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## Some new fish otoliths from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland)

**ABSTRACT:** The assemblages of fish otoliths from littoral facies of the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland) contain numerous taxa unknown from the basinal facies of the Korytnica Clays. Eight species are new: *Ariosoma longicaudatum* sp. n., *Echelus arcuatus* sp. n., *Platycephalus fusculus* sp. n., *Argyrosomus incisus* sp. n., *A. polonicus* sp. n., *Cepola multicrenata* sp. n., *Liza steurbauti* sp. n., and *Sphyræna dentata* sp. n. Three genera have not hitherto been reported from the Korytnica Basin (*Echelus*, *Platycephalus*, and *Liza*). All the investigated taxa represent littoral fishes of tropical and/or subtropical climatic zones, and some of them (*Platycephalus*) bear Indo-Pacific bioprovince affinities.

### INTRODUCTION

The aim of the present paper is to supplement the previous data on the ubiquitous fish otoliths (FRIEDBERG 1924; CHAINE & DUVERGIER 1928; ŚMIGIELSKA 1966, 1979) occurring in the world-famous Korytnica Clays developed within the Middle Miocene (Badenian) Korytnica Basin on the southern slopes of the Holy Cross Mountains, Central Poland.

The investigated material comes from the littoral facies of the Korytnica Clays, exposed in two localities in the village Korytnica (see Text-fig. 1), viz. Mt. Lysa (*Ly* in Text-fig. 1A), and Korytnica-Plebania (*Pn* in Text-fig. 1A). The recognized assemblages contain most of the otolith taxa known from the Korytnica Clays, but they also display numerous forms absent in the Clays. Some of these forms represent the new taxa of the specific rank. Moreover, a few of the recognized genera have not hitherto been reported from any locality of the Fore-Carpathian area in southern Poland, and the two investigated littoral facies of the Korytnica Basin may therefore be regarded as their spatial refuges in the Middle Miocene (Badenian) sea which encroached upon the southern slopes of the Holy Cross Mountains.

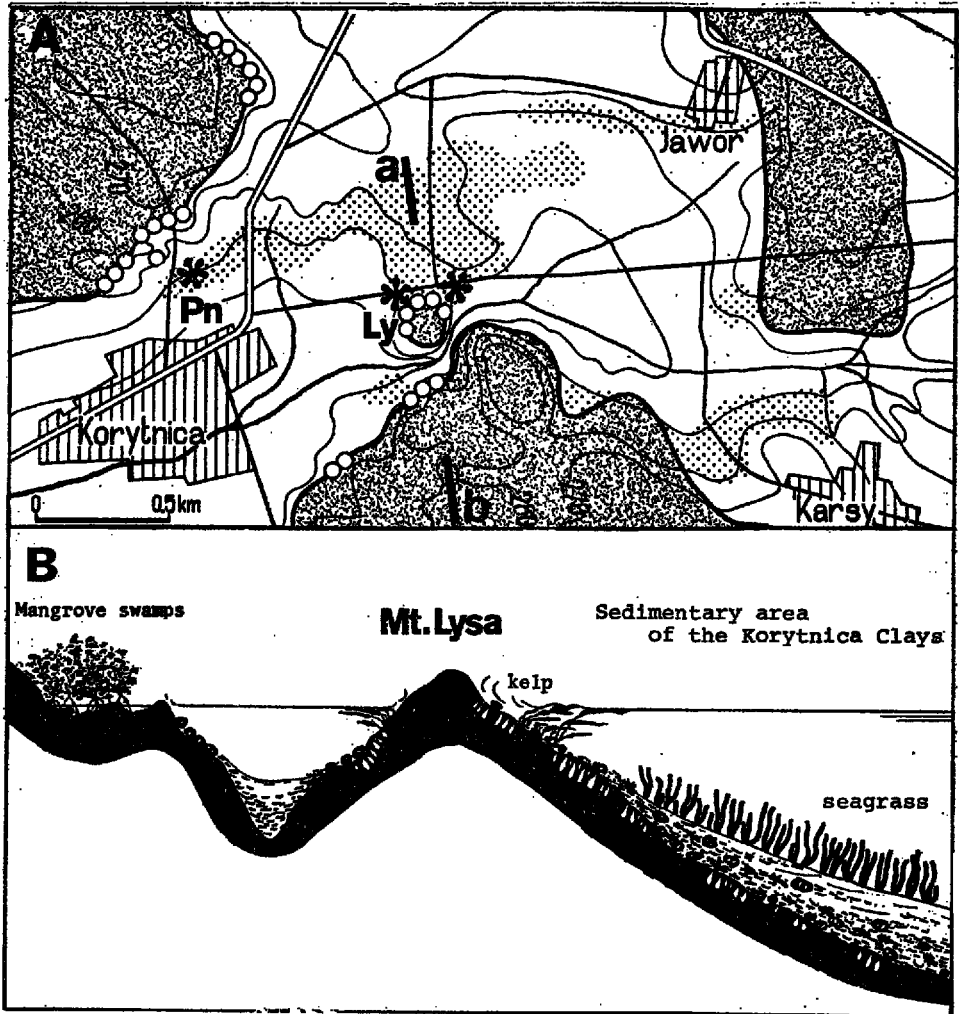


Fig. 1

**A** — Paleoenvironmental sketch of the southern part of the Korytnica Basin, to show localities yielding the investigated assemblages of fish otoliths: Ly — Mt. Lysa, Pn — Korytnica-Plebania; asterisked are the sampling sites; leaders (a—b) denote the line of the section presented in B

Within the sketch indicated are: marine area of the basin during the Middle Miocene (Badenian) transgression (blank), present-day outcrops of the Korytnica Clays (stippled), preserved fragments of littoral structures (circled), and land or island areas along the seashore (hatched); adopted from BAŁUK & RADWAŃSKI (1977, Text-fig. 2)

**B** — Idealized section of the shorezone at Mt. Lysa, to show the environmental conditions under which the investigated fishes have lived: the rocky bottom (Upper Jurassic limestones) damaged by gregarious rock-borers is covered by clayey, oyster shellbed containing littoral rubble, and overgrown by seagrass meadows; and by kelp at the water surface; adopted from BAŁUK & RADWAŃSKI (1977, Text-fig. 5)

The otolith-bearing deposits of Korytnica are developed at Mt. Lysa as clayey, oyster shellbed replete with highly diversified paleontological content (see BAŁUK & RADWAŃSKI 1977, RADWAŃSKA 1982, RADWAŃSKA & RADWAŃSKI 1984), and at the locality Korytnica-Plebania as clays with shell content, the composition of which much deviates from that occurring in the basinal facies of the Korytnica Clays (see BAŁUK 1984).

#### FREQUENCY AND PRESERVATION OF THE OTOLITHS

Contrary to the fish otoliths known from the Korytnica Clays (cf. ŚMIGIELSKA 1979, RADWAŃSKA 1982), all the herein introduced taxa are represented by a low number of individuals. Taking into account the comparable sample volume, the sieving and sifting procedure of which yielded the investigated otolith material, these new taxa correspond to the fish species relatively very rare in the Korytnica Basin. The same concerns the allies of the new taxa, which are also reported in the present paper.

