A C T A P A L A E O N T O L O G I C A P O L O N I C A
Vol. 23 1978 No. 3

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INARTICULATE BRACHIOPODS FROM THE LOWER ORDOVICIAN OF THE HOLY CROSS MOUNTAINS, POLAND

Abstract. — Two inarticulate brachiopod assemblages are recognized in the Lower Ordovician of the Holy Cross Mountains, Poland, as characteristic of the local *Lingulella zejszneri* and *Acontiodus rectus sulcatus* zones. They occur with conodonts typical of the Scandinavian *Paltodus deltifer* and *Baltoniodus navis* + *Baltoniodus triangularis* Zones. One new genus (*Quasithambonia*) and five new brachiopod species: *Rowellella distincta, Quasithambonia rarispinosa, Spondylotreta maior, Scaphelasma bukowkense, Eoconulus dyminensis* are established from the *Acontiodus rectus sulcatus* zone.

INTRODUCTION

Inarticulate brachiopods occur rather commonly in the Lower Ordovician of the Holy Cross Mountains. Up to now they have been but mentioned or briefly described in the Polish literature (Samsonowicz 1916; Czarnocki 1919; Kozłowski 1948; Tomczyk 1962; Bednarczyk 1959*a*, 1959*b*, 1964). They form the basis for the recognition of two local stratigraphic zones. The *Lingulella zejszneri* zone, recognized in the lowermost Ordovician of Kielce area, which comprises two subzones, *Thysanotos siluricus* (older — Zbilutka beds) and *Conotreta czarnockii* (younger — Koziel beds). Somewhat higher in the section, the *Acontiodus rectus sulcatus* zone (Bukówka beds) has been recognized (Bednarczyk 1964, 1971), based upon conodonts as well as inarticulate brachiopods.

These phosphatic, tiny brachiopods are difficult to extract from the rock and this is the principal reason for our poor knowledge of them. Mechanical methods of preparation were ineffective while the chemical ones have been not commonly used. In the last twenty years, however, our knowledge of inarticulate brachiopods has much progressed. In Poland, detailed research has started on the brachiopods of Wysoczki (Holy Cross Mountains) cherts (chalcedonites) equivalent to the *Thysanotos siluricus* subzone of the local *Lingulella zejszneri* zone (Biernat and Williams 1971; Biernat 1971, 1973), the collection being obtained from chalcedonites by hydrofluoric acid treatment.

The brachiopods investigated here have been obtained from limestones, using acetic acid, of the local *Acontiodus rectus sulcatus* zone found in the borehole Bukówka IG-1 and in the quarry at Bukówka hill by Kielce (cf. Bednarczyk 1971). They constitute a very characteristic and well differentiated assemblage. The associated conodonts represent the *Baltoniodus navis* + *Baltoniodus triangularis* zone, thus indicating a late Lower Arenig age for the investigated brachiopods.

The collection is deposited at the Institute of Paleobiology of the Polish Academy of Sciences, Warszawa (abbreviated as ZPAL in the text).

The photographs were taken by Miss Lidia Łuszczewska (Institute of Geology of the Warsaw University) and Mr. Sławomir Woźniak (Institute of Paleobiology of the Polish Academy of Sciences).

BIO- AND LITHOSTRATIGRAPHY OF THE LOWER ORDOVICIAN DEPOSITS OF THE KIELCE AREA

Lingulella zeiszneri zone

The zone is represented by glauconitic siltstones intercalated with clayey shales and chalcedonites (Bednarczyk 1964: Zbilutka beds and Koziel beds), the latter occurring abundantly in the *Thysonotos siluricus*

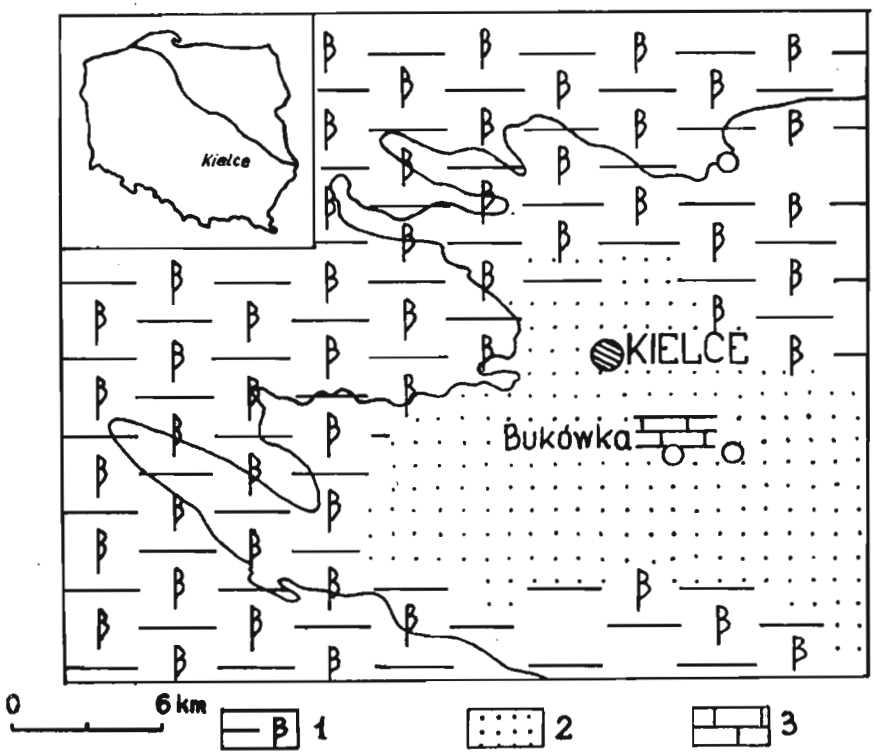

Fig. 1. Diagrammatic sketch map of the Arenigian facies of the western part of the Kielce region. *1* clayey facies with graptolites, *2* silty-sandy facies, *3* calcareous facies.

subzone. The chalcedonites appear commonly in the central (Bardo synclinorium) and south-western parts of the Kielce area (Table 1; Bednarczyk 1966b; Chlebowski 1971).

Apart from inarticulate brachiopods (Table 1), dendroid graptolites, sponge spicules, bryozoans and carapace fragments of indeterminable trilobites, the chalcedonites contain also abundant conodonts (Table 2; Bednarczyk 1974, 1975; Szaniawski 1976). Those conodonts indicate that the *Thysanotos siluricus* subzone of the Kielce area is equivalent to the Upper Tremadoc *Paltodus deltifer* Zone of Scandinavia (Lindström 1971; Van Vamel 1974; Viira 1974).

Acontiodus rectus sulcatus zone

Deposits attributed to this zone have been recorded in the borehole Bukówka IG-1 by Kielce (Bednarczyk 1971: figs 1, 2). They are represent-

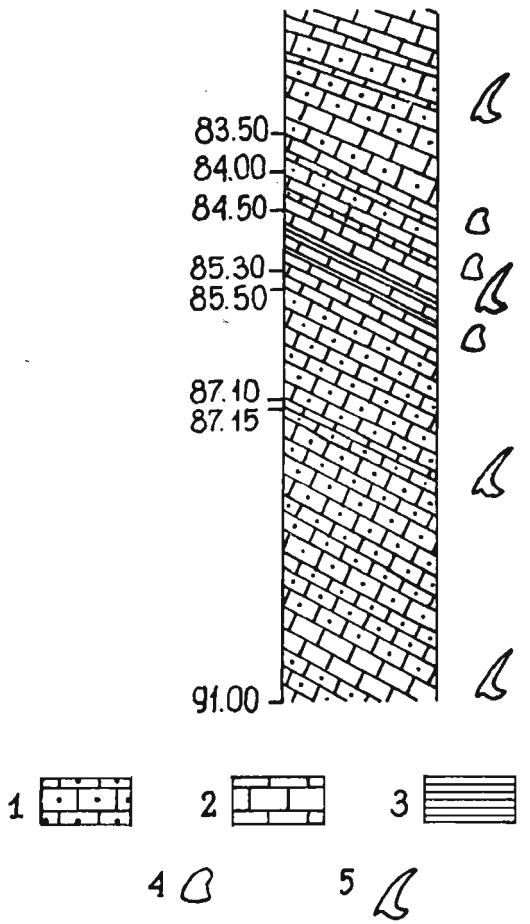

Fig. 2. Fragment of the lithological profile of the Arenigian from borehole Bukówka IG-1. *1* sandstones, *2* limestones, *3* claystones, *4* occurrence sites of brachiopods, *5* occurrence sites of conodonts.

ed by brown-reddish calcareous-dolomitic sandstones irregularly intercalated with dolomitic limestones (Bukówka beds, Bednarczyk 1964). Higher in the section, the sandstones pass into grey to brown-grey organodetritic limestones intercalated with thin layers of red shales. Inarticulate brachiopods occur at the top of the zone, at the depth of 83.5 to 85.5 m (Table 1; fig. 2).

Very few articulate brachiopods occur in both the limestones and sandstones, *Apheoorthis* cf. *christianae* (Kierulf) among others. The associated fauna comprises trilobites (*Nileus armadillo* (Dalman) and *Cybele bellatula* (Dalman)), gastropods (*Modestospira polonica* (Gürich)), sporadic ostracods and bryozoans (*Diplotrypa metropolitana* (Pander)). Conodonts occur commonly (Table 2). They indicate that this zone is equivalent to the *Baltoniodus navis* + *Baltoniodus triangularis* zone (late Lower Arenig) of Scandinavia (Lindström 1971).

REMARKS ON THE LOWER ORDOVICIAN BRACHIOPOD ASSEMBLAGES OF THE HOLY CROSS MOUNTAINS

Two distinct brachiopod assemblages can be recognized in the Lower Ordovician of the Holy Cross Mountains. These are the assemblages of the *Lingulella zejszneri* and *Acontiodus rectus sulcatus* zones. They differ in their taxonomic diversity and dominant inarticulate brachiopod groups.

The older assemblage (*Lingulella zejszneri* zone) is the more diverse. It consists of 16 genera (21 species) assigned to 6 families. It is dominated by the obolids (5 genera, 11 species). *Rowellella* sp. is especially interesting, since it is the oldest known representative of the genus (Biernat 1973). The type species, *Rowellella minuta* Wright, is described from the Upper Ordovician of England (Wright 1963); *R.margarita* Krause and Rowell, and *Rowellella* sp. from the Middle Ordovician of Nevada (Krause and Rowell 1975); *R.rugosa* Gorjansky, from the upper zones of the Lower Ordovician (Arenig to Volkhovian) of the East European Platform (Gorjansky 1969); and *Rowellella* sp. from the Arenigian to Volkhovian strata of Estonia (Biernat 1973) and north-western Poland (Bednarczyk 1977). The second most diverse family in the local *Lingulella zejszneri* zone is the Acrotretidae. This family is represented by 5 genera (6 species) of fairly uniform external and internal structure of the shell. In the family Siphonotretidae 3 monospecific genera are present, *Alichovia analogica* Biernat, being the oldest known representative of that genus. The type species, *A.ramispinosa* Gorjansky, is limited to Middle Ordovician strata (Idavere horizon) of the north-western part of the East European Platform (Gorjansky 1969). Other families, viz. Acrothellidae, Discinidae, and Paterulidae are represented by single and monospecific genera.

