, Ohrid (samples *1* and *2*); *see also* BITNER (1990, p. 143).

Family **Platidiidae** THOMSON, 1927
Genus *Platidia* DA COSTA, 1852

Platidia sp.
(Pl. 6, Figs 1—5)

MATERIAL: 23 complete specimens, 4 pedicle valves.

DIMENSIONS: Maximum length 1.7 mm, with 1.5 mm, thickness 0.6 mm.

DESCRIPTION: The shell is very small (max. length 1.7 mm), subcircular to ovally elongated in outline, sometimes asymmetrical. The shell surface is smooth, but indistinct growth lines are

visible in some specimens. The shell is plano-convex to slightly biconvex. The anterior commissure is rectimarginate. The hinge line is straight, shorter than the greatest width of the shell. The amphithyridid foramen is large and circular in outline. The teeth are short, with feeble dental plates. The internal features of the brachial valve are unknown.

REMARKS: The preservation state of the investigated specimens, making a study of the internal features of the brachial valve impossible, allows only for idendification to the genus level.

The Bulgarian specimens differ from the Miocene and Recent forms of the species *Platidia anomioides* (SCACCHI & PHILIPPI) in much smaller size (*cf.* DAVIDSON 1887, DREGER 1889, FISCHER & OEHLERT 1891, SACCO 1902, ATKINS 1959, BRUNTON & CURRY 1979, LOGAN 1979, COOPER 1981b, POPIEL-BARCZYK & BARCZYK 1990), showing the greatest similarity in shell size to *Platidia* cf. *anomioides* from the Roztocze Hills described recently by the author (BITNER 1990).

OCCURRENCE: Miocene of Bulgaria—Ohrid (samples *1* and *2*).

Family **Thecideidae** GRAY, 1840
Genus *Thecidellina* THOMSON, 1915

Thecidellina sp.
(Pl. 6, Figs 6—7)

MATERIAL: One complete specimen and one brachial valve.

DIMENSIONS: Length 1.7 mm, width 1.4 mm, thickness 0.8 mm.

DESCRIPTION: The shell is very small, subtriangular in outline. It is sligthly biconvex, with pedicle valve much more convex than the brachial one. The brachial valve is nearly flat and circular in shape. On the pedicle valve there is a very shallow sulcus. The shell surface is smooth. The ventral area is triangular, flat, without pseudodeltidium. Interiorly, the smooth rim surrounds the brachial valve, forming posteriorly the well developed bridge. Anteriorly the rim forms a single, undivided median septum. The brachial ridges are poorly developed.

REMARKS: Three genera of the family Thecideidae* are known from the Tertiary deposits: *Lacazella* MUNIER-CHALMAS, *Glazewskia* PAJAUD, and *Thecidellina* THOMSON. Some authors (ELLIOTT 1953, 1965; COOPER 1988) report, however, one genus more, viz. *Bifolium* ELLIOTT. In the opinion of PAJAUD (1970), the Tertiary species included into the genus *Bifolium* belong to other genera, and the stratigraphic range of that genus is restricted to the Lower Cretaceous.

A very limited material prevents any detailed investigations, but it allows for excluding the genera *Lacazella*, *Glazewskia*, and *Bifolium*. The genera *Lacazella* and *Glazewskia* have clearly different internal structures of the brachial valve. In turn, *Bifolium*, shows similarities in the internal features, but it has well defined deltidium on the ventral area. The studied specimens have the features typical of the genus *Thecidellina*, e.g. a flat, triangular area without pseudodeltidium, a single, undivided septum and a well developed bridge.

* The systematics recommended by BAKER (1990) is not taken into account.

This is the first occurrence of *Thecidellina* in the Paratethys. At present, the genus *Thecidellina* lives in the Pacific and Indian Oceans (COOPER 1973, 1981a; ZEZINA 1976; d'HONDT 1987), the Caribbean Sea (COOPER 1977; LOGAN 1977, 1990) and in the Mauritanian region of the Atlantic Ocean (LOGAN 1988). It is also known from the Tertiary deposits of Island Eua, Central Pacific (COOPER 1971), of Java and Santo Island, southwest Pacific (COOPER 1978), of Cuba and the Caribbean region (COOPER 1979), and of the United States (COOPER 1988). ELLIOTT (1948, p. 16) mentioned the occurrence of *Thecidellina* in the Tertiary of Europe, giving, however, neither illustrations nor references. In the opinion of THOMSON (1927), the specimen from the Miocene of Italy described as "*Lacazella mediterranea* (RISSO) var. *testudinaria* (MICHELOTTI)" by SACCO (1902, Pl. 6, Fig. 45) belongs also to the genus *Thecidellina*.

OCCURRENCE: Miocene of Bulgaria—Bivolare.

PALEOECOLOGICAL REMARKS

For a purpose of ecological analysis and comparisons with other Miocene brachiopod assemblages the percetages of particular species (Text-fig. 2) are compared.

The brachiopod assemblage from the coral reef deposits at Bivolare (Text-fig. 2*A*) contains the following species: *Ancistrocrania abnormis* (DEFRANCE), *Argyrotheca cuneata* (RISSO), *A. cordata* (RISSO), and *Thecidellina* sp. The dominant species are *A. cuneata* and *A. cordata* (53.8% and 33.0% respectively). This assemblage differs from other Miocene brachiopod assemblages of the Paratethys mainly by the presence of the genus *Thecidellina* THOMSON. Recently, *Thecidellina* is common in shallow waters where it is associated with corals and coralline algae, occupying cryptic habitats (JACKSON & *al.* 1971, COOPER 1977, LOGAN 1977). Also such genera as *Argyrotheca* and *Platidia* are