All the investigated fish otoliths (see Text-figs 2—22 and Pls 1—5) represent the sagittae, and other stones of the audial apparatuses have not been obtained.

The state of preservation of the collected otoliths is remarkably good, although some of those from the Mt. Lysa locality are superficially corroded by subsoil leaching.

#### SYSTEMATIC ACCOUNT

##### Order Anguilliformes

##### Suborder Anguilloidei

##### Family Congridae

##### Genus *Ariosoma* SWAINSON, 1838

##### *Ariosoma longicaudatum* sp. n.

(Text-figs 2—3 and Pl. 1, Figs 1—3)

1979. *Conger muraena balearica* (De la ROCHE); T. ŚMIGIELSKA, pp. 303—304, Text-fig. 7 and Pl. 2, Figs 1—2.

1981. *Ariosoma* aff. *balearicum* (DELAROCHE, 1809); E. STEURBAUT, p. 4, Pl. 1, Figs 15—16.

**HOLOTYPE:** The specimen presented in Text-fig. 2 and Pl. 1, Fig. 1.

**TYPE LOCALITY:** Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**TYPE HORIZON:** Middle Miocene (Badenian).

**DERIVATION OF THE NAME:** Latin adjective *longicaudatum*, after elongated shape of the cauda.

**MATERIAL:** 15 specimens, in majority well preserved.

## DIMENSIONS (in mm):

Figured in:		L	H	T
Pl. 1	Text-figs 2-3			
Fig. 1	Fig. 2	5	4.5	1.4
Fig. 2	Fig. 3, Item 1	4.5	4	1.3
Fig. 3	Fig. 3, Item 4	4.5	4	1.2
—	Fig. 3, Item 3	4	3.5	1.2
—	Fig. 3, Item 2	3.5	3	1.1

**DIAGNOSIS:** Otoliths rhomboid in outline, elongated parallelly to sulcus acusticus; inner side convex, smooth; sulcus acusticus horizontal long, and narrow; crista superior slightly, and crista inferior distinctly bowed; the latter swollen in its posterior part; area present below the highly arched dorsal margin of sagitta; outer side convex and featured with a central node.

**DESCRIPTION:** Otoliths are rhomboid in outline, biconvex, with their dorsal margin more convex than the other margins; anterior margin is straight and slightly concave, and ventral margin is symmetrically convex. Inner side is smooth

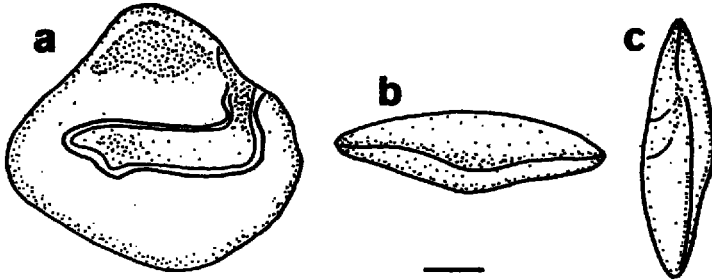


Fig. 2. *Ariosoma longicaudatum* sp. n.; holotype (left sagitta) a inner side, b lateral view, c anterior view; scale bar 1 mm

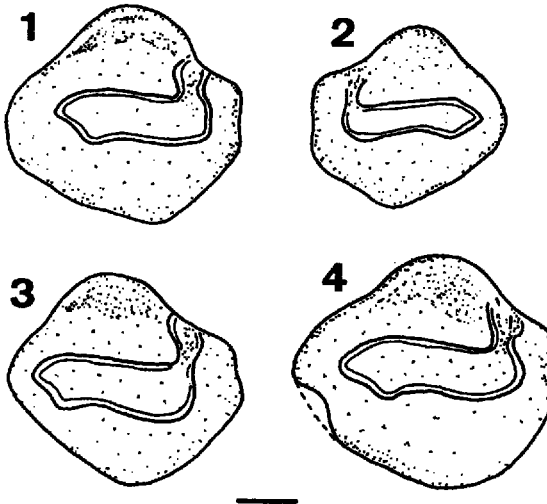


Fig. 3. *Ariosoma longicaudatum* sp. n.; paratypes 1 and 3-4 left sagitta, 2 right sagitta; all from inner side; scale bar 1 mm.

and uniformly convex. Sulcus acusticus is horizontal and bears long, narrow, and sharply tipped cauda. Crista superior is straight or very indistinctly bowed. Crista inferior is S-shaped, and distinctly bowed and swollen in its posterior part. Aperture of sulcus acusticus is distinct towards dorsal margin, and developed as a small, narrow canal which widens in its upper part. Area, present below dorsal margin, is elongated and tapers posteriorly. Outer side is convex and featured with a broad central node.

REMARKS: Otoliths of the newly established species, *Ariosoma longicaudatum* sp. n., are close to the present-day species *Ariosoma balearicum* (DELAROCHE, 1809), differing (see Text-fig. 4) in a more irregular outline of sagitta, in longer,

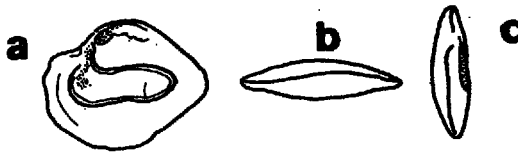


Fig. 4. *Ariosoma balearicum* (DELAROCHE, 1809): a present-day specimen, right sagitta (redrawn from: STEURBAUT 1981, Pl. 2, Fig. 3)  
a inner side, b lateral view, c anterior view; scale bar 1 mm

narrower and sharply tipped sulcus acusticus, in straight course of crista superior, and in having crista inferior more distinctly arched.

The new species differs from *Ariosoma moravicum* (ŠULC, 1932), known from the Miocene deposits of Moravia (cf. ŠULC 1932, p. 169, Text-fig. 2), in the outline more elongated parallelly to sulcus acusticus, in structure of sulcus acusticus, and in well developed area. It also differs from *Ariosoma globosum* (STEURBAUT, 1981), known from the Oligocene deposits of Aquitaine (cf. STEURBAUT 1981, Pl. 1, Figs 17—20), in general outline, in inner side more flat, and in having its outer side pronouncedly more convex.

To the synonymy of the new species, *Ariosoma longicaudatum* sp. n., included are the otoliths from the Korytnica Basin, described by SMIGIELSKA (1979) as *Congermuraena balearica* (De la ROCHE), and those from the Miocene deposits of the Aquitaine Basin, described by STEURBAUT (1981, p. 4) as *Ariosoma* aff. *balearicum* (DELAROCHE, 1809), which differ from *Ariosoma balearicum* (DELAROCHE, 1809) by irregular outline of sagitta, more elongated and narrower cauda, and by shape of both crista superior and crista inferior.

OCCURRENCE: Outside the Korytnica Basin, the newly established species is recognized only in the Miocene of Aquitaine (cf. STEURBAUT, 1981).