Table 1

Distribution of inarticulates in the Lower Ordovician of the Holy Cross Mountains

Species / Zone or subzone	*Lingulella zejszneri* 1	*Lingulella zejszneri* 2	*Acontiodus rectus sulcatus*
Obolidae			
Obolus cf. *appolinis*	+		
Schmidtites complexus	+	+	
Thysanotos siluricus	+	?	
Lingulobolus feistmantelli minor	+	+	
Lingulella (*Leptembolon*) *insons*	+	+	
L. (*L.*) *insons lata*	+	+	
L. (*L.*) *santacrucensis*	+	+	
L. (*L.*) *zejszneri*	+	+	
Lingulella lepis	+	+	
Rowellella distincta sp.n.			+
R. sp. 2	+		
Quasithambonia rarispinosa gen. n., sp. n.			+
Acrotretidae			
Conotreta samsonowiczi	+	+	
C. cf. *czarnockii*		+	+
Ditreta dividua	+		
Semitreta maior	+		
S. sp.			+
Spondylotreta dissimilis	+		
S. maior sp.n.			+
Eurytreta intermedia			+
E. minor	+		
Scaphelasma bukowkense sp.n.			+
Torynelasma rossicum			+
Ephippelasma spinosum			+
Myotreta crassa			+
Acrothellidae			
Orbithele bicornis	+		
Discinidae			
?*Orbiculoidea subovalis*	+		
Siphonotretidae			
Siphonotreta acrotretomorpha	+	+	
Helmersenia cf. *ladogensis*	+		
Alichovia analogica	+		
Paterulidae			
Elliptoglossa sp.	+		
Elkaniidae			
Broeggeria salteri		+	
Eoconulidae			
Eoconulus dyminensis sp.n.			+

1 *Thysanotus siluricus* Subzone, 2 *Conotreta czarnockii* Subzone

Table 2

Distribution of conodonts in the Lower Ordovician of the Holy Cross Mountains

Species / Zone or subzone	*Lingulella zejszneri*		*Acantiodus rectus sulcatus*
	1	2	
Acodus firmus	+		
Drepanodus arcuatus	+		+
Drepanoistodus acuminatus	+		
D. forceps			+
D. inaequalis	+		
Oistodus lanceolatus			+
Paroistodus amoenus			+
P. parallelus			+
Pravognathus aengensis	+		
Prioniodus deltatus	+		
P. navis			+
Protopanderodus rectus			+
Scandodus vitreus	+		
Scolopodus peselephantis	+		

1 *Thysanotos siluricus* Subzone, 2 Conotreta czarnockii Subzone

The younger brachiopod assemblage (*Acontiodus rectus sulcatus* zone) appears less diverse. It comprises 10 monospecific genera (mostly new species) assigned to 3 families. The family Acrotretidae is, by far, dominant. It is represented by 7 well defined genera displaying variable internal structure and external morphology of the shell. The obolids occur subordinately, comprising only two genera: *Rowellella* is represented by a new and morphologically characteristic species *R.distincta* sp.n. and a new genus *Quasithambonia* in both its external and internal shell characteristics which is member of the subfamily **Acanthamboniinae** Cooper, the stratigraphic range of which was till now determined as Middle to Upper Ordovician (Cooper 1956; Wright 1963; Gorjansky 1969). The monogeneric family Eoconulidae is represented by *Eoconulus dyminensis* sp.n. characterized by its very asymmetric shell shape.

Thus the recognized brachiopod assemblages are quite distinct, as there are only two common genera, *Conotreta* and *Spondylotreta*, which are both very rare.

BASIN CHARACTERICS AND BRACHIOPOD LIFE CONDITIONS IN THE LOWER ORDOVICIAN OF THE HOLY CROSS MOUNTAINS

The marine basin covering the southern Holy Cross Mts area at the Tremadoc and Arenig boundary displayed a considerable bottom relief (Bednarczyk 1966*a*; Chlebowski 1971). A rapid nearshore sedimentation

probably prevailed in the western and eastern marginal parts of the basin. This is evidenced by thick (over 30 m) sandy deposits with psephitic intercalations. Under such conditions, larger-sized inarticulata brachiopods of the genera *Thysanotos*, *Lingulobolus*, and *Lingulella* developed.

The sedimentation rate was much slower in the environs of Kielce and the Bardo synclinorium. In fact, the deposits are only a few meters thick and are dominated by silty-chalcedonitic sediments with pyroclastic matter and pebbles encrusted by bryozoans. Several sedimentary structures resulting from gravitational slides reflect some local vertical movements of the sea bottom (Chlebowski 1971). Siliceous sponges flourished in the shallow, well aerated and lit basin, thus indicating a high silica contents in the sea water (Turnau-Morawska 1958). The evironment was also inhabited by oscillatoracean algae (Starmach 1963), acritarchs (Górka 1967), graptolites, conodontophorids (Kozłowski 1948), and a number of thin-shelled phosphatic inarticulate brachiopods (Biernat 1971, 1973). The latter group displays interesting characterics. It is fairly diverse although dominated by the obolids. The acrotretids represent a single phyletic lineage with a dorsal septum in the form of an elongate septal ridge slightly variable in width, length and height. Siphonotretids are fairly abundant and include *Alichovia analogica* Biernat, characterized by multiple-branched spines (Biernat 1973).

The assemblage is dominated by juveniles (sometimes in almost complete developmental series, e.g. in *Semitreta maior* Biernat), while adults are uncommon and gerontic specimens are lacking. This does not result from any preservation bias, since adult brachiopods possess much thicker shells and hence have more chance to be preserved in the fossil state than their juveniles. They juvenile mortality rate must have been very high. This may indicate some temporary environmental disturbances hindering the brachiopods from achieving maturity. Such disturbances could result from volcanic activities in the sedimentary environment. A competition for space induced by the overcrowding could also play a role.

The inarticulata brachiopods could be epibionts attached to floating algae, which would have increased their ability to disperse all over the basin. They could also have been part of the sessile benthos, attached permanently by their pedicles (acrotretids) and spines (siphonotretids) to benthic algae or perhaps dendroid graptolites. Such a life habit would have been favourable for small brachiopods, since the settlement sites would have always been located above and at a variable distance from the sediment-water interface (Rowell 1971). The investigated brachiopods were not endangered by any sudden burial (cf. Gorjansky 1969). However, the multiple-branched spines of *Alichovia analogica* Biernat suggest that the species lived close to the bottom, the spines acting not only as an anchor but also as a protective thicket against an incursion of non-

nutritious particles into the body cavity, i.e. as an additional and good filtering apparatus (Biernat 1971).

In the Late Arenig, the area still remained tectonically active, resulting in a further differentiation of the basin. Three facies belts occurred at that time: (i) the deep, graptolite-bearing clay facies in the south-west, (ii) the shallow-neritic carbonate-sandy facies in the environs of Kielce, and (iii) the sandy-silty facies (Bednarczyk 1966*a*). Thick shelled organism are associated with the sandy-silty facies. In fact, there are thick-ribbed orthids, rather massive bryozoans (*Diplotrypa*), thick-shelled gastropods (*Modestospira*), and comparatively large-sized trilobites *Cyrtometopus*, *Nileus*, *Cybele* (Bednarczyk 1964). In contrast the clay facies belt is dominated by graptolites, and the carbonate zone by inarticulate brachiopods along with conodonts.

The carbonate facies was probably due to the development of calcareous algae. These plants produced microhabitats suitable for conodontophorids and especially for brachiopods. The associated brachiopod assemblage contains unusually large amounts of gerontic forms, whereas other ontogenetic stages may be absent (e.g. in *Ephippelasma spinosum* Biernat, *Scaphelasma bukowkense* sp.n.). Juveniles also occur (e.g. in *Eoconulus dyminensis* sp.n., *Quasithambonia rarispinosa* sp.n., *Myotreta crassa* Gorjansky), but they are few. Furthermore, all the specimens are extremely thick-shelled and often display very thickened and hence more prominent internal structural elements, e.g. both ventral and dorsal muscle scars, median plates or dorsal septum. In *Ephippelasma spinosum* Biernat, the dorsal septum appears extremely large and massive relatively to the size of the entire shell (pl. 21). Such thick brachiopod shells may suggest turbulent environmental conditions. Some species (e.g. *Eoconulus dyminensis* sp.n.) probably settled on local hardgrounds formed at an early submarine-diagenetic stage (Rowell and Krause 1973). This is indicated by their considerable asymmetry in shell shape and their thick and irregular radial plicae resembling oysters. The shells probably either lying free at the bottom or were cemented to the substrate, the latter mode of life resembling that of the Late Cretaceous craniids (Surlyk 1973: fig. 1). The majority of eoconulid shells show regularly or irregularly truncated apical parts, and the latter when preserved are always much exfoliated relative to the other parts of valves. This may point to a contact of the apex with the substrate. There are, however, no distinct traces of brachiopod attachment to any organism. This contrasts with the observations by Krause and Rowell (1975: pl. 8: 27, 30) who illustrated a complete articulated shell of *E.antelopensis* Krause and Rowell displaying traces of cementation to a host.

The life habits remain inaccurately known not only in the eoconulids, but also in all of the acrotretids. Judged from the fragmentary data available, the acrotretid mode of life might have been fairly variable.

The Arenig sedimentation was accompanied by a volcanic activity, just as in the Tremadoc, as can be seen by the pyroclastic present in silty-sandy deposits at Bukówka Hill (Chlebowski 1971).

MATERIAL

The investigated collection of inarticulate brachiopods is fairly large (over 150 specimens), and shows a range of variability. The specimens are unusually thick-shelled and well-preserved. There are few fragmented individuals. The most abundant species are *Ephippelasma spinosum* and *Eoconulus dyminensis* sp.n. representing over 70% of the collection. *Quasithambonia rarispinosa* sp.n., *Myotreta crassa*, *Scaphelasma bukowkense* sp.n. and *Spondylotreta maior* sp.n. are less common (25% of the collection). *Torynelasma rossicum*, *Eurytreta intermedia*, and *Conotreta* cf.*czarnockii* are represented each by a few specimens.

The collection is dominated by dorsal valves. However, the ventral to dorsal valve ratio is variable among the species. For example *Eoconulus dyminensis* sp.n. is represented mostly by dorsal valves; there are only two ventral valves in the total of over 70 specimens. In contrast, there are only 3 dorsal valves in the total of some 30 specimens of *Myotreta crassa*; in the case of *Quasithambonia rarispinosa* sp.n., 15 ventral valves and a single dorsal one have been found.

In most species, only gerontic specimens have been found (e.g. *Ephippelasma spinosum*, *Scaphelasma bukowkense* sp.n., *Spondylotreta maior* sp.n, *Eurytreta intermedia*, *Conotreta* cf. *czarnockii*). In some species, almost complete growth series are available, apart from the earliest shell developmental stage (e.g. *Quasithambonia rarispinosum* sp.n., *Eoconulus dyminensis* sp.n., *Rowellella distincta* sp.n.). *Myoyotreta crassa* and *Torynelasma rossicum* are represented only by a few juvenile dorsal valves.