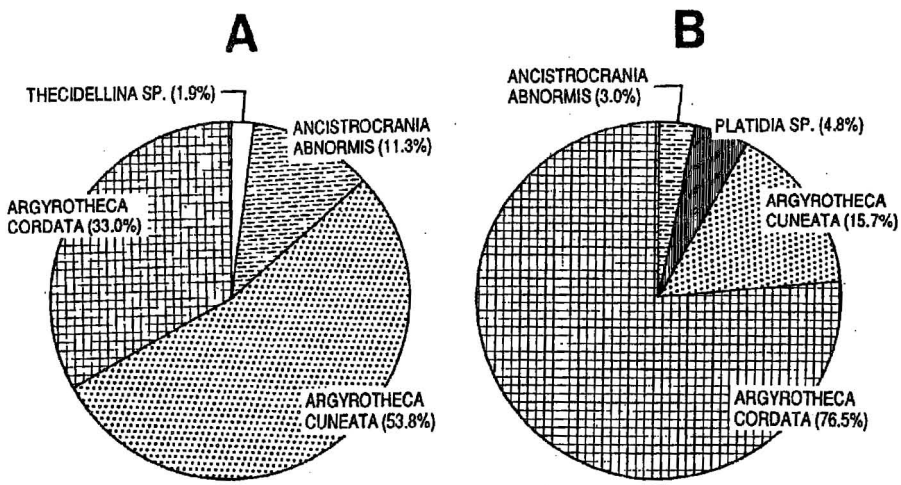


Fig. 2. Percentages of particular species in the samples from Bivolare (A) and Ohrid (B)

known from cryptic habitats in Recent reef environments (JACKSON & *al.* 1971; LOGAN 1975, 1977).

At Ohrid (Text-fig. 2*B*) the brachiopod assemblage also consists of four species. Three of them, i.e. *Ancistrocrania abnormis*, *Argyrotheca cuneata* and *A. cordata*, are the same as at Bivolare, while the fourth species, *Platidia* sp., is absent at Bivolare. The relative frequencies, however, are different. The dominant species is *Argyrotheca cordata* (76.5%), and *A. cuneata* is less numerous (15.7%).

Similarity in the composition of both assemblages, despite the difference in the character of the discussed reefs indicative of normal marine conditions (diversified coral fauna) during Bivolare reef formation and clearly restricted conditions during Ohrid reef formation (monospecific coral reef), is surprising and indicates relative insentivity of brachiopods (exactly genera *Argyrotheca* and *Ancistrocrania*) to environmental conditions. This is supported by the fact of a close similarity of brachiopod assemblages (*see* BARCZYK & POPIEL-BARCZYK 1977, BITNER 1990, POPIEL-BARCZYK & BARCZYK 1990) from the Badenian deposits in southern Poland, where *Argyrotheca* species often dominate. That region in Poland is out of the northern limit of coral reefs in the Paratethys. It is clear, however, that the thecideid brachiopods present at Bivolare, but absent in most of the Paratethys, are a good indicator of open marine and warm climate conditions.

Acknowledgements

Warm thanks are due to the late Professor E. KOJUMDGIEVA (Sofia) and to my husband Dr. A. PISERA (Institute of Paleobiology, Warsaw) for help and supplying the investigated material. The photographs were taken by Mr. M. DZIEWIŃSKI (Institute of Paleobiology, Warsaw) and E. STARNAWSKA, M.Sc. (Institute of Geological Sciences, Warsaw).

Institute of Paleobiology
of the Polish Academy of Sciences,
Al. Żwirki i Wigury 93,
02-089 Warszawa, Poland

REFERENCES

ATKINS, D. 1959. The growth stages of the lophophore of the brachiopods *Platidia davidsoni* (EUDES DESLONGCHAMPS) and *P. anomioides* (PHILIPPI), with notes on the feeding mechanism. *J. Marine Biol. Assoc. U. K.*, **38** (1), 103–132. Cambridge.

BAKER, P.G. 1990. The classification, origin and phylogeny of thecideidine brachiopods. *Palaeontology*, **33** (1), 175–191. London.

BARCZYK, W. & POPIEL-BARCZYK, E. 1977. Brachiopods from the Korytnica basin (Middle Miocene; Holy Cross Mountains, Poland). *Acta Geol. Polon.*, **27** (2), 157–167. Warszawa.

BITNER, M.A. 1990. Middle Miocene (Badenian) brachiopods from the Roztocze Hills, south-eastern Poland. *Acta Geol. Polon.*, **40** (3/4), 129–157. Warszawa.

BRUNTON, C.H.C. & CURRY, G.B. 1979. British Brachiopods. *Synopses of the British Fauna (New Series)*, **17**, 1–64. London.

COOPER, G.A. 1971. Eocene brachiopods from Eua, Tonga. *Geol. Survey Prof. Paper*, **640-F**, 1–8. Washington.

— 1973. New Brachiopoda from the Indian Ocean. *Smiths. Contrib. Paleobiol.*, **16**, 1–43. Washington.
— 1977. Brachiopods from the Caribbean Sea and adjacent waters. *Studies in Tropical Oceanography*, **14**, 1–212. Coral Gables, Florida.
— 1978. Tertiary and Quaternary brachiopods from the Southwest Pacific. *Smiths. Contrib. Paleobiol.*, **38**, 1–23. Washington.
— 1979. Tertiary and Cretaceous brachiopods from Cuba and the Caribbean. *Smiths. Contrib. Paleobiol.*, **37**, 1–45. Washington.
— 1981a. Brachiopods from the Southern Indian Ocean (Recent). *Smiths. Contrib. Paleobiol.*, **43**, 1–93. Washington.
— 1981b. Brachiopods from the Gulf of Gascogne, France (Recent). *Smiths. Contrib. Paleobiol.*, **44**, 1–35. Washington.
— 1988. Some Tertiary brachiopods of the East Coast of the United States. *Smiths. Contrib. Paleobiol.*, **64**, 1–45. Washington.