#### *Ariosoma* cf. *moravicum* (ŠULC, 1932)

(Text-fig. 5 and Pl. 2, Fig. 2)

MATERIAL: One, badly preserved specimen.

DESCRIPTION: Otoliths circular in outline. Inner side is convex and smooth; sulcus acusticus is horizontal, broad, and rounded at its end; both crista superior and crista inferior are straight in their course; oval area is developed below the dorsal margin. Outer side is symmetrically convex.

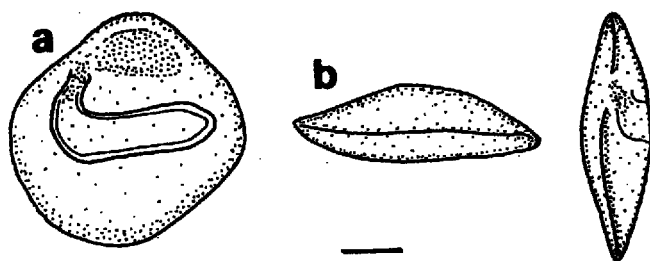


Fig. 5. *Ariosoma* cf. *moravicum* (ŠULC, 1932); right sagitta  
a inner side, b lateral view, c anterior view; scale bar 1 mm.

REMARKS: The investigated otolith, due to its shape and structure of sulcus acusticus, is close to *Ariosoma moravicum* (ŠULC, 1932). Its imperfect preservation state does not however allow to state the identity with the latter.

### Family Ophichtidae

Genus *Echelus* RAFINESQUE, 1810

*Echelus arcuatus* sp. n.

(Text-fig. 6 and Pl. 2, Fig. 3)

HOLOTYPE: The specimen presented in Text-fig. 6 (item 1) and Pl. 2, Fig. 3.

TYPE LOCALITY: Mt. Lyssa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

TYPE HORIZON: Middle Miocene (Badenian).

DERIVATION OF THE NAME: Latin adjective *arcuatus*, after arched shape of the cauda.

MATERIAL: 7 specimens, slightly eroded at the surface.

DIMENSIONS (in mm):

	Figured in:		L	H	T
	Pl. 2	Text-fig. 6			
Fig. 3		Item 1	4	2.1	0.9
—		Item 2	4	2.3	0.9
—		Item 3	4.2	2.5	0.9

DIAGNOSIS: Otoliths oval in outline; inner side arched and smooth; sulcus acusticus horizontal, divided into long, narrow and arched cauda, and oval ostium which is wider and shorter; anterior margin featured with deep excisura, antirostrum, and large rounded rostrum; outer side flat.

DESCRIPTION: Otoliths are thick, oval to slightly trapezoid in outline. Dorsal margin is straight, with well developed antero-dorsal corner; ventral margin is symmetrically arched, and anterior margin is straight. Inner side is arched and smooth. Sulcus acusticus is horizontal, divided into long, narrow, and arched cauda, and deep ostium of oval shape, twice shorter than cauda. Anterior margin is featured with deeply incised excisura, antirostrum, and large rounded rostrum. Outer side is flat or slightly convex centrally.

REMARKS: Otoliths of the newly established species, *Echelus arcuatus* sp. n., are close to the present-day species *Echelus myrus* (LINNAEUS, 1758), differing (see Text-fig. 7) in better developed antero-dorsal corner, deep excisura, antirostrum, more pronounced rostrum, and in strongly arched cauda.

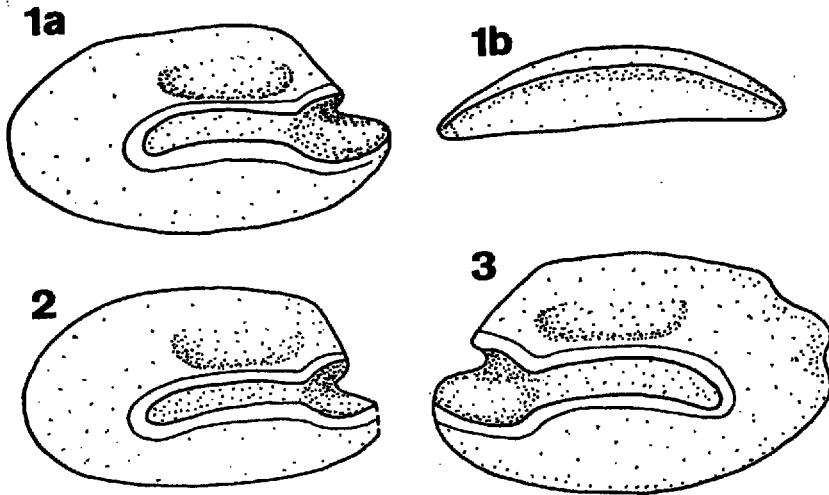


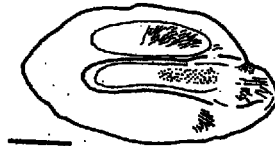
Fig. 6. *Echelus arcuatus* sp. n.

1 — holotype (left sagitta): 1a inner side, 1b lateral view; 2-3 — paratypes: 2 left sagitta, 3 right sagitta, both from inner side; scale bar as for Text-fig. 8

The new species differs from *Echelus* aff. *myrus* (LINNAEUS, 1758), described from the Miocene deposits of the Aquitaine Basin (STEURBAUT 1981, p. 12), in having deep excisura, more strongly arched cauda, and broader ostium.

Fig. 7

*Echelus myrus* (LINNAEUS, 1758): a present-day specimen, left sagitta (redrawn from: STEURBAUT 1981, Pl. 3, Fig. 11), taken from inner side; scale bar 1 mm



Order Scorpaeniformes  
Suborder Platycephaloidei  
Family Platycephalidae  
Genus *Platycephalus* BLOCH, 1795

*Platycephalus poyartinensis* STEURBAUT, 1981  
(Text-fig. 8 and Pl. 2, Figs 1a—b)

1981. *Platycephalus poyartinensis* n. sp.; E. STEURBAUT, p. 65, Pl. 17, Figs 17—19.

MATERIAL: 7 specimens, in majority well preserved.

REMARKS: The investigated otoliths are identical with the holotype of the species (see STEURBAUT 1981, Pl. 17, Fig. 17).

OCCURRENCE: The species has hitherto been known only from the Miocene of Aquitaine (STEURBAUT 1981).

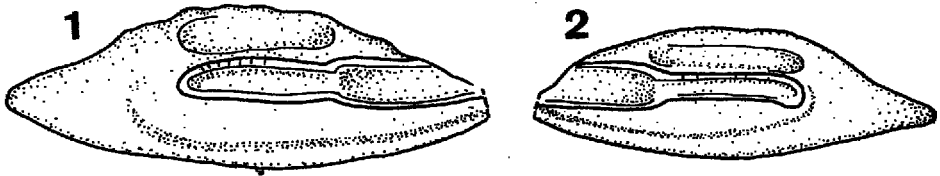


Fig. 8. *Platycephalus poyartinensis* STEURBAUT, 1981  
1 left sagitta, 2 right sagitta; both from inner side; scale bar 1 mm

*Platycephalus fusiculus* sp. n.