Most of the specimens show excellently-preserved elements of both external and internal shell structure which are not affected by any gerontic changes. This permits new data on some genera. In some species, the internal structural elements have been observed that were unknown or poorly known. In *Scaphelasma bukowkense* sp.n. cardinal muscles have been recorded in a ventral valve (pl. 19: 3*b*, 4*b*) not previously known in that genus (Krause and Rowell 1975: 49). Prominent dorsal cardinal muscles bordered by medial lateral ridges have been reported only from *S.anomalatum* from the Middle Ordovician of Nevada (Krause and Rowell 1975: 55, fig. 4; pl. 7: 12—14). An internal ventral tube continuing externally (pl. 20: 7, 8) has been observed in the ventral valve of *Myotreta crassa*.

There are no articulated shells in the investigated collection. The known fossil record of inarticulate brachiopods with valves together is in

generaly very poor (Rowell 1963; Rowell and Krause 1973; Wright 1963; Cooper 1956; Biernat 1973). Even articulated shells which were preserved become disarticulated during the process of their chemical extraction from a rock. The almost universal disarticulation of fossil inarticulate shells results mostly from the absence of developed effective hinge apparatuses, since the valves are only loosely joined at the posterior margins, and held by a system of "closing and opening muscles" acting during the animal's life. The thick-shelled nature of the investigated specimens could also favour the shell disarticulation just after the animal's death.

DESCRIPTIONS

Family **Obolidae** King, 1846
Genus *Rowellella* Wright, 1963
Rowellella distincta sp.n.
(pl. 17: 1, 2)

Holotype: ZPAL Bp.XXVII/25, pl. 17: 1; *paratype*: ZPAL Bp.XXVII/24, pl. 17: 2.

Type horizon: Grey-brown marly limestone, late Lower Arenig, *Acontiodus rectus sulcatus* Zone.

Type locality: Bukówka IG-1 at Kielce, Holy Cross Mountains.

Derivation of the name: *distinctus* (*Lat.*) as distinct from the other known species of the genus.

Diagnosis. — Shell small, well geniculated and thick with densely spaced concentric lamellae.

Material. — Three incomplete (posterior parts damaged) brachial valves, a few very small fragments of ventral or brachial valves.

Dimensions (in mm):

ZPAL Bp.XVII/	approximate length	valve width	no of lamellae per 0.5 mm
24 paratype	1	0.86	13
25 holotype	1	0.75	12

Description. — Shell small, geniculated, thick, very elongate; lateral margins almost parallel and highly deflected toward the opposite valve; anterior margin slightly arcuate. Shell surface bearing distinct lamellae with thickened and somewhat raised edges covered additionally by fine, regularly arranged growth lines. Internally, muscle scars are elongate, well developed, bounded laterally and anteriorly by thickened ridges (pl. 17: 1*c*, 2*b*); at the anterior margin a few weak traces of pallial sinuses are preserved.

Remarks. — The species is characteristic by its small size, distinct shell geniculation and dense surface concentric ornamentation, differing in these features from the known members of the genus. *Rowellella* sp. from the chalcedonites of Wysoczki (Holy Cross Mountains) and *Rowellella* sp. from the Volkhov horizon of Estonia (Biernat 1973: pl. 3: 1) have surface lamellae which are much thinner and more distant one from the another. *R.rugosa* Gorjański from the Volkhov horizon, Leningrad environs, is similarly outlined but surface lamellae are much stronger, fewer and

very distant from one another. *R.minuta* Wright the Portrane limestone species (Wright 1963: pl. 1: 8—12, 14—28) is the closest to our form both in the shell outline and character of the surface lamellae but it is smaller and the shell geniculation is less pronounced. *R.margarita* Krause and Rowell from the Middle Ordovician of Nevada (Krause and Rowell 1975: pl. 3: 6) is more elongate, and suboval with the surface lamellae less distinct. *R.lamellosa* Popov from the Middle Ordovician of Kazachstan (Popov 1976: pl. 3: 1—3) differs in its densely lamellose shell surface — the lamellae being of slightly uneven appearance. These features distinguish Popov's species from all those mentioned above.

All the species of the genus *Rowellella* are chiefly united by their elongate shell, with a tendency to be geniculated and by lamellar surface. The most variable feature is the shell ornamentation — its pattern being sufficiently well differentiated. The subfamily rank of the genus is discussed by Krause and Rowell (*op. cit.*). They rightly believe in its closer affinity to the Lingulellinae than the Glosellinae.

Occurrence. — As for the holotype.

Genus *Quasithambonia* gen.n.

Type species: *Quasithambonia rarispinosa* gen. et sp.n.

Derivation of the name: *quasi* (*Lat.*) looking almost like *Acanthambonia* Cooper.

Genus monotypic: diagnosis as for the type species.

Occurrence. — Lower Ordovician: late Lower Arenig, Bukówka Hill near Kielce, Holy Cross Mountains.

Remarks. — The general shell shape and outline, morphology of the posterior margin and the available structure of the dorsal interior confirm some relationship to *Acanthambonia* Cooper. Unfortunately *Acanthambonia*, the only member of Acanthamboninae Cooper, is based on scarce and imperfectly known species. The internal structure is only partly known, particularly the brachial valve, and the available illustrations of the interior rather poor (Wright 1963: pl. 1: 29—31; pl. 4: 11, 15, 16, 19; Cooper 1956: pl. 9*a*: 5; Gorjansky 1969: pl. 6: 7, 8). Our genus is characteristic by its external morphology and ventral interior.

Quasithambonia rarispinosa gen. et sp.n.
(pl. 17: 3—5)

Holotype: ZPAL Bp.XXVII/2, pl. 17: 4.

Type horizon: grey-brown marly limestone, late Lower Arenig, *Acontiodus rectus sulcatus* zone.

Type locality: Bukówka Hill near Kielce, Holy Cross Mountains.

Derivation of the name: because of the rarely spaced surface spines.

Diagnosis. — Small occasional surface spines; ventral adductor scars small, oval, parallel, slightly divergent to somewhat convergent anteriorly; dorsal adductor scars oval, median thickening, narrow.

Material. — Ten disarticulated adult ventral valves, one dorsal, ten immature ventral and dorsal, and a few fragments of valves.

Dimensions (in mm):

ZPAL Bp.XVII/	pedicle valve length	pedicle valve width	no of concentric lines per 1 mm	no of spines per 1 mm
1	1.0	1.0	6	ca 16
2 holotype	1.0	1.0	7	ca 11

Description. — Shell small, outline circular, length almost equal to the width, moderately biconvex, biconvexity more pronounced posteriorly, posterior margin gently arched. Ventral beak slightly raised, situated a little posteriorly and somewhat anchylosed toward the posterior margin. Dorsal beak rather smaller, not anchylosed. Surface concentric lines are on the posterior half of the shell, more numerous and distinct anteriorly but in general of irregular appearance and arrangement. Surface spines rare, small, opening into the shell interior, enlarging in number posteriorly (pl. 17: 3*a*, 4*a*, 5).

In the ventral interior, two small, oval to suboval adductor scars almost parallel to slightly divergent anteriorly. One specimen (pl. 17: 3*b*) shows two adductor scars somewhat convergent anteriorly, this may be pathological. In the dorsal interior, two small and distinctly oval adductor scars diverge anteriorly and are placed about the midlength of the valve of both sides of the median thickening. Vascular grooves diverge anteriorly like those in *Acanthambonia minutissima* Cooper (Cooper 1956: pl. 18*D*: 23).

Remarks. — Our material includes particularly well preserved juvenile specimens, referred to *Q.rarispinosa*. The smallest specimens about 0.25 mm—0.35 mm long are relatively thick-shelled, and have a circular outline similarly to the adults, with the apical part of the pedicle valve elongate and narrow posteriorly, the brachial valve being smaller without a pronounced apex. The surface spines are extremely rare and small. A single specimen of the ventral valve with the adductor scars divergent posterioly, is provisionally included into *Q.rarispinosa* sp.n. (pl. 17: 3).

The newly proposed species shows some relationship to the genus *Acanthambonia* Cooper in the similar shell shape and outline, morphology of the posterior part of the shell, and in the structure of the dorsal interior. The differences lie in the ventral valve structure and rare surface spinosity. The cardinal muscle scars are small, never attaining the midlength of the valve, usually a little divergent in the anterior direction.

Occurrence. — Poland: As for the holotype.

Family **Acrotretidae** Schuchert, 1893
Genus *Conotreta* Walcott, 1889
Conotreta cf. czarnockii Bednarczyk, 1959
(pl. 18: 2)

Material. — Two incomplete brachial valves and one fragmentary pedicle valve. Dimensions (in mm):

ZPAL XXVII/	brachial valve length	brachial valve width	septum length	cardinal muscle scar l:w
43	0.75	0.60	0.4	0.2:0.13

Remarks. — The character of the pedicle valve and, to a great extent, of the brachial one (cardinal muscle scars, septum) suggest to *C.czarnockii* Bednarczyk, from the Lower Ordovician of the Holy Cross Mountains (Bednarczyk 1959*a*: pl. 1: 2).

Occurrence. — Poland: Lower Ordovician (late Lower Arenig, Holy Cross Mountains).

Genus *Semitreta* Biernat, 1973
Semitreta sp.
(pl. 19: 7; pl. 20: 5*a*, *b*)

Material. — One brachial valve, slightly damaged.

Dimensions (in mm):

ZPAL Bp.XXVII/	brachial valve length	brachial valve width	length of septum
42	0.5	0.65	0.25

Remarks. — The general character of the brachial valve suggests some similarity to the genus *Semitreta* described from the chalcedonites of Wysoczki (Biernat 1973: 76). Unfortunately no pedicle valve is preserved.

Occurrence. — Poland, Lower Ordovician. Late Lower Arenig (Bukówka Hill, Holy Cross Mountains).

Genus *Eurytreta* Rowell, 1966
Eurytreta intermedia Biernat, 1973
(pl. 20: 3, 6; pl. 22: 1, 2)

1973. *Eurytreta intermedia* Biernat: 72, pl. 9: 7—11; pl. 10: 13.

Material. — One incomplete pedicle valve and four brachial ones.

Dimensions (in mm):

ZPAL Bp.XXVII/	brachial valve length	brachial valve width	cardinal muscles brachial valves	brachial septum valve
31	0.6	0.7	0.1×0.05	0.3
32	0.4	0.77	0.3×0.1	0.5
33	0.6	0.7	0.3×0.1	ca. 0.4
34	0.4	0.5	— —	0.2

Occurrence. — Poland: late Lower-Middle Ordovician (North-Eastern Poland, Bukówka Hill, Holy Cross Mountains).

Genus *Spondylotreta* Cooper, 1956
Spondylotreta maior sp.n.
(pl. 17: 6; pl. 18: 1, 3—8)

Holotype: ZPAL Bp.XXVII/19; pl. 18: 6; *paratype*: ZPAL Bp.XXVII/17; pl. 18: 4.

Type horizon: grey-brown marly limestone, late Lower Arenig, *Acontiodus rectus sulcatus* zone.

Type locality: Bukówka Hill near Kielce, Holy Cross Mountains.

Derivation of the name: *maior* (*Lat.*) — of larger size in comparison to the known species of *Spondylotreta*.

Diagnosis. — Thick-shelled large *Spondylotreta* with wide and low ventral conus.