DAVIDSON, T. 1870. On Italian Tertiary Brachiopoda. *Geol. Mag.*, **7** (8-10), 359–370, 399–408, 460–466. London.
— 1886-1888. A monograph of Recent Brachiopoda. *Trans. Linnean Soc. London, Ser.* 2, Zoology, 3 parts, 1–248. London.

DREGER, J. 1889. Die tertiären Brachiopoden des Wiener Beckens. *Beiträge zur Paläont. Oesterreich-Ungarns*, **7** (2), 179–192. Wien–Leipzig.

ELLIOTT, G.F. 1948. Palingenesis in Thecidea (Brachiopoda). *Ann. Mag. Nat. Hist., Ser.* 12, **1**, 1–30. London.
— 1953. The classification of the thecidean brachiopods. *Ann. Mag. Nat. Hist., Ser.* 12, **6**, 693–701. London.
— 1965. Order uncertain – Thecideidina. *In*: R.C. MOORE (*Ed.*), *Treatise on Invertebrate Paleontology*, part H (Brachiopoda), *H*857–*H*862. Lawrence, Kansas.

FISCHER, P. & OEHLERT, D.P. 1891. Brachiopodes. Expéditions scientifiques du "Travailleur" et du "Talisman" pendant les années 1880, 1881, 1882, 1883, pp. 1–140. Paris.

HOENINGHAUS, F.W. 1828. Beitrag zur Monographie der Gattung *Crania*, pp. 1–14.

d'HONDT, J.-L. 1987. Observations sur les Brachiopodes actuels de Nouvelle-Calédonie et d'autres localités de l'Indo-Pacifique. *Bull. Mus. Natn. Hist. Nat., Paris*, 4 Sér., **9**, section A, **1**, 33–46. Paris.

JACKSON, J.B.C., GOREAU, T.E. & HARTMANN, W.D. 1971. Recent brachiopod-coralline sponge communities and their paleoecological significance. *Science*, **173**, 623–625.

JULIEN, M. 1940. Révision de la faune vindobonienne de Sain-Fons (Rhône). *Trav. Lab. Geól. Fac. Sci. Lyon*, **38** (31), 1–60. Lyon.

KOJUMDGIEVA, E. 1960. *In*: E. KOJUMDGIEVA & B. STRACHIMIROV, Les fossiles de Bulgarie; *VII*, Tortonien, pp.1–246. *Bolg. Akad. Nauk*; Sofia.
— 1976a. Paléoécologie des communautés des Mollusques du Miocène en Bulgarie du Nord–Ouest; I. Méthodes et generalites. *Geologica Balc.*, **6** (1), 31–52. Sofia.
— 1976b. Paléoécologie des communautés des Mollusques du Miocène en Bulgarie du Nord–Ouest; *II.* Communautés des Mollusques du Badenien (Miocene moyen) en Bulgarie du Nord–Ouest. *Geologica Balc.*, **6** (2), 63–94. Sofia.
— 1977. Paléoécologie des communautés des Mollusques du Miocène en Bulgarie du Nord–Ouest; V. Certaines particularites des communautés. *Geologica Balc.*, **7** (1), 81–96. Sofia.
— (*Ed.*). 1978. Guide de l'excursion du IX Symposium du groupe "Paratethys" Neogène en Bulgarie du Nord–Ouest, pp. 1–42. Sofia.
— & POPOV, N. 1988. Lithostratigraphy of the Neogene sediments in Northwestern Bulgaria. *Palaeont., Stratigr. and Lithol.*, **25**, 3–26. Sofia.

LEE, D.E. & BRUNTON, C.H.C. 1986. *Neocrania* n. gen., and revision of Cretaceous–Recent Brachiopod genera in the family Craniidae. *Bull. British Mus. Nat. Hist. (Geol.)*, **40** (4), 141–160. London.

LOGAN, A. 1975. Ecological observations on the Recent articulate brachiopod *Argyrotheca bermudana* DALL from the Bermuda Platform. *Bull. Marine Sci.*, **25** (2), 186–204.
— 1977. Reef-dwelling articulate brachiopods from Grand Cayman, B.W.I. *Proceedings, Third International Coral Reef Symposium*, 87–93. Miami, Florida.
— 1979. The Recent Brachiopoda of the Mediterranean Sea. *Bull. Inst. Oceanographique Monaco*, **72** (1434), 1–112. Monaco.
— 1983. Brachiopoda collected by CANCAP I–III expeditions to the south-east North Atlantic, 1976–1978. *Zool. Meded.*, **57** (18), 165–189. Leiden.
— 1988. Brachiopoda collected by CANCAP IV and VI expeditions to the south-east North Atlantic, 1980–1982. *Zool. Meded.*, **62** (5), 59–74. Leiden.
— 1990. Recent Brachiopoda from the Snellius and Luymes expeditions to the Surinam-Guyana shelf, Bonaire-Curacao, and Saba Bank, Caribbean Sea, 1966 and 1969–1972. *Zool. Meded.*, **63** (11), 123–136. Leiden.