(Text-fig. 9 and Pl. 1, Figs 4a—b, 5a—b)

**HOLOTYPE:** The specimen presented in Text-fig. 9 (Item 1) and Pl. 1, Fig. 4a—b.

**TYPE LOCALITY:** Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**TYPE HORIZON:** Middle Miocene (Badenian).

**DERIVATION OF THE NAME:** Latin noun *fusiculus* (a small spindle), after general outline of the sagitta.

**MATERIAL:** 11 specimens with their rostral parts damaged.

**DIMENSIONS (in mm):**

Figured in:		L	H	T
Pl. 1	Text-fig. 9			
Fig. 4a—b	Item 1	7	2.2	0.5
Fig. 5a—b	Item 2	8	2	0.5
—	Item 3	—	1.8	0.4

**DIAGNOSIS:** Otoliths fusiform in outline; dorsal margin straight; both antero- and postero-dorsal corners strongly developed; posterior margin much elongated and sharply ended; inner side convex; sulcus acusticus divided into long narrow and slightly arched cauda, and shorter but broad ostium; enough deep area developed above crista superior; ventral groove well advanced; outer side concave.

**DESCRIPTION:** Otoliths are much elongated, fusiform in outline. Dorsal margin is straight, slightly swollen in its posterior part. Both antero- and postero-

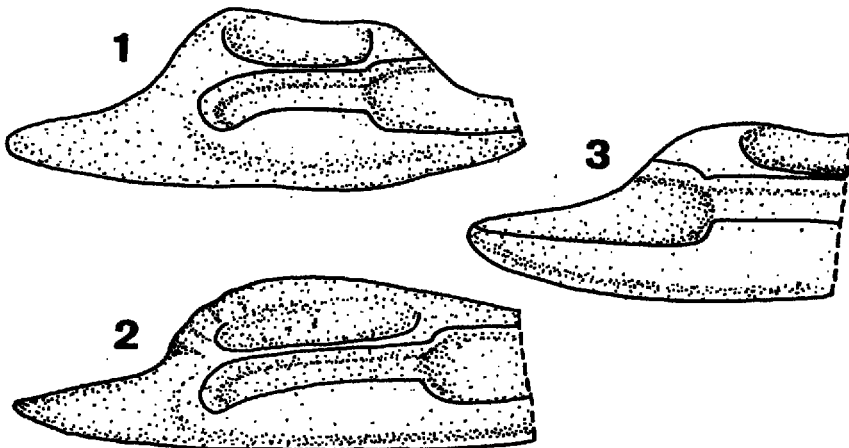


Fig. 9. *Platycephalus fusiculus* sp. n.

1 — holotype (left sagitta), inner side; 2-3 — paratypes: 2 left sagitta, 3 right sagitta, rostral part; both from inner side; scale bar 1 mm

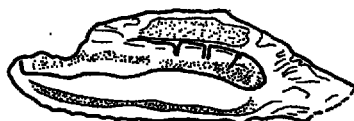


-dorsal corners are strongly developed. Posterior margin is much elongated and sharply ended. Inner side is convex. Sulcus acusticus is horizontal, and divided into long, slightly arched cauda, and shorter but broad ostium. Anterior margin featured with shallow excisura and long, sharp rostrum. Enough deep area occurs above crista superior. Ventral groove is well advanced. Outer side is concave.

REMARKS: Otoliths of the newly established species, *Platycephalus fusciculus* sp. n., are comparable to the present-day species *Platycephalus cirronasus* RICHARDSON, 1848, differing (see Text-fig. 10) in postero-dorsal corner better developed, broader and deeper ostium, and in crista superior more arcuated at the cauda/ostium junction.

Fig. 10

*Platycephalus cirronasus* RICHARDSON, 1848: a present-day specimen, right sagitta (redrawn from: STEURBAUT 1981, Pl. 17, Fig. 20), taken from inner side; scale bar as for Text-fig. 7



The new species differs also from the other ancient species of the genus, particularly from the above reported *Platycephalus poyartinensis* STEURBAUT, 1981, and from *P. lafondi* STEURBAUT, 1981 (see STEURBAUT 1981, p. 64 and Pl. 17, Fig. 14) in more advanced antero- and postero-dorsal margins, and in proportions between cauda and ostium.

### Order Perciformes

### Suborder Percoidei

### Family Sciaenidae

### Genus *Argyrosomus* De la PYLAIE, 1835

### *Argyrosomus incisus* sp. n.

(Text-fig. 11 and Pl. 3, Figs 1a—c, 2a—c)

1979. *Sciaena* cf. *aquila* LACÉPÈDE; T. SMIGIELSKA, p. 318, Pl. 7, Fig. 1a—c.

HOLOTYPE: The specimen presented in Text-fig. 11 (item 1) and Pl. 3, Fig. 1a—c.

TYPE LOCALITY: Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

TYPE HORIZON: Middle Miocene (Badenian).

DERIVATION OF THE NAME: Latin adjective *incisus*, after the deeply incised cauda.

MATERIAL: Two, well preserved specimens.

DIMENSIONS (in mm):

Figured in:		L	H	T
PL 3	Text-fig. 11			
Fig. 1a—c	Item 1	12	7	6 (max)
Fig. 2a—c	Item 2	13	7.5	5 (max)

DIAGNOSIS: Otoliths oval in outline, elongated parallelly to sulcus acusticus; inner side S-shapely arched; ostium large, almost circular, adjacent to dectle anterior margin, and continuing along crista superior, and partly along crista inferior; cauda broad, deeply incised and contacting dorsal and posterior margins along crista superior; colliculi not developed; outer side provided with large, rectangular swelling situated postero-dorsally, and capped with mammillar node.

DESCRIPTION: Otoliths are oval in outline, elongated parallelly to sulcus acusticus. Dorsal and posterior margins are straight; ventral margin is regularly convex; anterior margin is convex and dectle. Postero-dorsal corner is well de-

veloped. Inner side is S-shapedly arched and strongly convex. Sulcus acusticus is divided, with large, almost circular ostium, tightly adjoining anterior margin, and continuing along crista superior, and partly also along crista inferior. Cauda is broad, L-shaped, and deeply incised (see Text-fig. 11 and Pl. 3, Figs. 1b and 2b);

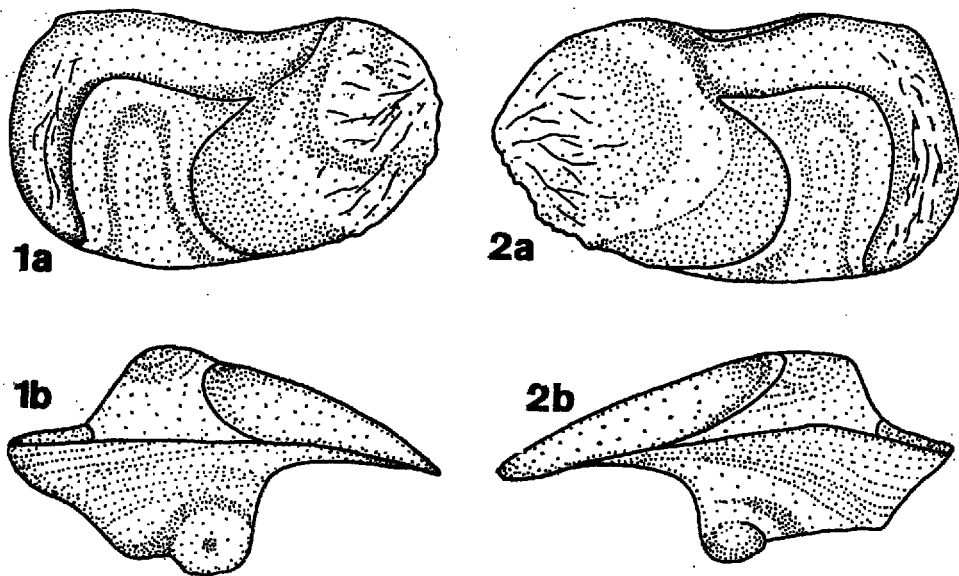


Fig. 11. *Argyrosomus incisus* sp. n.