Material. — Five fragmentary pedicle valves and four brachial ones.

Dimensions (in mm):

ZPAL Bp.XXVII/	pedicle valve length	brachial valve length	brachial valve width	cardinal muscle scars width : length	dorsal median septum length
16		1.15	0.9	0.37 : 0.20	0.46
17		0.90	0.66		0.4
18		1.0	0.7	0.3 : 0.1	0.4
19	0.2		0.2		
20	ca 1.0		ca 1.0		
21	ca 1.0		1.0		
39	ca 0.7		ca 0.7		
50	0.22		0.3		

Description. — Shell comparatively large, thick, conus high but very wide; pseudointerarea planar, interthroug marked. Brachial valve flat to slightly concave posteriorly. Surface concentric ornament thick, interspersed by fewer microlines; some traces of nodulae-like structures are present on the anterior half of the pedicle valve (pl. 18: 6*a*).

Ventral interior with small pedicle tube; two plates, components of a median septum, close and parallel, are apically high and thick (pl. 18: 3, 6*b*). Simple vascular ridges well developed on the anterolateral parts of valve. Dorsal interior with well marked median plate; two bounding laterally propareas small; median septum arising anteriorly from a posterior median thickening. Cardinal muscle scars elliptical and distinctly developed (pl. 18: 4, 8).

Remarks. — The specimens are close to the Lower Ordovician *Spondylotreta faceta* Gorjansky from the Leetseian and Volkhovian of the north-western East European Platform (Gorjansky 1969: 66, pl. 10: 7—12). They differ mostly in being larger and in having much wider and lower ventral conus. *S.dissimilis* Biernat, from the chalcedonites of Wysoczki (Biernat 1973: pl. 11: 2—9; pl. 12: 1, 2), is smaller and thin-shelled with a median plate and septum. The present specimens belong to a new species. Although rather fragmentary in their preservation, they possess a few features (e.g. size and shape of the ventral conus surface ornamentation) judged to be of specific value. From the other known species of the genus, *S.parva* Wright from the Portrane Limestone of Eire is much smaller with indistinct pseudointerarea (Wright 1963: 238, pl. 2: 17, 20—23; pl. 3: 1, 5, 9, 15). *Spondylotreta* sp., the Meiklejohn species of Nevada (Krause and Rowell 1975: 41, pl. 5: 1—11) is very close to our species in having low and wide ventral conus.

Occurrence. — Poland: late Lower Arenig, Bukówka Hill, Holy Cross Mountains.

Genus *Myotreta* Gorjansky, 1969

Myotreta has previosly only been described from the Early Ordovician (Arenig) of the USSR — near Leningrad, West Estonia and the Central and East part of Poland, and also probably from the Middle Ordovician, found in erratic boulders of Central Poland at Mochty (Gorjansky 1969; Biernat 1973).

The genus is characterised mostly by the shape of the ventral conus and of the dorsal septum — the feature used, among others, to infer some taxonomic and phylogenetic relationships in acrotretaceans. Krause and Rowell (1975: 61) suggested some similarity to *Ephippelasma*. The internal pedicle tube recently found in *M.crassa* Gorjansky is a feature characteristic of the Ephippelasmatinae. However the structure of the dorsal septum, is one of the differing features. Further data on *Ephippelasma* and *Myotreta* is needed.

Myotreta crassa Gorjansky, 1969
(pl. 20: 4, 7, 8)

1973. *Myotreta crassa* Gorjansky; Biernat: 81, pl. 13: 1—9; pl. 14: 6—7; pl. 15: 1—5.

Material. — Thirty five pedicle valves and brachial ones of different size, a few fragments of valves.

Dimensions (in mm):

ZPAL Bp.XXVII/	brachial valve length	pedicle valve length	width	length of septum
22		0.4	0.5	
23		0.4	0.4	
36	0.54		0.33	0.2

Remarks. — The general appearance and internal structure agree with *Myotreta crassa* Gorjansky mentioned in the synonymy. An additional feature seen in the specimens from Bukówka is the external extension of the internal pedicle tube. The dorsal septum in our specimens remains very small, with only some tendency to be laterally folded. Some variation occurs in the width of the ventral conus, which can either be widened anteriorly or narrowed due to its sides lying almost parallel to one another.

Occurrence. — Poland: Lower Ordovician (NE Poland, Holy Cross Mts). USSR: Lower Ordovician (Leningrad environs, Estonia).

Genus *Scaphelasma* Cooper, 1956
Scaphelasma bukowkense sp.n.
(pl. 18: 9; pl. 20: 1—6)

Holotype: ZPAL Bp.XXVII/13; pl. 19: 5 (brachial valve); *paratype* ZPAL Bp.XXVII/11; pl. 19: 6 (pedicle valve).

Type horizon: grey-brown marly limestones, late Lower Arenig, *Acontiodus rectus sulcatus* zone.

Type locality: Bukówka Hill near Kielce, Holy Cross Mountains.

Derivation of the name: coming from the Bukówka locality.

Diagnosis. — Thick-shelled *Scaphelasma* with rare macrolines posteriorly and numerous lamellae anteriorly, ventral and dorsal cardinal muscle scars with bounding ridges.

Material. — Four pedicle and 10 brachial valves from Bukówka Hill outcrop: six brachial valves from the Bukówka IG-1 boring (depth 83.50 m—94.0 m). All specimens of somewhat different sizes.

Dimensions (in mm):

ZPAL Bp.XXVII/	length		width	cardinal muscles	
	brachial valve	pedicle valve		length	width
11		0.76	1.0		
12		0.57	0.84		
13	0.77		ca 1.0	0.22	0.15
14	0.73		ca 1.0	0.17	0.10
15	0.57		0.84	0.14	0.06
40	0.30		0.40		

Description. — Shell thick, subcircular to somewhat transversely oval in outline. Pedicle valve procline, pseudointerarea weakly marked, intertrough narrow, pedicle foramen subapical, round to slightly oval. Brachial valve usually convex, in some cases gently convex posteriorly. Surface macrolines rare and rather indistinct on the posterior half of the valve becoming crowded anteriorly and of lamellar appearance. Concentric microlines usually very fine and regularly arranged.

In the ventral interior pronounced apical process; cardinal muscle scars bound on their inner sides by distinct lateral ridges (pl. 19: 6c). Dorsal interior with a median plate of variable appearance, usually lenticular. Median septum of slightly changeable appearance at the ventroanterior and posteroventral margins, arising in the posterior half of the valve and usually extending almost to the end of the anterior margins. In some valves, a marginal limbus-like structure occurs. Cardinal muscle scars elongate, of varying size, divergent anteriorly with bounded lateral ridges (pl. 19: 4b, 5b).

Remarks. — This is not a common species in the Bukówka section. The number of available specimens is to small to consider the problem of the limits of variability. The material, although scarce, is, however, valuable in showing some additional

details of the shell interior: 1) the ventral cardinal muscle scars, not observed up to now in the genus (Krause and Rowell 1975: 49) being conspicuous and 2) the dorsal cardinal scars, well developed, with distinct bounding ridges rare in the genus. Up to now ridges have been described only in *S.anomalatum* Krause and Rowell from the Middle Ordovician of Nevada (Krause and Rowell 1975: pl. 7: 2; fig. 46).

Our species is distinguished from others of the genus chiefly on the basis of moderately subtransverse shell outline, more thin in comparison to the general shell thickness, surface concentric macrolines and lamellae, and the ventral and dorsal distinct muscle scars with bounding ridges. *Scaphelasma subquadratum* Biernat, from the Ordovician of nort-eastern Poland, possesses regularly arranged concentric macrolines, shorter and less pronounced dorsal septum (Biernat 1973: pl. 16: 1—6). *S.septatum rugosum* Gorjansky, from the Ordovician (Volkhovian and Kundian) of the north-western USSR and Estonia, has rare but very thick and almost regularly arranged concentric ridges (Gorjansky 1969: pl. 12: 1—4), as has *S.lamellosum* Krause and Rowell, from the Middle Ordovician of Nevada (Krause and Rowell 1975: pl. 6: 13—29). *S.tumidatum* Krause and Rowell has less subdued concentric ridges and a sulcate brachial valve and *S.anomalum* Krause and Rowell a broad, shelf-like dorsal pseudointerarea (*op.cit.*: pl. 7: 1—14; pl. 7: 6).

Occurrence. — As for the holotype.

Genus *Torynelasma* Cooper, 1956
Torynelasma rossicum Gorjansky, 1969
(pl. 20: 1, 2, 9)

1973. *Torynelasma rossicum* Gorjansky; Biernat: 91, pl. 20: 1—12; pl. 21: 2—5; figs. 9, 18, 34.

Material. — One fragmentary pedicle valve and two brachial ones.

Dimensions (in mm):

ZPAL Bp.XXVII/	length		width	distance of dorsal septum	
	brachial valve	pedicle valve		from apex	from anterior margin
26		0.20	0.30		
48	0.52		0.65	0.10	0.10
49	0.50		0.60	0.15	0.13

Remarks. — The specimens from Bukówka are similar to those described by the present authors (Biernat 1973) from north-eastern Poland. To mention, the specimens at hand are juvenile. The brachial valve (to about 0.4 mm long) shows broadly triangular pseudointerarea, weakly marked median plate and two propareas with somewhat rised margins. Median septum is comparatively high with a posteroventral thickening, constituting an incipient surmounting plate.

Occurrence. — Poland: late Lower-Middle Ordovician, (NE Poland and Holy Cross Mts). USSR: late Lower-Middle Ordovician (Estonia and environs of Pskov).

Genus *Ephippelasma* Cooper, 1956

Remarks. — When analyzing all the known species of *Ephippelasma* one can divide them into two distinct groups based on the development of the median dorsal structure. The first group comprises *E.spinosum* Biernat, *E.maior* Biernat with well-developed two components of the dorsal septum, and the second group (*Ephippelasma minutum* Cooper, *E.intutum* Popov) has the surmounting plate digitate or lamellose and buttressed only posteriorly. In other features, all the species show a great similar-

ity in their development. It seems very probable that two developmental lines are represented: first an enlargment of the supporting median plate (*E.spinosum*), and secondly its decay (*E.minutum*).

Ephippelasma spinosum Biernat, 1973
(pl. 21: 1—13)

1975. *Ephippelasma spinosum* Biernat; Krause and Rowell: 61, pl. 8: 7—22; pl. 10: 1—4, 7, 8; pl. 11: 12.

Material. — Over 50 brachial valves, 3 pedicle ones, many fragments; gerontic valves predominant.

Dimensions (in mm):

ZPAL Bp.XXVII/	brachial valve		dorsal muscle	
	length	width	length/width	
7	0.7	ca 1.00	0.27	0.20
8	ca 0.5	ca 0.60	0.22	0.13
9	0.4	0.42	0.12	0.10
10	0.8	ca 1.00	0.42	0.22
37	1.1	0.75		
38	0.58	0.60	ca 0.30	0.20

Remarks. — Two features of the brachial valve merit some mention. These are: cardinal muscle scars and median septum. The dorsal muscle scars are always large, oval in outline and, to a varying degree, divergent anteriorly. On very old valves they form thickened and, sometimes, elevated platforms with some traces, meandric in pattern, of muscle attachment. In many valves the cardinal muscle scars are bound by lateral ridges. The median septum is spectacularly developed being large, thick and having numerous underneath spines (pl. 21: 3, 6, 9, 11, 12).