— & NOBLE, J.P.A. 1983. Recent brachiopods from Malta. *Central Medit. Natur.*, **1** (2), 33—42.
MICHALIK, J. & ZÁGORŠEK, K. 1986. Biostratigraphy, lithofacial development and fauna of Badenian sediments in the Devin—Záhradky section (Bratislava). *Západné Karpaty, Séria Paleontológia*, **11**, 35—55. Bratislava.
PAJAUD, D. 1970. Monographie des Thécidées (Brachiopodes). *Mém. Soc. Géol. France (Nouvelle Série)*, **112**, pp. 1—349. Paris.
— 1977. Les Brachiopodes du Pliocène I de la région d'Aguilas (sud d'Almeria, Espagne). *Ann. Paléont. (Invertébrés)*, **63** (1), 59—75. Paris.
PISERA, A. 1993 (*in press*). Miocene reefs of the Paratethys region: a review. *In*: C. JORDAN, M. COLGAN & M. ESTEBAN (*Eds*), Miocene reefs: a global comparison.
POPIEL-BARCZYK, E. & BARCZYK, W. 1990. Middle Miocene (Badenian) brachiopods from the southern slopes of the Holy Cross Mountains, Central Poland. *Acta Geol. Polon.*, **40** (3/4), 159—181. Warszawa.
SACCO, F. 1902. I Brachiopodi dei terreni terziarii del Piemente e della Liguria, pp. 1—50. Torino.
TADDEI-RUGGIERO, E. 1985. Paleoecologia e biostratigrafia delle calcareniti a brachiopodi di Castro (Lecce). *Boll. Soc. Natur. Napoli*, **92**, 347—413. Napoli.
THOMSON, J.A. 1927. Brachiopod morphology and genera (Recent and Tertiary). *New Zealand Board of Science and Art*, **7**, 1—338. Wellington.
ZEZINA, O.N. 1976. Ekologia i rasprostranene sovremennykh brakhiopod, pp. 1—138. *Nauka*; Moskva.

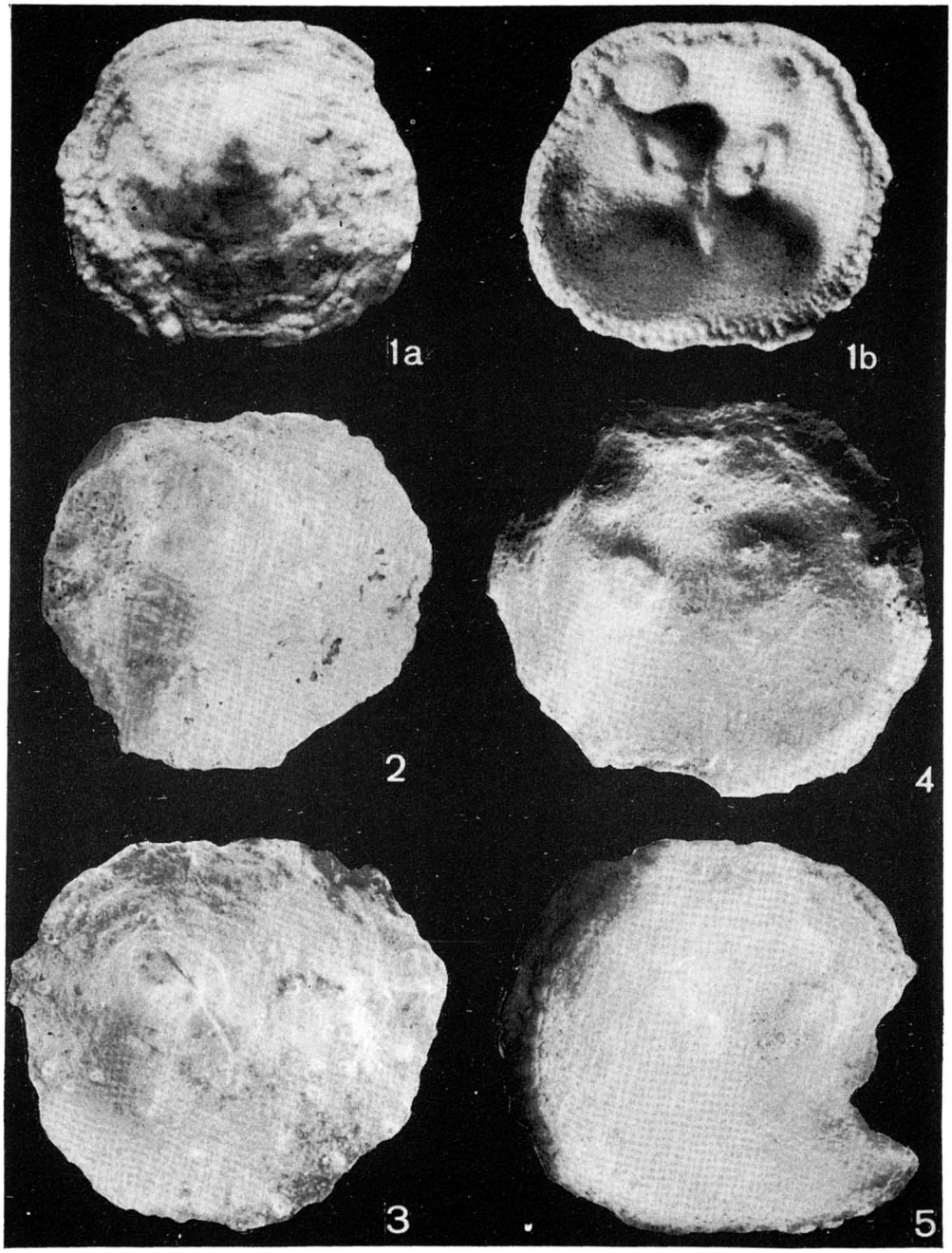
M.A. BITNER

BADEŃSKIE RAMIENIONOGI Z RAF KORALOWYCH PÓŁNOCNO-ZACHODNIEJ BUŁGARII

(Streszczenie)

W pracy opisano zespół ramienionogów z dolno- i górnobadeńskich raf koralowych północno-zachodniej Bułgarii (*patrz* fig. 1). W zespole tym (*patrz* fig. 2 oraz pl. 1—6) stwierdzono obecność pięciu gatunków, tj. *Ancistrocrania abnormis* (DEFRANCE), *Argyrotheca cuneata* (RISSO), *A. cordata* (RISSO), *Platidia* sp. oraz *Thecidellina* sp., które nie były dotychczas znane z osadów mioceńskich Bułgarii. Zespół ten pod względem składu wykazuje duże podobieństwo do innych zespołów ramienionogów mioceńskich z obszaru basenów Paratetydy (*por.* BITNER 1990).