1 — holotype (left sagitta): 1a inner side, 1b lateral view; 2 — paratype (right sagitta): 2a inner side, 2b lateral view; scale bar as for Text-fig. 14

it wholly contacts dorsal and posterior margins along crista superior. Colliculi are not developed. Outer side (see Pl. 3, Figs 1c and 2c) is concave in the part corresponding to ostium, and it is featured with large, rectangular swelling situated postero-dorsally.

**REMARKS:** Otoliths of the newly established species, *Argyrosomus incisus* sp. n., are close to the present-day species *Argyrosomus regius* (ASSO, 1801) and *A. hololepidotus* (LACÉPÈDE, 1802), differing (see Text-fig. 12) in broad, more circular ostium, contacting anterior margin wholly along crista superior and partly along crista inferior. They also differ in broader, less distinctly bent cauda which is deeply incised and contacting, along crista superior, to dorsal and posterior margins.

To the synonymy of *Argyrosomus incisus* sp. n., included is the otolith from the Korytnica Basin, described by ŚMIGIELSKA (1979) as "*Sciaena cf. aquila* LACÉPÈDE". It is understood that ŚMIGIELSKA (1979) regarded this otolith as similar to the species *Sciaena aquila* (RISSO, 1826), which was however ascribed by her to another author. The species *Sciaena aquila* (RISSO, 1826) has recently been synonymized (see NOLF & STEURBAUT 1979, p. 12) with *Argyrosomus regius* (ASSO, 1801). The investigated two otoliths, that one discussed by ŚMIGIELSKA (1979, p. 318 and Pl. 7, Fig. 1a—c) and reillustrated in this paper (Text-fig. 11, item 2; and Pl. 3, Fig. 2a—c) including, are herein regarded as conspecific. They both bear the features so distinct from *Argyrosomus regius* (ASSO, 1801) that

neither an assignation as conformis (supposedly, an intention of ŚMIGIELSKA, 1979) nor synonymizing of the specimen illustrated by ŚMIGIELSKA (1979) with the latter species, as offered by STEURBAUT (1981, p. 99), do not appear justifiable.

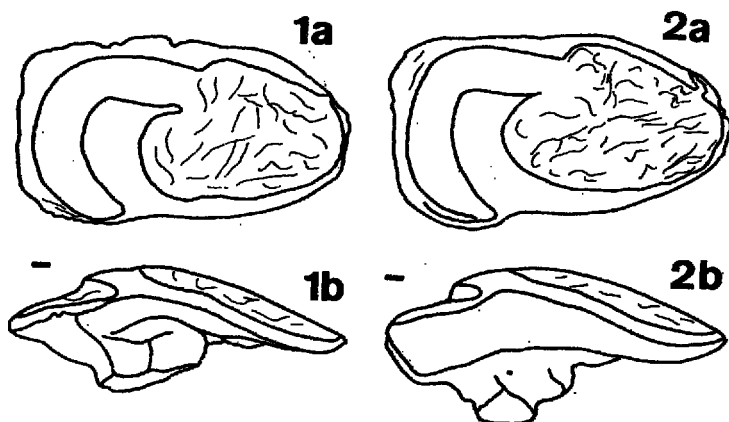


Fig. 12

1 — *Argyrosomus hololepidotus* (LACÉPÈDE, 1802): a present-day specimen, left sagitta (redrawn from: NOLF, personal comm. 1984); 1a inner side, 1b lateral view; scale bar 1 mm

2 — *Argyrosomus regius* (ASSO, 1801): a present-day specimen, left sagitta (redrawn from: NOLF, personal comm. 1984); 2a inner side, 2b lateral view; scale bar 1 mm

*Argyrosomus polonicus* sp. n.

(Text-figs 13—14 and Pl. 4, Figs 1a—c, 2a—c, 3a—c)

71950. *Sciaena pecchlioti* LAWLEY, 1976; W. WEILER, p. 224, Pl. 3, Fig. 13.

1978. *Sciaena pecchlioti* LAWLEY, 1976; T. ŚMIGIELSKA, pp. 317—318, Text-fig. 21 and Pl. 7, Fig. 2a—c.

1980. *Argyrosomus* sp.; H. CAPETTA & D. NOLF, p. 11, Pl. 3, Fig. 1.

**HOLOTYPE:** The specimen presented in Text-fig. 13 (item 1) and Pl. 4, Fig. 1a—c.

**TYPE LOCALITY:** Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**TYPE HORIZON:** Middle Miocene (Badenian).

**DERIVATION OF THE NAME:** Latin adjective *polonicus*, after the country of its finding.

**MATERIAL:** 4 specimens, 3 of which well preserved.

**DIMENSIONS** (in mm):

Figured in:				
Pl. 4	Text-figs 13—14	L	H	T
Fig. 1a—c	Fig. 13, Item 1	9.5	6	4 (max)
Fig. 2a—c	Fig. 13, Item 2	9	6	4.5 (max)
Fig. 3a—c	Fig. 14	7	5.3	2.3 (max)

**DIAGNOSIS:** Otoliths oval in outline; dorsal margin provided with a node at the middle; inner side convex, smooth; sulcus acusticus divided into large, spadleform ostium, and deep and narrow cauda which parallels dorsal and posterior margins of the otolith; in profile, the otolith is thin in its anterior part (below ostium), and afterwards it yields drop-like swellings, and finishes with thick posterior margin; outer side convex, ornamented with drop-like swellings situated near posterior margin.

**DESCRIPTION:** Otoliths are oval in outline, elongated parallelly to sulcus acusticus. Dorsal margin is straight, at its middle provided with a processus. Posterior margin is also straight or slightly concave. Dorsal margin is regularly convex.