The shells are similar to those of north-eastern Poland in many features (Biernat 1973: 23) and also with those from the Middle Ordovician of Nevada (Krause and Rowell 1975: pl. 8: 18—22). The specimens from north-eastern Poland are more juvenile and possess a less-developed dorsal septum and vestigial dorsal cardinal muscle scars (Biernat 1973: pl. 23: 1—10). The specimens from Nevada include shells from juveniles with the beginning of a septum, up to advanced adults with well-developed spinosity underneath the surmounting plate (Krause and Rowell 1975: pl. 8: 7—12) and distinct cardinal muscle scars, like those from the Bukówka section (pl. 21: 3*a*, 8, 10). They are slightly smaller than our specimens.

E.minutum Cooper, from the Pratt Ferry Fm. of Alabama (Cooper 1956: pl. 17*A*) has a digitate surmounting plate without a supporting median septum. Similarly, *E.intutum* Popov from the Middle Ordovician of Kazachstan, USSR (Popov 1975: fig. 1; pl. 5: 7—15) possesses two small ridges, diverging anteriorly buttressing the surmounting plate at its posterior end. The plate, has incipient parallel lamellae instead of underneath spines.

Occurrence. — Poland: Lower-Middle Ordovician (north-eastern Poland, Holy Cross Mts). USA: Lower-Middle Ordovician (Nevada).

Family **Eoconulidae** Rowell, 1965
Genus *Eoconulus* Cooper, 1956
Eoconulus dyminensis sp.n.
(pl. 20: 10—12; pl. 22: 3—5)

Holotype: ZPAL Bp.XXVII/27; pl. 22: 3 (brachial valve); *paratype* ZPAL Bp.XXVII/35; pl. 22: 4 (brachial valve).

Type horizon: grey-brown marly limestone, late Lower Arenigian, *Acontiodus rectus sulcatus* zone.

Type locality: Bukówka Hill near Kielce, Holy Cross Mountains.

Derivation of the name: after the name of village Dyminy near Kielce.

Diagnosis. — Eoconulids with variable shape shell, surface ornament consisting of concentric micro- and macrolines and radial irregular foldings.

Material. — Over forty valves (two pedicle ones) of different size, many fragments. Dimensions (in mm):

ZPAL Bp.XXVII/	brachial valve	
	length	width
27	1.30	ca 2.00
28	ca 1.00	1.70
29	0.80	1.20
30	ca 1.00	1.40
35	1.66	1.33
45	0.75	0.85
46	0.50	0.70
47	0.40	0.50

Description. — Shell small, thick, the largest exceeding 1.3 mm in width, moderately conical, apical part blunt, apex somewhat subcentral and only sometimes preserved. Shell outline varying from round-subtransverse to subquadrate. Surface concentric microlines regularly spaced, interspersed by slightly thicker macrolines. Sometimes irregular and discontinuous wide radial foldings form meandric pattern (pl. 22: 4*a*).

Interior. Margins with a marked limbus-like structure (pl. 22: 5*b*). In a few brachial valves brown coloured cardinal muscle scars are widely oval and, in general, large (pl. 22: 4*b*). In the interior of two valves (the pedicle ones?) attachments of the cardinal muscles are like elevated platforms, oval in outline, and scarce traces of an apical structure (apical boss) are discernible.

Remarks. — The specimens are quite variable in size. They range from small (about 0.4 mm long) that are extremely lowly conical to larger and more subquadrate in outline; apex blunt and usually preserved. Surface microlines are very fine, with the radical foldings marked very weakly if at all. During the shell growth such features as ornamentation, shape and outline of shell are the most susceptible to environmental influence. This is shown by our adult shells which are irregularly shaped, and their ornament is highly asymmetrical (pl. 22: 4*a*).

Eoconulus dyminensis sp.n. is distinguishable by its irregular outline and surface ornament. In overal shape it shows great similarity to *E.antelopensis* Krause and Rowell but differs mainly in being widely conical and in having irregular foldings (Krause and Rowell 1975: pl. 8: 28—32). This peculiarity of the ornamentation serves to distingiush our form from all the other species of *Eoconulus*.

Occurrence. — As for the holotype.

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REFERENCES

BEDNARCZYK, W. 1959*a*. On genus *Conotreta* from the Lower Ordovician of the Holy Cross Mts. — *Bull. Acad. Pol. Sci., Sér. Sci. Chim. Géol. Géogr.*, **7**, 6, 463—468.

— 1959*b*. Four new species of *Conotreta* from the Upper Tremadocian of the Holy Cross Mts. — *Ibidem*, **7**, 7, 509—513.

— 1964. Stratygrafia i fauna tremadoku i arenigu (oelandianu) regionu kieleckiego Gór Świętokrzyskich (The stratigraphy and fauna of the Tremadocian and Arenigian, Oelandian in the Kielce region of the Holy Cross Mts., Middle Poland). — *Biul. Geol. Uniw. Warsz.*, **4**, 3—127, 188—197.

— 1966*a*. Paleogeografia dolnego ordowiku w regionie kieleckim Gór Świętokrzyskich (Lower Ordovician palaeogeography of the Kielce region in the Holy Cross Mts.). — *Acta Geol. Pol.*, **16**, 1, 92—106.

— 1966*b*. Litologia dolnego ordowiku (elandu) w regionie kieleckim Gór Świętokrzyskich (Lithology of the Lower Ordovician, in the Kielce region of the Holy Cross Mts.). — *Biul. Geol. Uniw. Warsz.*, **8**, 4—53.

— 1971. Stratigraphy and palaeogeography of the Ordovician in the Holy Cross Mts. — *Acta Geol. Pol.*, **21**, 4, 574—616.

— 1974. Current Conodont research. — *Pander Letter*, **7**, 6. U. S. Geol. Survey Washington, D. C., Washington.

— 1975. Couche de Zbilutka. Lexique Stratigraphique International, Europe, Pologne. CNRS (in press).

— 1977. Stratygrafia dolnego ordowiku z wybranych profilów rejonu Łeby (NW Polska), 1—11. MS, Archiwum Zakładu Nauk Geologicznych P.A.N., Warszawa.

BIERNAT, G. 1971. On branched surface spines in some inarticulate brachiopods. Palaeozoic perspectives: A palaeontological tribute to G. Arthur Cooper. — *Smith. Contr. Palaeobiol.*, **3**, 83—92.

— 1973. Ordovician inarticulate brachiopods from Poland and Estonia. — *Palaeont. Polonica*, **28** (1972), 1—116.

— and WILLIAMS, A. 1970. Ultrastructure of the protegulum of some acrotretid brachiopods. — *Palaeontology*, **13**, 491—502.

— and — . 1971. Shell structure of the siphonotretacean brachiopods. — *Ibidem*, **14**, 423—430.

CHLEBOWSKI, R. 1971. Petrografia utworów ordowiku rejonu synkliny bardziańskiej w południowej części Gór Świętokrzyskich (Petrography of the Ordovician deposits of the Bardo syncline in southern part of the Świętokrzyskie Mountains). — *Arch. Mineral.*, **29**, 1/2, 193—304.

COOPER, G. A. 1956. Chazyan and related brachiopods. — *Smiths. Misc. Coll.*, **127**, 2245.

CZARNOCKI, J. 1919. Stratygrafia i tektonika Gór Świętokrzyskich (Stratigraphy and tectonics of the Holy Cross Mts.). — *Prace Tow. Nauk. Warszawskiego*, **28**, 1—172.

GÓRKA, H. 1969. Microorganisms de l'Ordovicien de Pologne (Mikroorganizmy z ordowiku Polski). — *Palaeont. Polonica*, **22**, 1—102.

GORJANSKY, W. Ju. (ГОРЯНСКИЙ, В. Ю.) 1969. Беззамковые брахиоподы кембрийских и ордовикских отложений северо-запада Русской платформы. — Изд. „Недра", 3—126, Ленинград.

KOZŁOWSKI, R. 1948. Les graptolites et quelques nouveaux groupes d'animaux du Tremadoc de la Pologne. — *Palaeont. Polonica*, **3**, 1—235.

KRAUSE, F. F. and ROWELL, A. J. 1975. Distribution and systematic of the inarticulate brachiopods of the Ordovician carbonate mound of Meiklejohn Peak, Nevada. — *Paleont. Contr. Univ. Kansas*, **61**, 1—74.

LINDSTRÖM, M. 1971. Lower Ordovician Conodonts of Europe. — *Geol. Soc. America. Mem.*, **127**, 21—61.

POPOV, L. E. (ПОПОВ, Л. Е.) 1975. Беззамковые брахиоподы из среднего ордовика хребта Чингиз. — *Палеонт. жур.*, **4**, 32—41.

ROWELL, A. J. 1962. The genera of the brachiopod superfamilies Obolellacea and Siphonotretacea. — *J. Paleont.*, **36**, 136—152.

— 1965. Inarticulata. *In*: R. C. Moore (ed.), Treatise on Invertebrate Paleontology. Part H., 260—299, Univ. Press, Kansas.

— and KRAUSE, F. F. 1973. Habitat diversity in the Acrotretacea (Brachiopoda, Inarticulata). — *J. Palaeont.*, **47**, 791—800.

SAMSONOWICZ, J. 1916. Materiały do geologii Gór Świętokrzyskich. Kambr i kambrosylur Gór Świętokrzyskich (On the Cambrian rocks of the St. Cross Mountains, Poland). — *Spraw. Pos. Tow. Nauk. Warsz. Wydz. Mat.-Przyr.*, **9**, **4**, 322—351.

STARMACH, K. 1963. Blue-green algae from Tremadocian of the Holy Cross Mts, Poland). — *Acta Palaeont. Pol.*, **8**, 4, 451—460.

SURLYK, F. 1973. Autecology and taxonomy of two Upper Cretaceous craniacean brachiopods. — *Bull. Geol. Soc. Denmark*, **22**, 3, 213—219.

SZANIAWSKI, H. 1976. Konodonty w warstwach chalcedonowych dolnego ordowiku Gór Świętokrzyskich (streszczenie referatu). Materiały do II Naukowej Konferencji Paleont. etc. Kielce.

TOMCZYK, H. 1962. Problem stratygrafii ordowiku i syluru w Polsce w świetle ostatnich badań (Stratigraphic problem of the Ordovician and Silurian in Poland in the light of the recent studies). — *Prace Inst. Geol.*, **35**, 1—83.

TURNAU-MORAWSKA, M. 1958. Warstwy chalcedonowe tremadoku Gór Świętokrzyskich. Studium petrograficzne (Chalcedonites and associated rocks of the Tremadoc in the Holy Cross Mts, Central Poland. A petrographic study). — *Rocz. P. T. Geol.*, **27**, 169—193.

VAN WAMEL, W. A. 1974. Conodont biostratigraphy of the Upper Cambrian and Lower Ordovician of North-Western Öland, South-Eastern Sweden. — *Utrecht Micropaleont. Bull.*, **10**, 7—126.