Ramienionogi z rzędu Thecideida reprezentowane przez gatunek *Thecidellina* sp. zostały po raz pierwszy stwierdzone w miocenie Paratetydy.

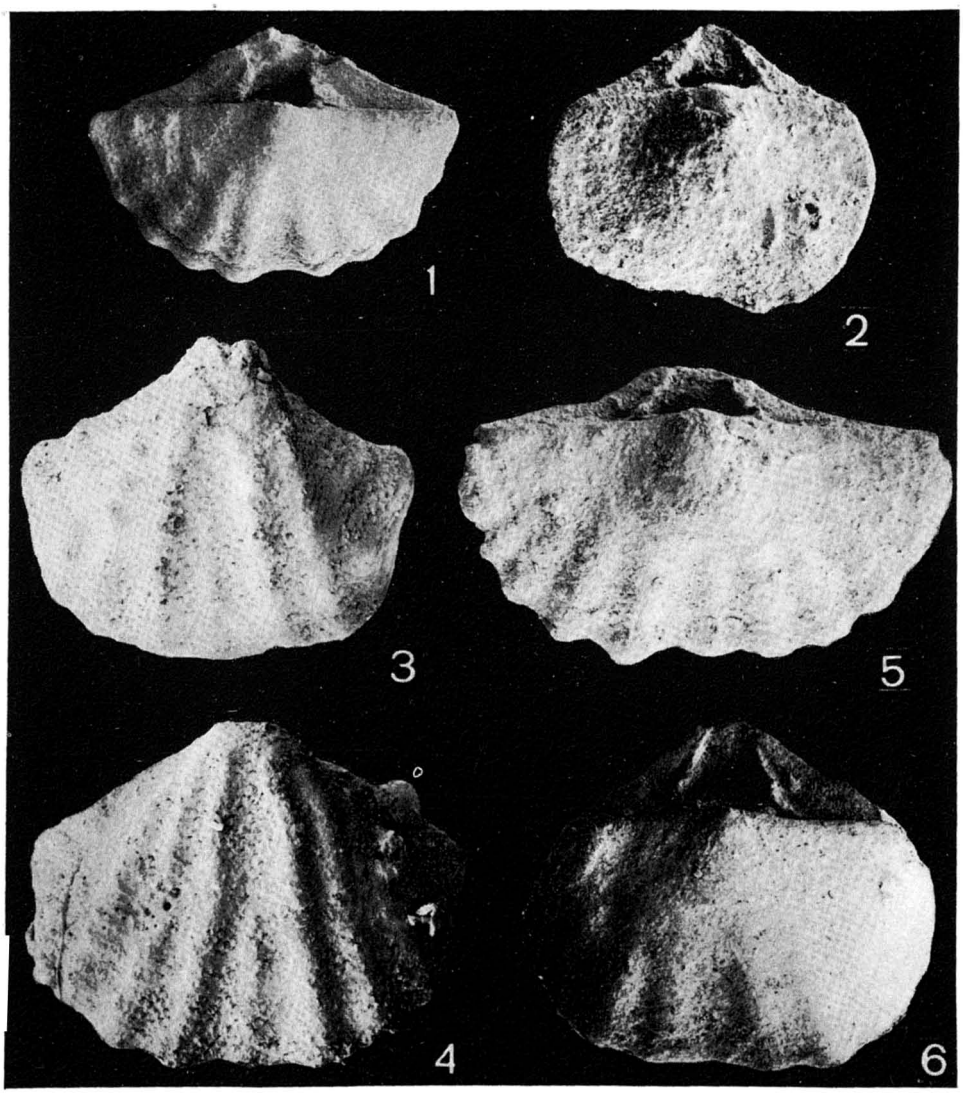


Ancistrocrania abnormis (DEFRANCE *in* HOENINGHAUS, 1828)

1 – Brachial valve (1a outer, 1b inner view), Ohrid (sample 2), ZPAL Bp.XXXVI/16, × 15

2-3 – Outer views of brachial valves; 2 – ZPAL Bp.XXXVI/18, Bivolare, SEM × 17; 3 – ZPAL Bp.XXXVI/1, Ohrid (sample 1), SEM × 35

4-5 – Inner views of brachial valves (*5* is slightly damaged); 4 – ZPAL Bp.XXXVI/2, Ohrid (sample 1), SEM × 22; 5 – ZPAL Bp.XXXVI/17, Ohrid (sample 2), SEM × 22