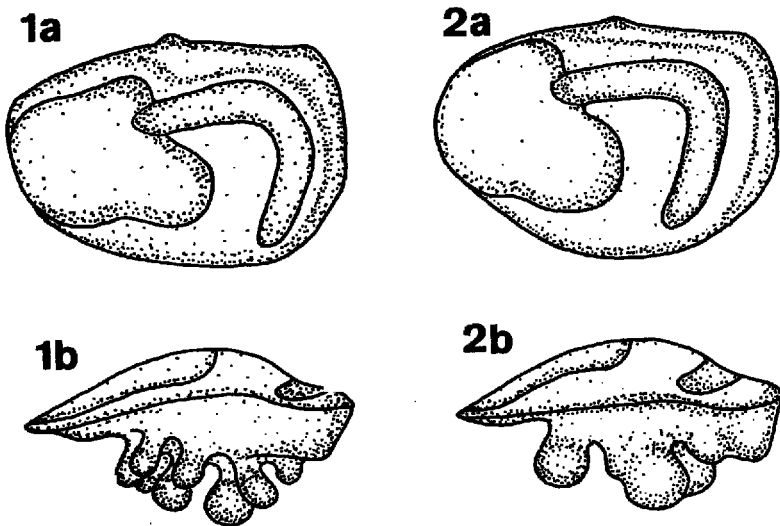


Fig. 13. *Argyrosomus polonicus* sp. n.

1 — holotype (right sagitta): 1a inner side, 1b lateral view; 2 — paratype (right sagitta): 2a inner side, 2b lateral view; scale bar as for Text-fig. 14

Postero-dorsal corner is well developed. Inner side is convex, but in posterior part of cauda it becomes slightly concave (see Text-figs 13—14 and Pl. 4, Figs 1b, 2b, 3b). Sulcus acusticus is divided into large, spadleform ostium, and deep and narrow cauda. Ostium partly contacts anterior margin, and ostial crista superior

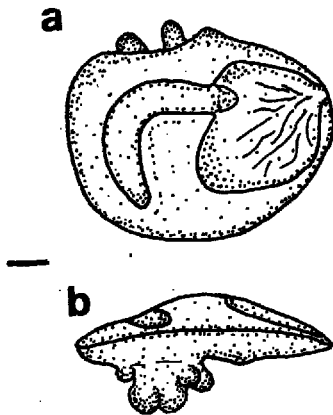


Fig. 14

*Argyrosomus polonicus* sp. n.

left sagitta of a juvenile specimen: a inner side, b lateral view; scale bar 1 mm

and crista inferior are distinctly arched. Cauda parallels dorsal and posterior margins of the otolith. Outer side (see Pl. 4, Figs 1c, 2c, 3c) is convex and ornamented with drop-like swellings. In profile, the otolith is thin and slightly convex in its anterior part (below ostium), and afterwards it yields drop-like swellings, and finishes with thick posterior margin.

REMARKS: Otoliths of the newly established species, *Argyrosomus polonicus* sp. n., are close to the present-day species *Argyrosomus regius* (ASSO, 1801) and *A. hololepidotus* (LACEPEDE, 1802), differing in shape of sulcus acusticus, in narrower cauda more distant to the otolith margin, and in sculpture of the outer side.

The species *Argyrosomus polonicus* sp. n. differs from the above-established species *A. incisus* sp. n. in more elongated ostium, contacting the anterior margin along much shorter distance, and in narrower, less incised cauda distinctly separated from the otolith margin.

The otoliths attributed to the newly established species, *Argyrosomus polonicus* sp. n., were formerly reported from the Korytnica Basin by ŚMIGIELSKA (1979) under the name of "*Sciaena pecchioli* LAWLEY, 1876". The latter assignation is evidently erroneous, because the otolith illustrated by ŚMIGIELSKA (1979, Text-fig. 21 and Pl. 7, Fig. 2a—c) distinctly differs from the type figured by LAWLEY (1876, Pl. 5, Figs 5 and 5a—b), and which is to be included into the synonymy of *Argyrosomus regius* (ASSO, 1801). The specimen presented by ŚMIGIELSKA (1979) and reillustrated in this paper (Text-fig. 14 and Pl. 4, Fig. 3a—c) is smaller than the others under investigation (see dimensions), and it is also flatter and less ornamented on its outer side. The features of its general outline and the structure of sulcus acusticus are identical, and thus the discussed specimen is interpreted as a juvenile of *Argyrosomus polonicus* sp. n.

To the synonymy of *Argyrosomus polonicus* sp. n. included is, although with a hesitation, an otolith from the Miocene deposits of Kostej, Transylvanian Basin, Rumania, reported by WEILER (1950, p. 224 and Pl. 3, Fig. 13) as "*Sciaena pecchioli* LAWLEY, 1876". This otolith also differs distinctly from the type of LAWLEY (1876). Its differences to the Korytnica specimens are in deeper area and another ornamentation pattern of the outer side.

### Family Cepolidae

#### Genus *Cepola* LINNAEUS, 1764

#### *Cepola macrophthalma* (LINNAEUS, 1758)

(Text-fig. 15 and Pl. 5, Figs 1—4)

1906. *Otolithus (Cepola) praerubescens* BASSOLI et SCHUBERT sp. nov.; R. J. SCHUBERT, p. 642, Pl. 18, Figs 1—5.  
 1906. *Otolithus (Cepola) praerubescens* BASSOLI; G. BASSOLI, p. 54, Pl. 2, Fig. 43.  
 1942. *Cepola praerubescens* SCHUB.; W. WEILER, p. 54, Pl. 4, Figs 41a—b, 53a—b, 54a—b.  
 1950. *Cepola praerubescens* BASSOLI & SCHUBERT, 1906; W. WEILER, p. 230, Pl. 4, Fig. 23.  
 1968. *Cepola praerubescens* BASSOLI et SCHUBERT; T. ŚMIGIELSKA, p. 286, Pl. 18, Fig. 2.  
 1977. *Cepola praerubescens* LINNAEUS, 1764; D. NOLF, p. 56, Pl. 16, Figs 10—11.  
 1979. *Cepola rubescens* LINNAEUS, 1766; T. ŚMIGIELSKA, pp. 322—324, Text-fig. 25 (Item 2a—b, 3a—b, 4a—b, 5a—b) and Pl. 6, Figs 5—6 [non Text-fig. 25, Item 1a—b, and Pl. 6, Fig. 7].  
 1981. *Cepola macrophthalma* (LINNAEUS, 1758); D. NOLF, p. 141, Pl. 2, Figs 9—12.

MATERIAL: 21 specimens, in majority well preserved.

REMARKS: The investigated otoliths (see Text-fig. 15 and Pl. 5, Figs 1—4) coincide with those illustrated under diverse names (see synonymy), and formerly also reported from the Korytnica Basin (ŚMIGIELSKA 1906, 1979).

The Korytnica otoliths determined by ŚMIGIELSKA (1979) as "*Cepola rubescens* LINNAEUS, 1766" were subsequently discussed by STEURBAUT (1981) who included them to the group of *Cepola* aff. *macrophthalma* (LINNAEUS, 1758) and indicated their differences in ostial crista inferior being upwardly more arched when comparing to the present-day forms. It is however thought that such a dif-

ference is of a very low importance, and in some of the otoliths illustrated by ŚMIGIELSKA (1979, Pl. 6, Figs 5–6) it cannot be recognized. Small differences in the outline of sagitta, in more or less developed excisura, and in the course of sulcus acusticus are to be interpreted as resulting from the intraspecific variability of *Cepola macrophthalma* (LINNAEUS, 1758), as evidenced by the shape range of the present-day forms of this species (see NOLF 1981, Pl. 2, Figs 9–12), and of the ancient forms illustrated by SCHUBERT (1906, Pl. 19, Figs 1–5) under the name of "*Otolithus (Cepola) praerubescens* BASSOLI et SCHUBERT".