VIIRA, V. (ВИЙРА, В.) 1974. Коногонты ордовика прибалтики. 3—140. Изд. „Валгус". Таллин.

WRIGHT, A. D. 1963. The fauna of the Portrane limestone. 1: The inarticulate brachiopods. — *Bull. Brit. Mus. Nat. Hist. Geol.*, **8**, 223—254.

WIESŁAW BEDNARCZYK I GERTRUDA BIERNAT

BRACHIOPODA INARTICULATA Z DOLNEGO ORDOWIKU GÓR ŚWIĘTOKRZYSKICH, POLSKA

Streszczenie

Opisany w pracy zespół brachiopodów bezzawiasowych pochodzi z szarobrunatnych wapieni należących do lokalnej zony *Acontiodus rectus sulcatus* (arenig), nawierconych i okresowo odsłoniętych w kamieniołomie na górze Bukówce koło Kielc (Bed-

narczyk 1971: fig. 1, 2). Zespół ten składający się z 10 gatunków, w tym 6 nowych, charakteryzuje się przewagą przedstawicieli rodziny Acrotretidae, którą reprezentuje 7 rodzajów (tabela 1). Rodzinę Obolidae sygnalizują dwa rodzaje, w tym jeden nowy, a rodzinę Eoconulidae jeden rodzaj i jeden gatunek. Współwystępujące z brachiopodami konodonty (tabela 2) umożliwiają korelację tej części zony *Acontiodus rectus sulcatus* ze skandynawską zoną *Baltoniodus trangularis* + *Baltoniodus navis* (Lindström 1971).

Starszy od wymienionego zespół brachiopodów napotkano w mułowcach i chalcedonitach miejscowej zony *Lingulella zejszneri* (Bednarczyk 1971; Biernat 1973). Jest on bardziej zróżnicowany niż zespół z arenigu gdyż obejmuje 21 gatunków należących do 16 rodzajów i 6 rodzin. Dominują w nim gatunki z rodziny Obolidae. Jest ich w zespole 11 zgrupowanych w 5 rodzajów. Drugą co do stopnia zróżnicowania jest rodzina Acrotretidae licząca 5 rodzajów i 6 gatunków. Pozostałe rodziny reprezentowane przez pojedyńcze gatunki to: Acrothellidae, Discinidae i Paterulidae (tabela 1). Towarzyszące brachiopodom tej zony konodonty (tabela 2) wskazują, że jej dolna część, podzona *Thysanotos siluricus*, odpowiada skandynawskiej zonie *Paltodus deltifer* (Lindström 1971).

Brachiopody bezzawiasowe żyjące w zbiorniku świętokrzyskim były formami epibiotycznymi, przytwierdzającymi się do alg, wraz z którymi mogły być przenoszone przez prądy. Niektóre z nich np: Acrotretidae przytwierdzały się do alg rosnących na dnie basenu przy pomocy nóżki, inne jak np. Siphonotretidae dodatkowo za pośrednictwem często rozgałęzionych kolców. Niewykluczone, że pewne brachiopody mogły przytwierdzać się do bentonicznych dendroidów. Wydaje się, że Eoconulidae żyły na lokalnych twardych dnach tworzących się we wstępnym stadium diagenezy (Rowell i Krause 1973). Na dnie leżały swobodnie, lub były doń przycementowane co sugeruje duża ilość zachowanych w stanie kopalnym skorupek z uszkodzonym umbo.

ВЕСЛАВ БЕДНАРЧИК, ГЭРТРУДА БЕРНАТ

BRACHIOPODA INARTICULATA НИЖНЕГО ОРДОВИКА СВЕНТОКШИСКИХ ГОР (ПОЛЬША)

Резюме

В статье описан сбор беззамковых брахиопод из серобурых известняков, принадлежащих к локальной зоне *Acontiodus rectus sulcatus* (аренит) и пробуренных и частично обнажённых в каменоломнях на горе Букувка около Кельц (Bednarczyk 1971: фиг. 1, 2).

Сбор состоит из 10 видов, в том 5 новых и характеризуется преобладанием семейства Acrotretidae, которые представляют собой 7 родов (таблица 1). Семейство

Obolidae представлено двумя родами, из них один новый, а семейство Eoconulidae одним родом и одним видом. Совместно выступающие с брахиоподами конодонты (таблица 2) позволяют сделать корреляцию этой части зоны *Acontiodus rectus sulcatus* со скандинавской зоной *Baltoniodus triangularis* + *Baltoniodus navis* (Lindström 1971).

Более старый по сравнению с выше указанным сбор брахиопод обнаружен в аргилитах и халцедонитах местной зоны *Lingulella zejszneri* (Bednarczyk 1971; Biernat 1973). Он является более разнородным по сравнению со сбором из аренига, так как он содержит 21 видов, принадлежащих до 16 родов и 6 семейств. В нём преобладают виды семейства Obolidae в количестве 11, группирующих 5 родов. Другим по степени разнородности является семейство Acrotretidae, включающие 5 родов и 6 видов. Остальные семейства представлены единичными видами, а именно: Acrothellidae, Discinidae, Paterulidae (таблица 1). Сопутствующие брахиоподам конодонты в этой зоне (таблица 2) указывают, что её нижняя часть, субзона *Thysanotos siluricus*, соответствует скандинавской зоне *Paltodus deltifer* (Lindström 1971). Беззамковые брахиоподы, живущие в свентокшиском бассейне были эпибионтными формами, прикреплёнными к альгам, совместно с которыми могли быть несены течениями. Некоторые из них, например Acrotretidae, прикреплялись ножкой к альгам, живущим на дне бассейна, другие, как например Siphonotretidae дополнительно используя широкоразветвлённые шипы. Неисключено, что некоторые брахиоподы могли прикрепляться к бентонным дендроидам. Возможно, что Eoconulidae жили на локальных твёрдых днах, образовавшихся в начальных стадиях диагенеза (Krause и Rowell 1973). Они лежали свободно на дне или были к нему прицементированы. Указывает на это большое количество створок с повреждённым умбом.

EXPLANATION OF THE PLATES 17—22

Plate 17

All figures × 36

Rowellella distincta sp.n.

1. *a* external, *b* lateral and *c* internal views of incomplete brachial valve. Holotype. ZPAL Bp.XXVII/25.
2. *a* exterior and *b* interior of brachial valve with posterior part damaged. Paratype. ZPAL Bp.XXVII/24.

Quasithambonia rarispinosa gen. et sp.n.

3. *a* exterior and *b* interior of a pedicle valve. ZPAL Bp.XXVII/1.
4. *a* exterior and *b* interior of a pedicle valve. Holotype. ZPAL Bp.XXVII/2.
5. Exterior of a damaged brachial valve with fragments of the surface spines. ZPAL Bp.XXVII/2*a*.

Spondylotreta maior sp.n.

6. *a* exterior and *b* interior of a brachial valve. ZPAL Bp.XXVII/16.

Plate 18

All figures × 36

Conotreta cf. *czarnockii* Bednarczyk

2. *a* exterior and *b* interior of a brachial valve. ZPAL Bp.XXVII/43.

Spondylotreta maior sp.n.

1, 3, 5, 7. Four ventral umbonal fragments with preserved internal structure. ZPAL Bp.XXVII/50, 39, 21, 20.
4. *a* oblique and *b* ventral views of a brachial valve. Paratype. ZPAL Bp.XXVII/17.
6. *a* external and *b* umbonal views of damaged pedicle valve, pallial sinuses well preserved. Holotype. ZPAL BpXXVII/19.
8. Interior of a brachial valve damaged marginally. ZPAL Bp.XXVII/18.

Scaphelasma bukowkense sp.n.

9. Apical wiew of a pedicle valve. ZPAL Bp.XXVII/12.

Plate 19

All figures × 36

Scaphelasma bukowkense sp.n.

1. *a* external and *b* internal views of a complete brachial valve. ZPAL Bp.XXVII/40b.
2. Exterior of the brachial valve. ZPAL Bp.XXVII/40b.
3, 4. *a* external, *b* ventral and *c* oblique views of two adult brachial valves. ZPAL Bp.XXVII/15; ZPAL Bp.XXVII/14.
5. *a* external and *b* internal views of adult brachial valve. Holotype. ZPAL Bp.XXVII/13.
6. *a* apical, *b* anterior and *c* interior views of a pedicle valve. Paratype. ZPAL Bp.XXVII/11.

Semitreta sp.

7. Incomplete brachial valve interior slightly anchylosed in the anterior direction. ZPAL Bp.XXVII/5.

Plate 20

All figures × 36

Torynelasma rossicum Gorjansky

1. *a* ventral and *b* oblique views of a brachial valve damaged marginally. ZPAL Bp.XXVII/49.
2. Incomplete pedicle valve in lateral view. ZPAL Bp.XXVII/26.
9. *a* anterior and *b* interior of adult brachial valve. ZPAL Bp.XXVII/48.

Eurytreta intermedia Biernat

3, 6. Two brachial valves in external (*3a*), ventral (*3b*, *6*) and oblique (*3c*) views. *3b*, *c* × 60; *3a*, *b* × 36. ZPAL Bp.XXVII/31, 33.

Semitreta sp.

5. *a* brachial valve interior, × 36, *b* exterior of the same valve, × 60. ZPAL Bp.XXVII/42.

Myotreta crassa Gorjansky

4. Adult brachial valve exterior (*a*), × 36; the same valve enlarged in ventral (*b*) and oblique (*c*) views, × 60. ZPAL Bp. XXVII/36.
7, 8. Two pedicle valves in lateral (*7a*) and dorsal (*7b*, *8*) views, × 36. ZPAL XXVII/22, 23.

Eoconulus dyminensis sp.n.
All figures × 36

10, 11, 12. Exterior (*10*, *12*) and interior (*11*) of three brachial valves, their size being slightly differentiated. ZPAL Bp.XXVII/45, 29, 30.

Plate 21

All figures × 36
Ephippelasma spinosum Biernat

1, 4. Two adult specimens. *1* with partly preserved pedicle valve in *a* ventral and *b* oblique views. *4* almost complete articulated shell in *a* posterior and *b* lateral views. The specimens are used for comparison and come from Szczawno Boring, North of Poland. ZPAL Bp.XXVII/4, 5.
2, 5, 7, 10. Exterior (*2a*) and interior (*2b*, *5*, *7*, *10*) of the brachial valves. ZPAL Bp.XXVII/9, 38, 38*a*, 37, 10.
3, 11. Two old brachial valves in *a* ventral and *b* anterior views. ZPAL Bp.XXVII/8, 7.
6, 9. Oblique view of two brachial valves. ZPAL Bp.XXVII/9, 26.
12. *a* ventral and *b* oblique views of adult brachial valve. ZPAL Bp.XXVII/6.
13. *a* internal and *b* posterior views of complete pedicle valve. ZPAL Bp.XXVII/3.

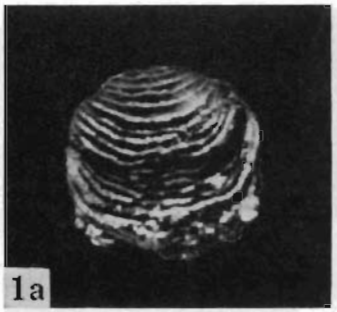
Plate 22

All figures × 36
Eurytreta intermedia Biernat

1. *a* adult brachial valve in external, *b* internal and *c* oblique views. ZPAL Bp.XXVII/33a.
2. Interior of a brachial valve. ZPAL Bp.XXVII/12.