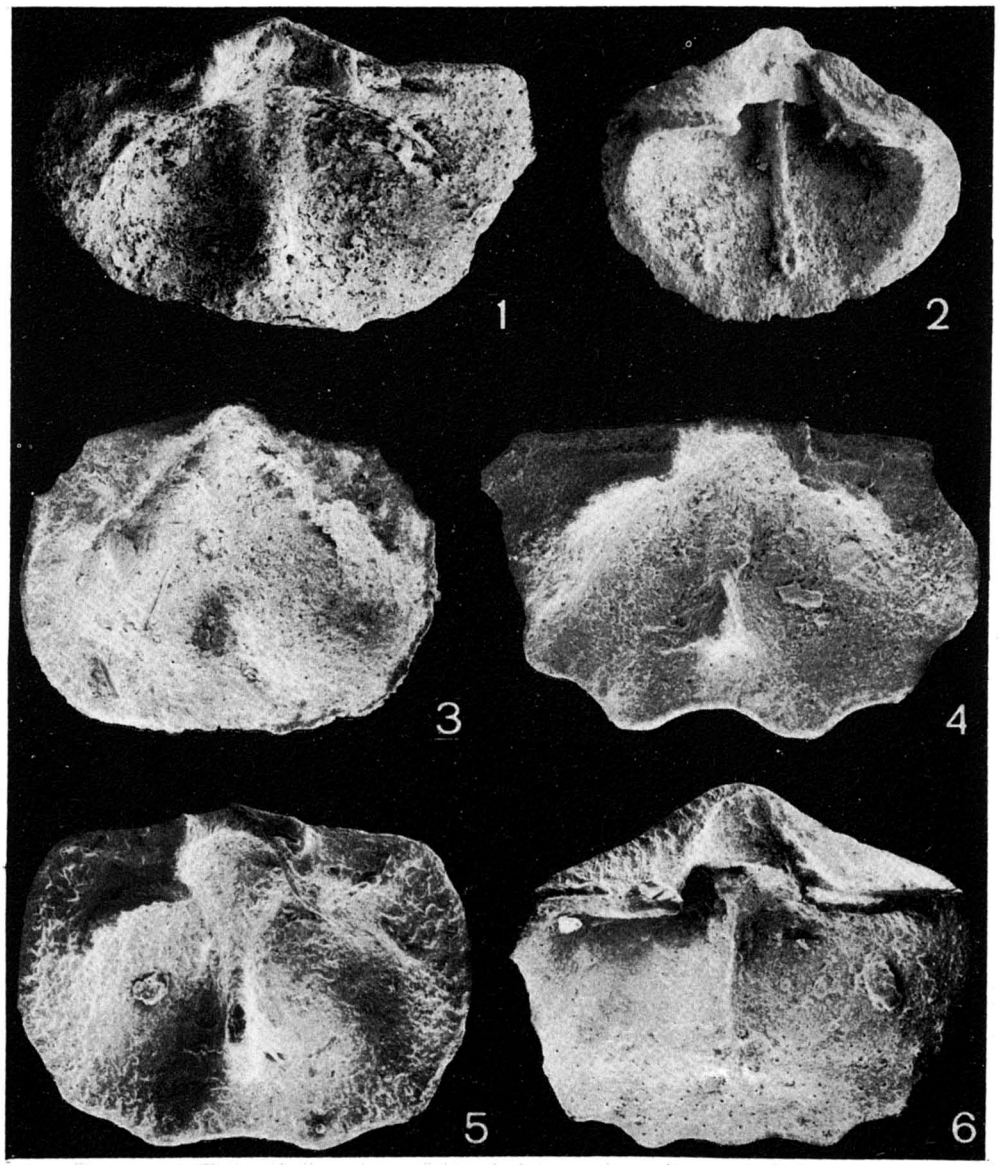
Argyrotheca cuneata (Risso, 1826)

1 – Dorsal view of complete specimen, Ohrid (sample 2), ZPAL Bp.XXXVI/115, SEM × 20

2 – Dorsal view of complete juvenile specimen, Ohrid (sample 1), ZPAL Bp.XXXVI/32, SEM × 50

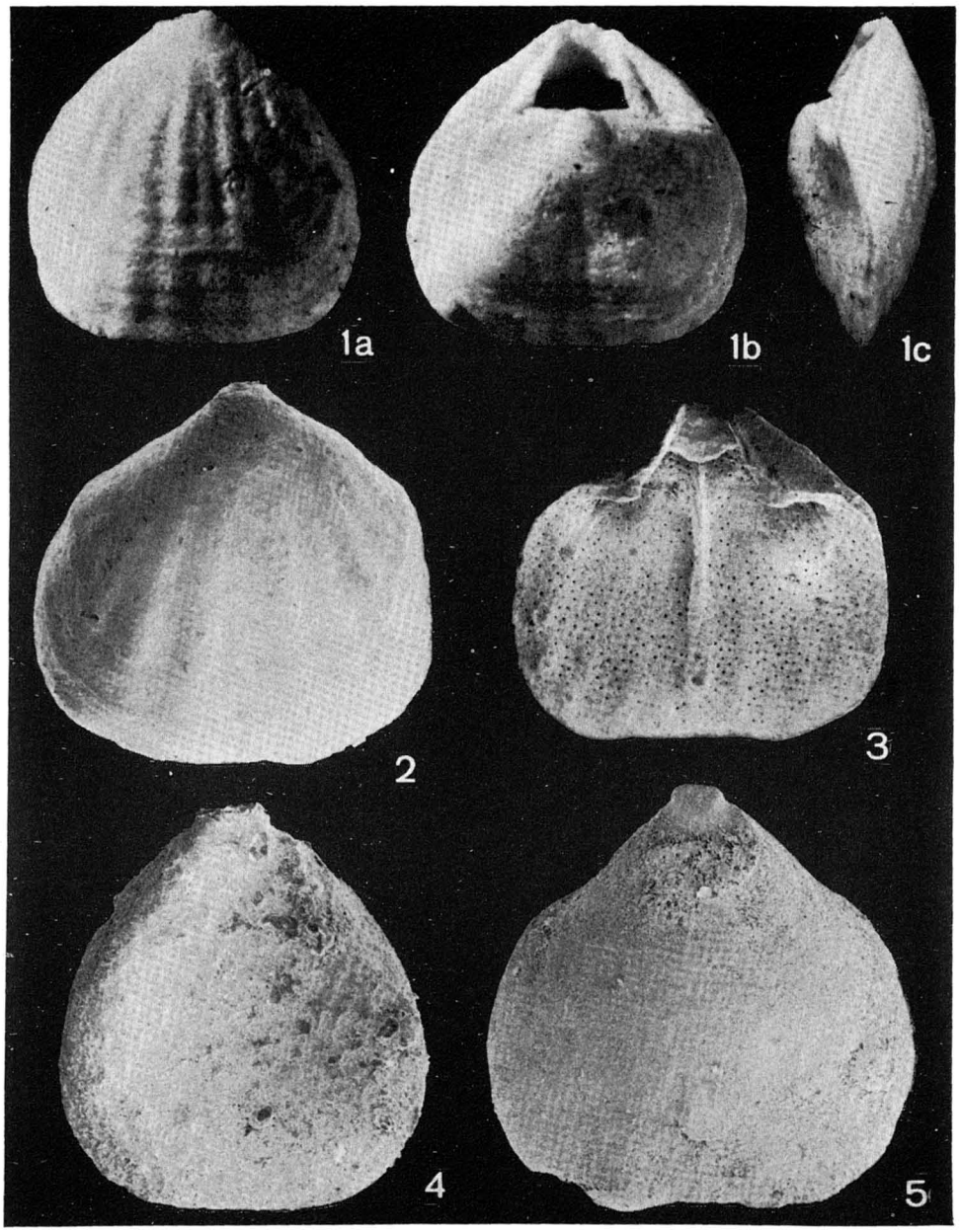
3-4 – Ventral views of complete specimens, Bivolare; 3 – ZPAL Bp.XXXVI/117, SEM × 30; 4 – ZPAL Bp.XXXVI/118, SEM × 27