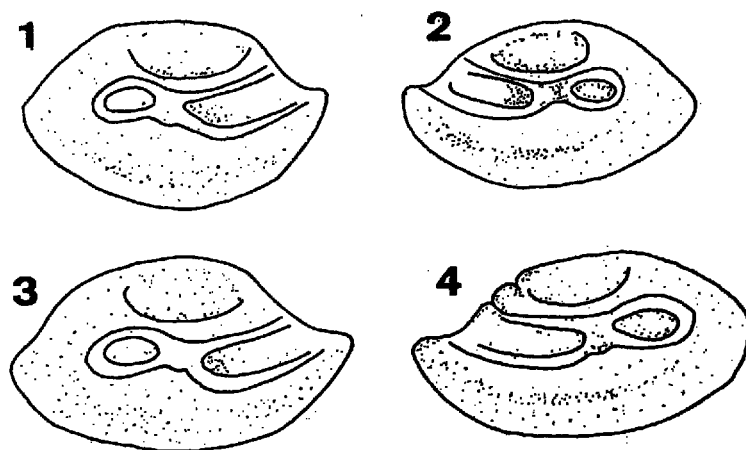


Fig. 15. *Cepola macrophthalma* (LINNAEUS, 1758)  
1 and 3 left sagitta, 2 and 4 right sagitta; all from inner side; scale bar 1 mm

**OCCURRENCE:** Outside the Korytnica Basin, the species is known from the Oligocene of Belgium (NOLF 1977), and from the Miocene of Austria (SCHUBERT 1906), Italy (BASSOLI 1906), Germany (WEILER 1942), and Rumania (WEILER 1950). At present, the species occurs i.a. in the Adriatic and the Mediterranean Sea (see ZEI 1963, NOLF 1981, RUTKOWICZ 1982).

*Cepola yrieuensis* STEURBAUT, 1981  
(Text-fig. 16 and Pl. 5, Figs 5–7)

1979. *Cepola rubescens* LINNAEUS, 1766; T. ŚMIGIELSKA, p. 323, Text-fig. 25, Item 1a–b and Pl. 6, Fig. 7 [non Text-fig. 25, Item 2a–b, 3a–b, 4a–b, 5a–b and Pl. 6, Figs 5–6].  
1981. *Cepola yrieuensis* n. sp.; E. STEURBAUT, p. 102, Pl. 29, Figs 13–17.

**MATERIAL:** 17 specimens, in majority well preserved.

**REMARKS:** The investigated otoliths (see Text-fig. 16 and Pl. 5, Figs 5–7) coincide with the holotype (see STEURBAUT 1981, Pl. 29, Fig. 13). The species has hitherto been known from the Korytnica Basin, and reported by ŚMIGIELSKA (1979) as one of the morphotypes of "*Cepola rubescens* LINNAEUS, 1766".

**OCCURRENCE:** Outside the Korytnica Basin, the species is known only from the Aquitanian Basin (STEURBAUT 1981).

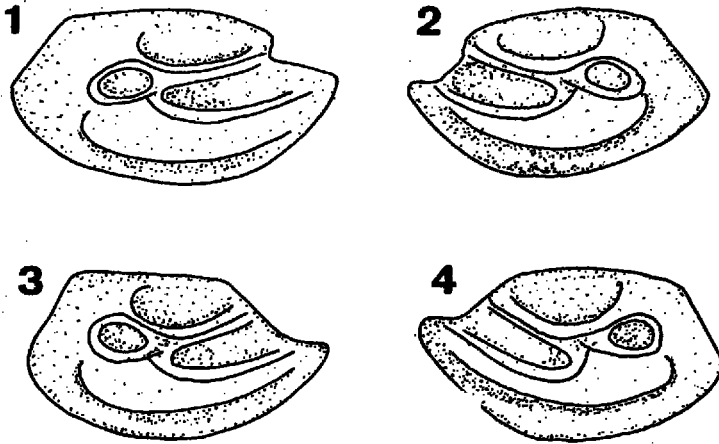


Fig. 16. *Cepola yrieuensis* STEURBAUT, 1981

1 and 3 left sagitta, 2 and 4 right sagitta; all from inner side; scale bar 1 mm

*Cepola multicrenata* sp. n.

(Text-fig. 17 and Pl. 5, Figs 8—10)

**HOLOTYPE:** The specimen presented in Text-fig. 17 (Item 2) and Pl. 5, Fig. 8.

**TYPE LOCALITY:** Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**TYPE HORIZON:** Middle Miocene (Badenian).

**DERIVATION OF THE NAME:** Latin adjective *multicrenata*, after numerous crenulations on the posterior margin.

**MATERIAL:** 25 specimens, in majority well preserved.

**DIMENSIONS (in mm):**

	Figured in:		L	H	T
	Pl. 5	Text-fig. 17			
Fig. 8		Item 1	5.6	3	0.5
Fig. 9		Item 2	3.8	2.2	0.5
Fig. 10		Item 3	5	2.8	0.5
—		Item 4	5	2.7	0.5
—		Item 5	5.5	2.6	0.5
—		Item 6	5	3	0.5

**DIAGNOSIS:** Otoliths of trapezoid outline; dorsal margin straight; posterior margin straight, distinctly crenulated, with postero-dorsal corner well developed; ventral margin symmetrically convex; anterior margin provided with well developed, sharp rostrum, shallow excisura, and well pronounced antirostrum; inner side slightly convex; sulcus acusticus divided into large, oval ostium, and twice smaller, amygdaloid cauda; colliculi well developed; crista superior forms distinct ledge; crista inferior forms swelling at ostium/cauda junction; ventral groove broad and shallow; outer side slightly concave.

**DESCRIPTION:** Otoliths are trapezoid in outline, elongated. Dorsal margin is straight or slightly waved; posterior margin, situated obliquely to dorsal margin, is also straight, but distinctly crenulated, and with postero-dorsal corner well developed. Ventral margin is symmetrically convex, sometimes slightly waved. Anterior margin in ostial part yields well developed, sharp rostrum; shallow ex-

cisura sometimes forms deep notch (see Text-fig. 17, item 6); antirostrum is well pronounced. Above antirostrum there sometimes appear secondary wavings, accentuated by narrow grooves. Inner side is slightly convex. Sulcus acusticus is horizontal, and divided into large, oval ostium, and twice smaller, amygdaloid cauda.