Eoconulus dyminensis sp.n.

3—5. Complete brachial valves in *a* external and *b* internal views; cardinal muscle scars preserved (*3b*, *4b*). *3* holotype, ZPAL Bp.XXVII/27; *4* paratype, ZPAL Bp.XXVII/35; and specimen ZPAL Bp.XXVII/28.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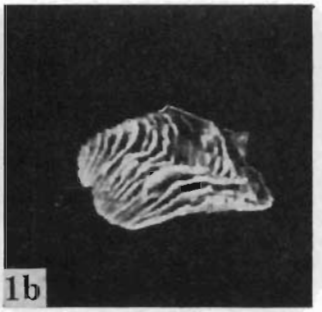
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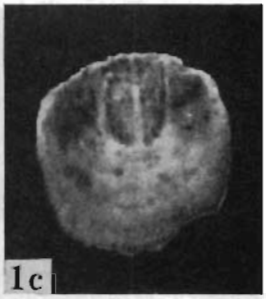
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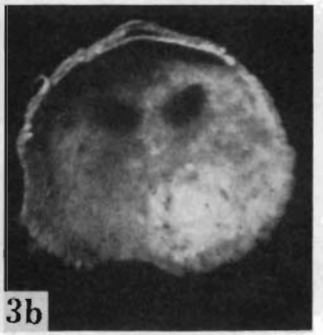
3a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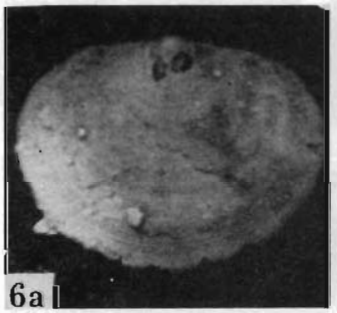
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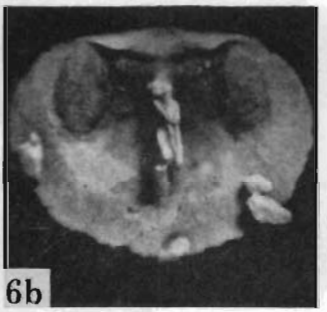
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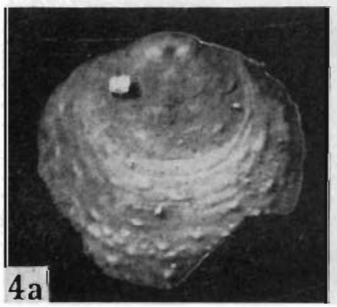
2b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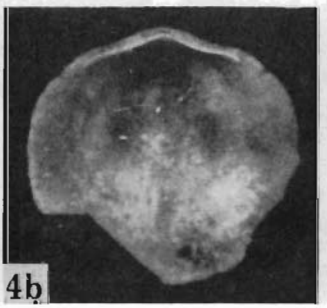
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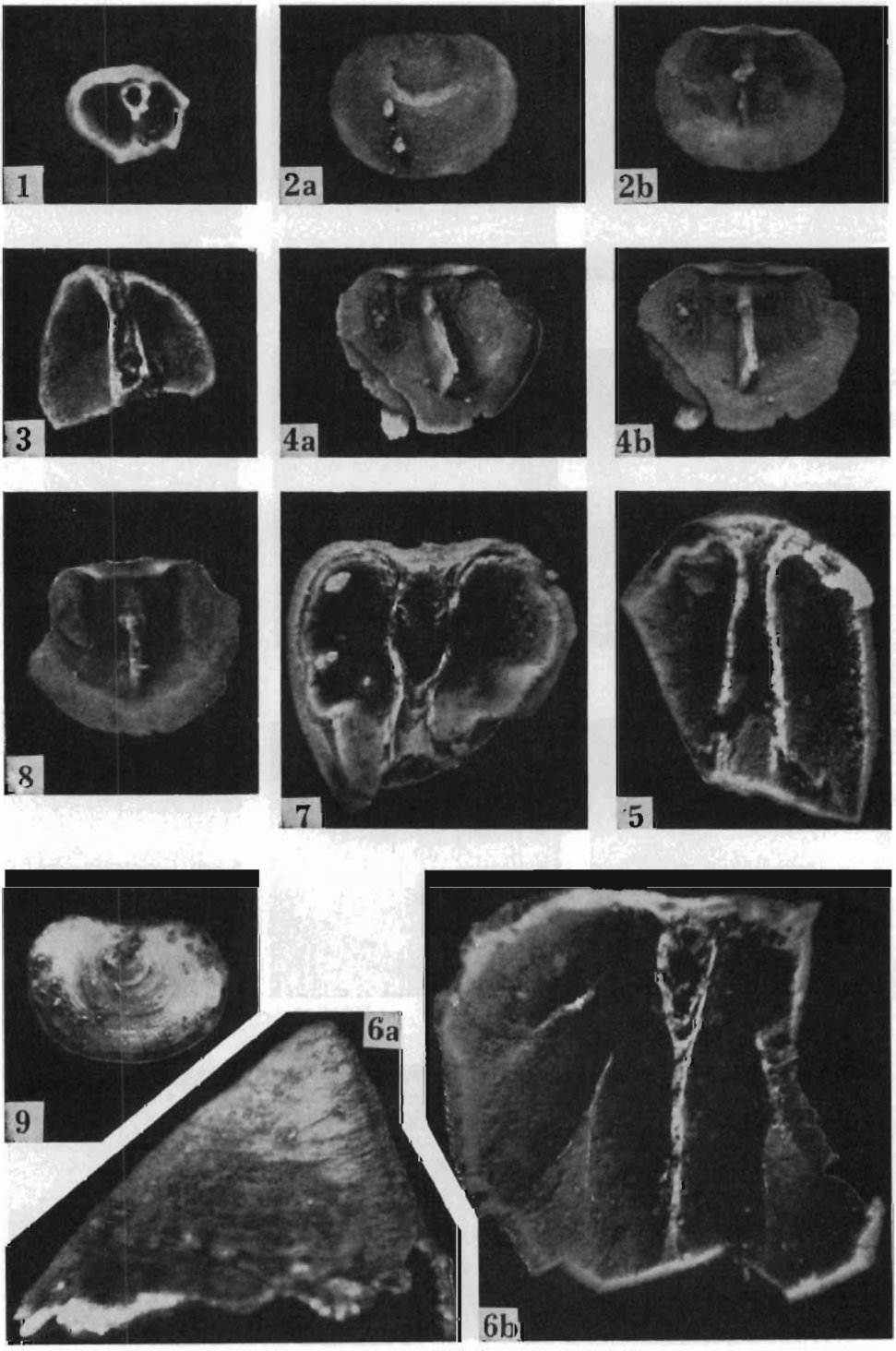
5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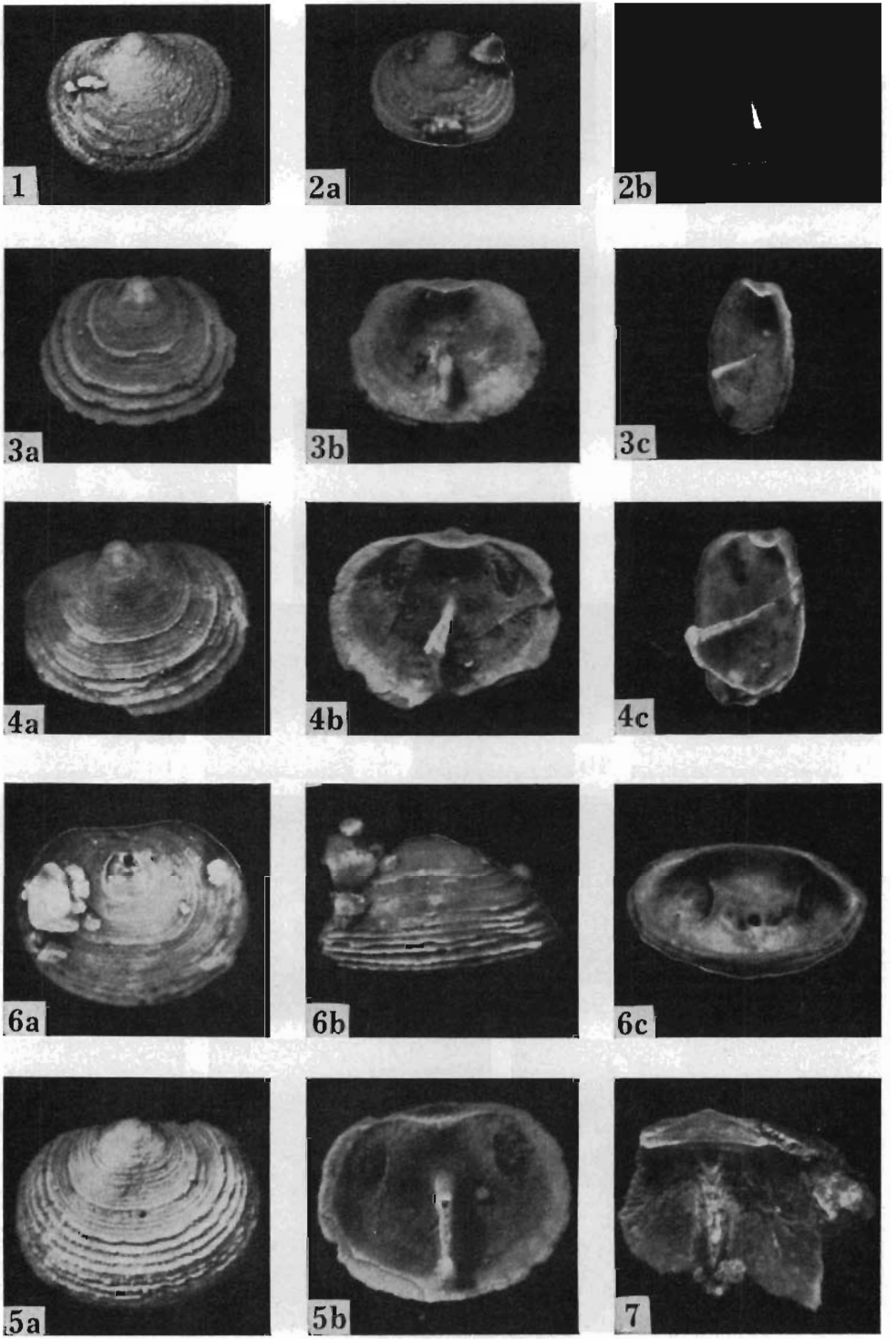
2b
3
4a
4b
8
7
5
9
6a
6b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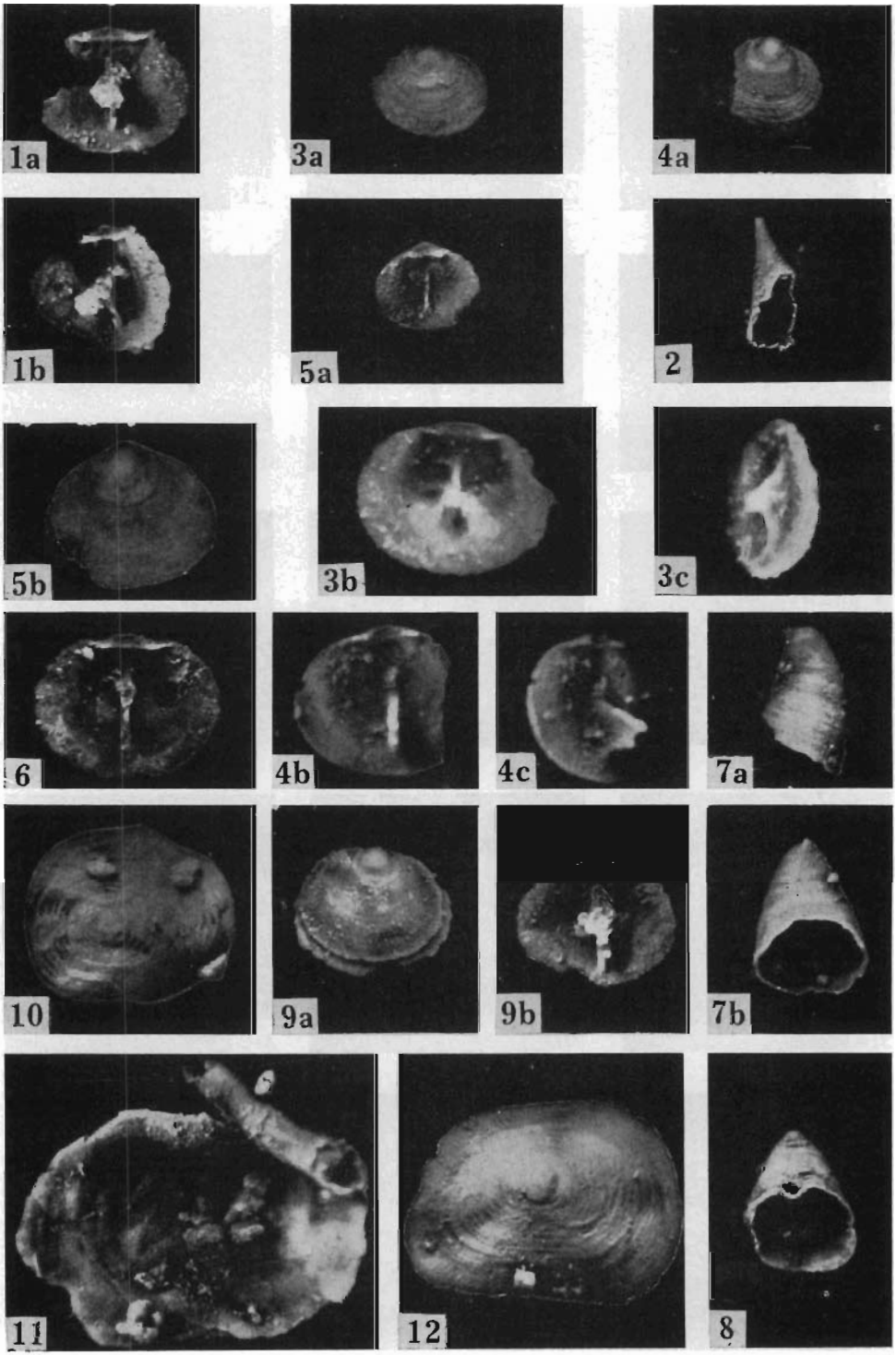
3a
3b
3c
4a
4b
4c
6a
6b
6c
5a
5b
7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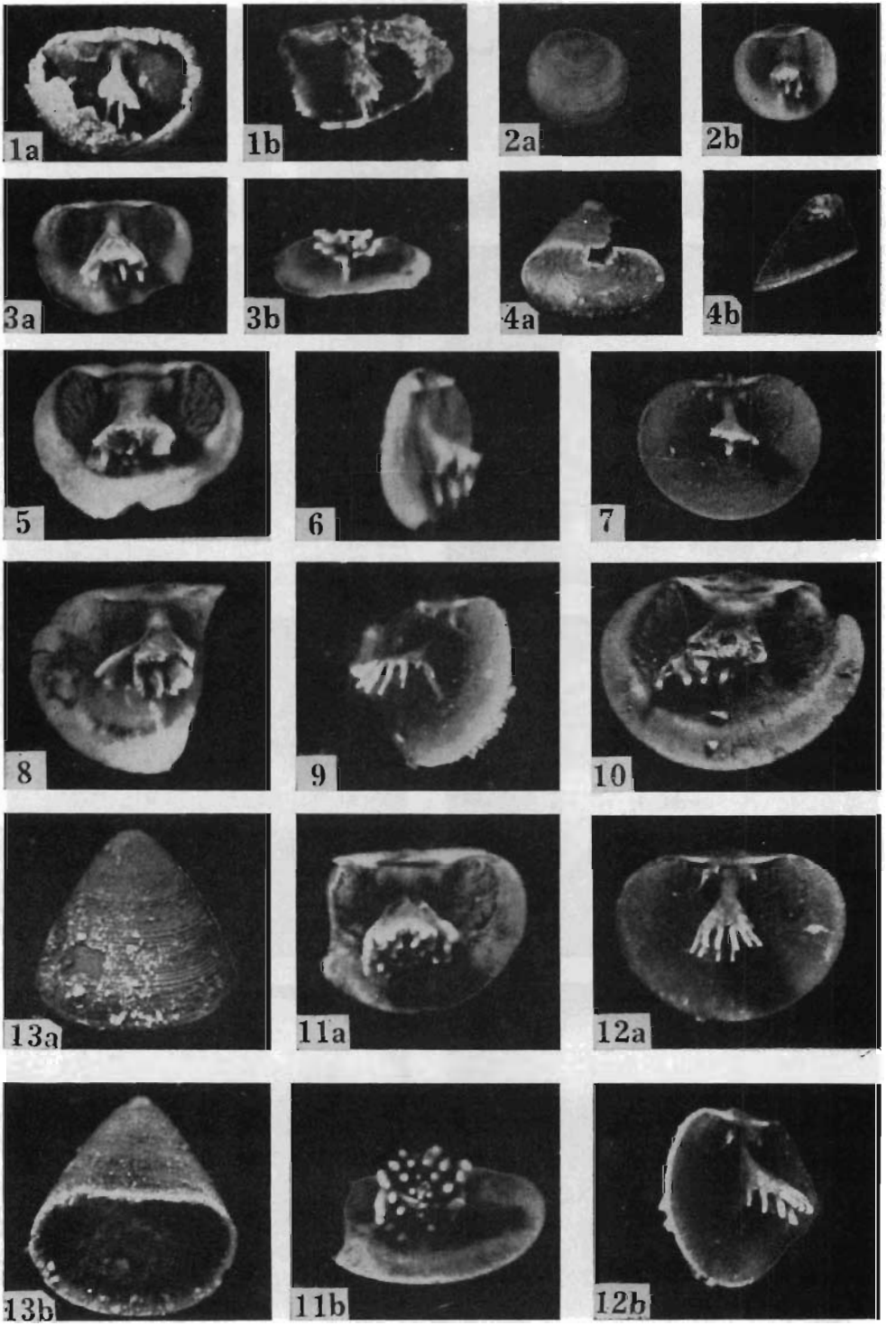
7b
11
12
8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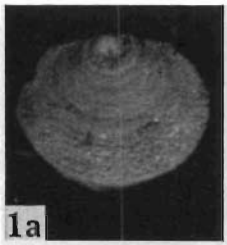
11b
12b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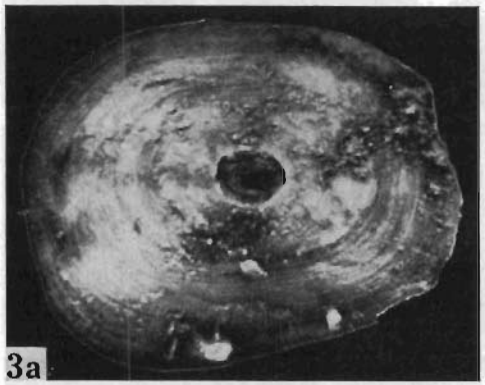
1b