5-6 – Dorsal views of complete specimens, Ohrid (sample 1), ZPAL Bp.XXXVI/30–31, SEM × 30



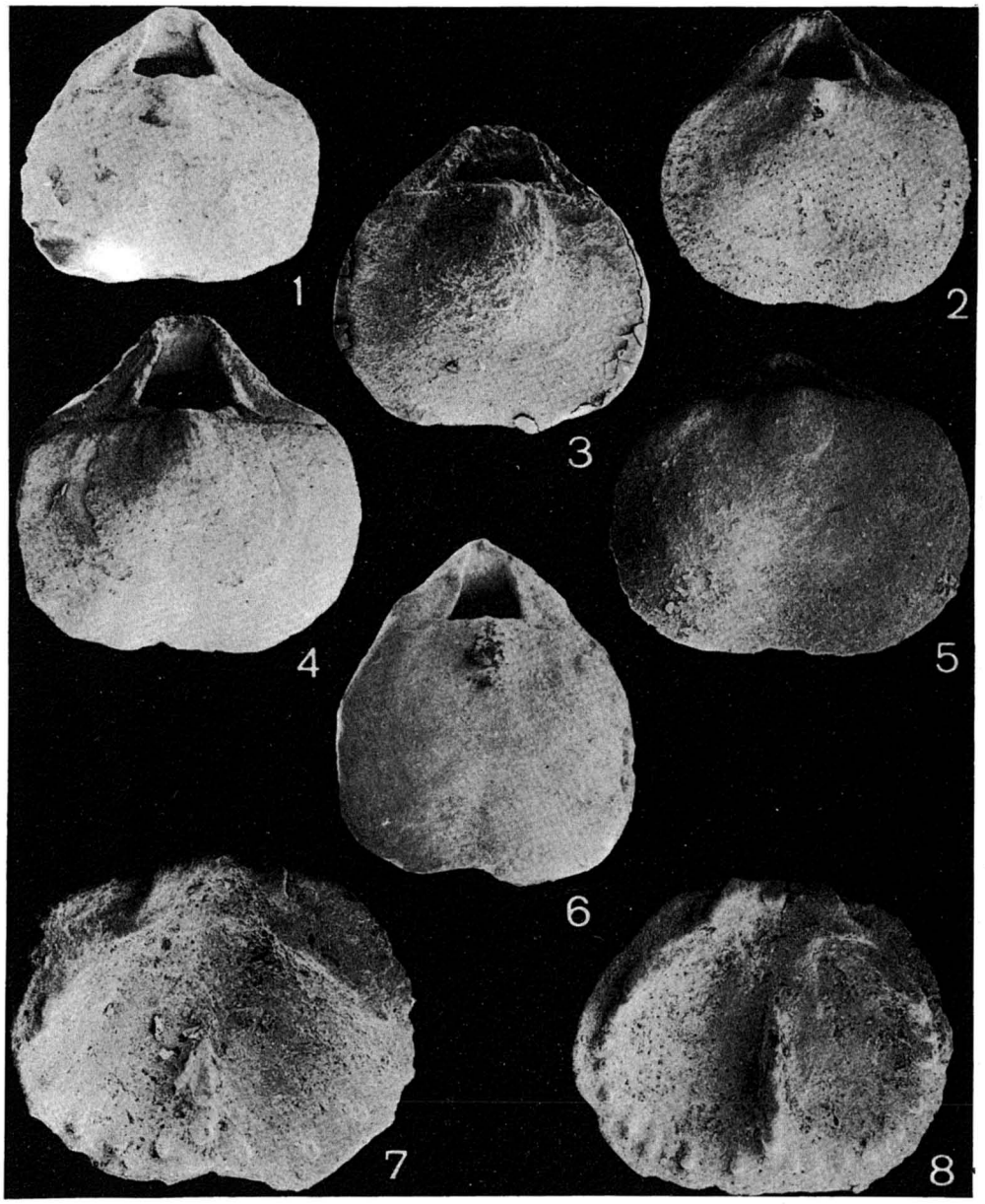
Argyrotheca cuneata (Risso, 1826)

1 – Inner view of brachial valve, Ohrid (sample 1), ZPAL Bp.XXXVI/33, SEM × 40
2 – Inner view of pedicle valve, Ohrid (sample 1), ZPAL Bp.XXXVI/34, SEM × 20
3-4 – Inner views of brachial valves, Ohrid (sample 1); 3 – ZPAL Bp.XXXVI/35, SEM × 67; 4 – ZPAL Bp.XXXVI/36, SEM × 53
5 – Inner view of brachial valve, Bivolare, ZPAL Bp.XXXVI/119, SEM × 50
6 – Inner view of pedicle valve, Bivolare, ZPAL Bp.XXXVI/120, SEM × 40



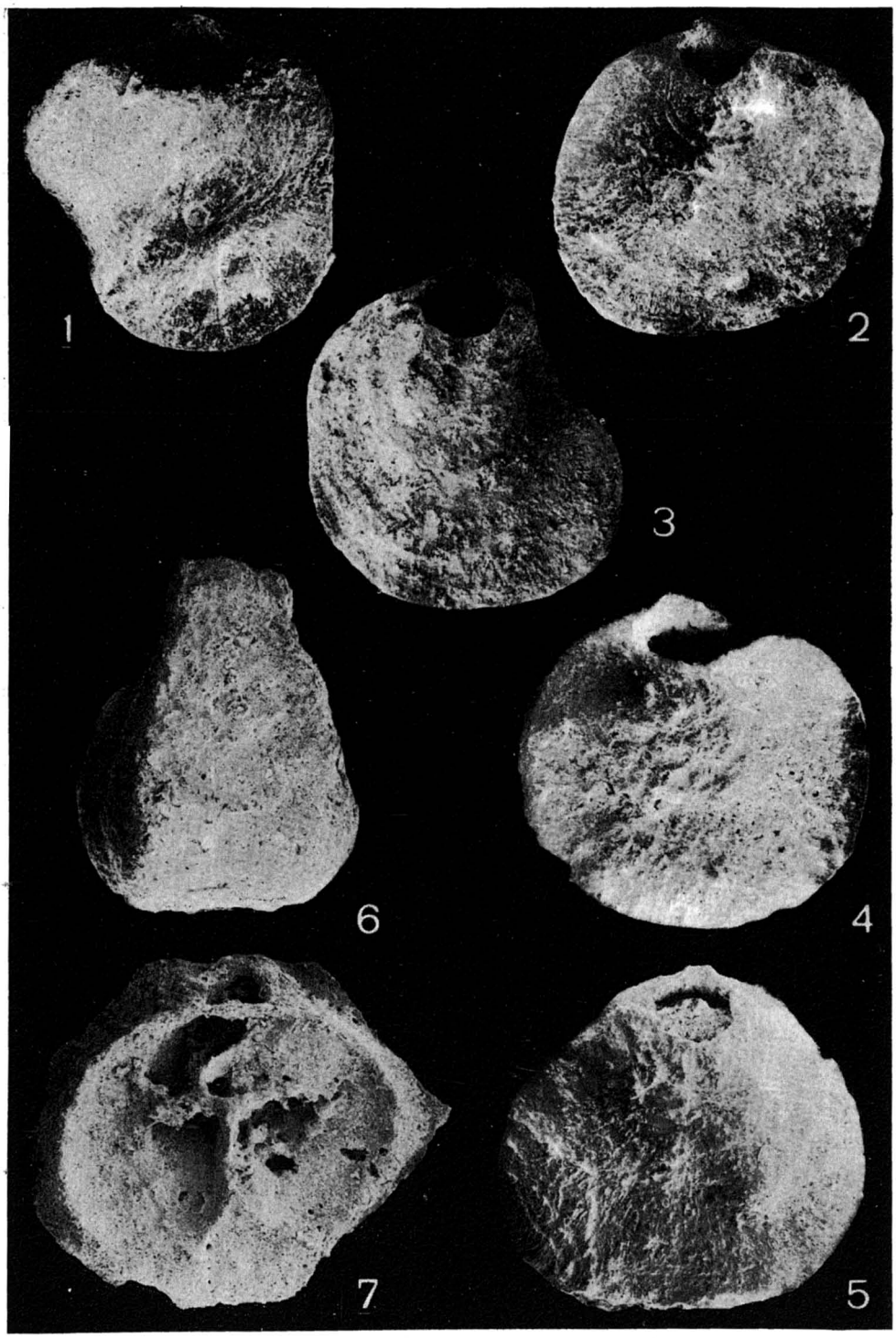
Argyrotheca cordata (Risso, 1826)

1 – Complete specimen (1a ventral, 1b dorsal, 1c lateral view), Ohrid (sample 2), ZPAL Bp.XXXVI/557, × 17
2 – Ventral view of complete specimen, Ohrid (sample 2), ZPAL Bp.XXXVI/558, SEM × 26
3 – Inner view of brachial valve, Ohrid (sample 2), ZPAL Bp.XXXVI/562, SEM × 26
4-5 – Ventral views of complete specimens, Ohrid (sample 1); 4 – ZPAL Bp.XXXVI/174, SEM × 70; 5 – ZPAL Bp.XXXVI/175, SEM × 43



Argyrotheca cordata (Risso, 1826)

1 – Dorsal view of complete specimen, Ohrid (sample 2), ZPAL Bp.XXXVI/559, SEM × 20
2 – Dorsal view of complete specimen, Ohrid (sample 1), ZPAL Bp.XXXVI/176, SEM × 20
3-4 – Dorsal views of complete specimens, Ohrid (sample 2); 3 – ZPAL Bp.XXXVI/560, SEM × 40; 4 – ZPAL Bp.XXXVI/561, SEM × 20
5-6 – Dorsal views of complete specimens, Ohrid (sample 1); 5 – ZPAL Bp.XXXVI/177, SEM × 33; 6 – ZPAL Bp.XXXVI/178, SEM × 20
7-8 – Inner views of brachial valves, Ohrid (sample 1); 7 – ZPAL Bp.XXXVI/179, SEM × 47; 8 – ZPAL Bp.XXXVI/180, SEM × 27



1-5 — *Platidia* sp.; dorsal views of complete specimens, Ohrid (sample 1); 1-2 — SEM × 56, 3 — SEM × 30, 4 — SEM × 52.5, 5 — SEM × 37.5, ZPAL Bp.XXXVI/636—640

6-7 — *Thecidellina* sp., Bivolare; 6 — Ventral view of complete specimen, ZPAL Bp.XXXVI/663, SEM × 30; 7 — Inner view of brachial valve, ZPAL Bp.XXXVI/664, SEM × 56