1c


2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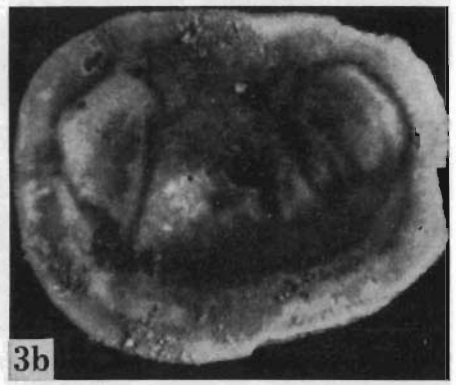
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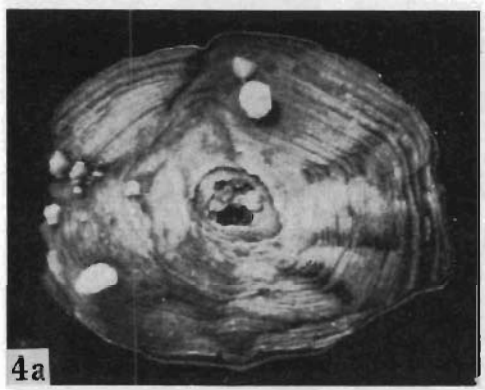
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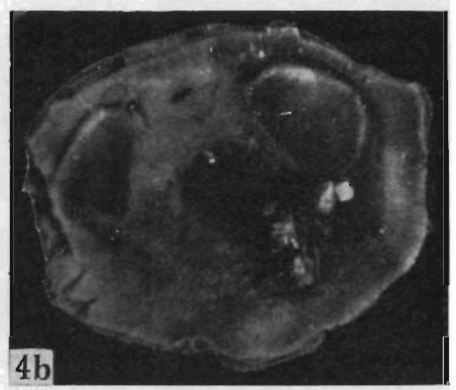
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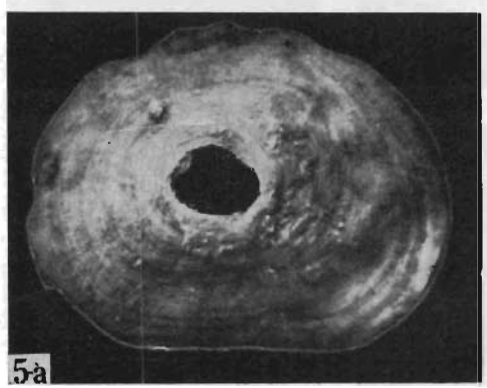
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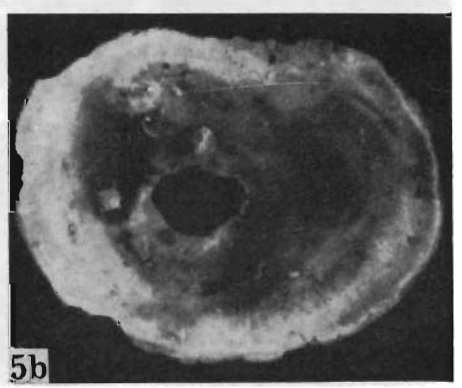
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