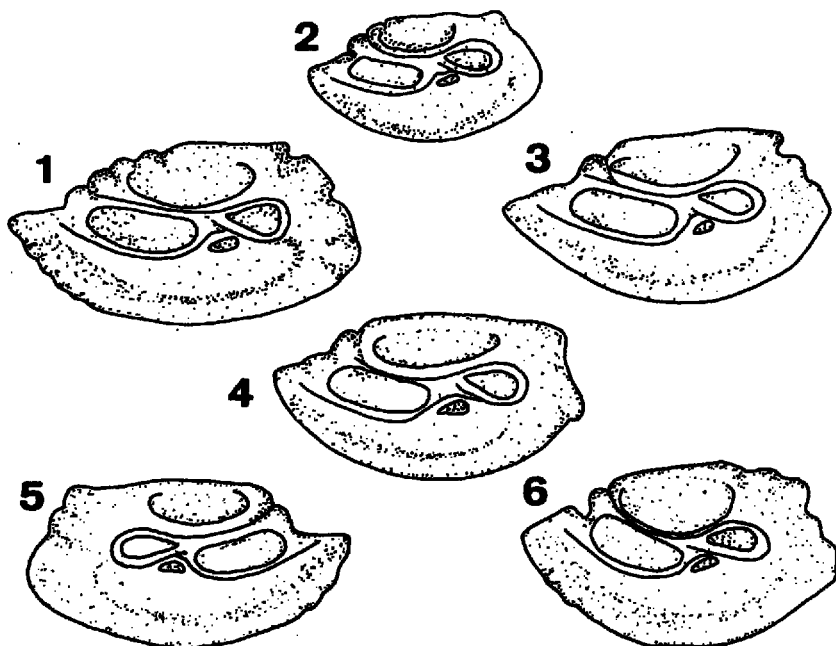


Fig. 17. *Cepola multicrenata* sp. n.

1 — holotype (right sagitta), inner side; 2-6 — paratypes (2-4 and 6 right sagitta, 5 left sagitta), inner side; scale bar 1 mm

Colliculi are well developed. Crista superior forms a distinct ledge, and a shallow, oval area develops above it. Crista inferior forms swelling which overlies a shallow depression at ostium/cauda junction. Ventral groove is broad and shallow. Outer side is slightly concave at the center, and towards the margins there develop wavings with small, narrow grooves.

REMARKS: The investigated otoliths, especially featured by their general outline and structure of sulcus acusticus, are very similar to the above-discussed, present-day species *Cepola macrophthalmia* (LINNAEUS, 1758), from which they differ in strong crenulation of the margins, in better development of postero-dorsal corner, and in the more trapezoid outline. Slight differences are also evident within sulcus acusticus: in *Cepola multicrenata* sp. n. colliculum in ostium is well developed and closed along the whole periphery, whereas in *C. macrophthalmia* (LINNAEUS, 1758) it is opened at the anterior margin.

The newly established species, *Cepola multicrenata* sp. n. differs from the preceding species, *C. yrieuensis* STEURBAUT, 1981, in crenulated margins, in postero-dorsal corner better developed, and in another shape of crista inferior at ostium/cauda junction.



*Cepola* sp.

(Text-fig. 18 and Pl. 5, Fig. 11)

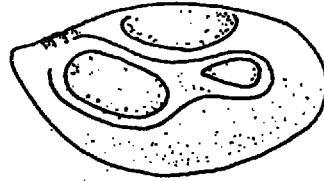
**MATERIAL:** One, well preserved specimen.

**DESCRIPTION:** Otolith oval in outline, with rounded margins. Anterior margin is straight, devoid of excisura and antirostrum. Inner side is convex. Sulcus acusticus is horizontal, and divided into large, oval ostium, and smaller, amygdaloid cauda. Colliculi are well developed. Above crista superior there appears wide and deep area. Ventral groove does not pronounce. Outer side is flat and smooth.

Fig. 18

*Cepola* sp.

right sagitta, inner side; scale as for Text-fig. 17



loid cauda. Colliculi are well developed. Above crista superior there appears wide and deep area. Ventral groove does not pronounce. Outer side is flat and smooth.

**REMARKS:** The investigated otolith, featured by its general outline and structure of sulcus acusticus, is assigned to the genus *Cepola* LINNAEUS, 1764. It is also regarded as similar to the present-day species *Cepola macrophthalmia* (LINNAEUS, 1758), but it differs in the absence of excisura and antirostrum, and in having large, oval ostium. A single specimen collected does not allow a more precise designation and/or comparison.

## Suborder Mugiloidei

## Family Mugilidae

Genus *Liza* JORDAN & SWAIN, 1884*Liza steurbauti* sp. n.

(Text-fig. 19 and Pl. 2, Fig. 4a—b)

**HOLOTYPE:** The specimen presented in Text-fig. 19 (item 1) and Pl. 2, Fig. 4a—b.**TYPE LOCALITY:** Korytnica-Plebania, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.**TYPE HORIZON:** Middle Miocene (Badenian).**DERIVATION OF THE NAME:** In honour of Dr. E. STEURBAUT, an outstanding student of the ancient fish otoliths.**MATERIAL:** 3 specimens, 2 of which with rostral part damaged.**DIMENSIONS (in mm):**

Figured in:		L	H	T
Pl. 2	Text-fig. 19			
Fig. 4a—b	Item 1	7	3	0.4
—	Item 2	8.5	3.5	0.5

**DIAGNOSIS:** Otoliths elongated, with dorsal margin concave, and ventral margin convex and undulated; inner side convex; sulcus acusticus slightly oblique, divided into deep, oval ostium, and long narrow cauda which posteriorly bends abruptly towards ventral margin deep area present above caudal crista superior; ventral groove well developed; outer side deeply concave.

**DESCRIPTION:** Otoliths distinctly elongated bear their dorsal margin concave, with postero-dorsal corner well developed. Both ventral and posterior margins are convex and undulated. Anterior margin is straight, undulated, and devoid of excisura, rostrum and antirostrum. Inner side is convex, and sulcus

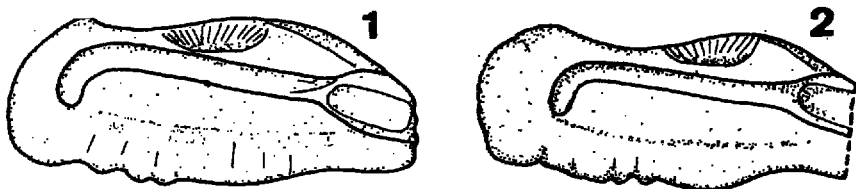


Fig. 19. *Liza steurbauti* sp. n.

1 — holotype (left sagitta), inner side; 2 — paratype (left sagitta), inner side; scale bar as for Text-fig. 17

acusticus is slightly oblique. Sulcus acusticus is divided into deep, oval ostium, and long narrow cauda which posteriorly bends abruptly towards ventral margin. Colliculi are well developed. A small but deep area appears above caudal crista superior. Ventral groove is well developed. Outer side is deeply concave (see Pl. 2, Fig. 4b), and bears a depression running along dorsal margin.

**REMARKS:** Otoliths of the newly established species, *Liza steurbauti* sp. n., are very close (see Text-fig. 20) to the present-day species *Liza ramada* (RISSO, 1826), from which they differ in having their anterior margin straight, in the absence of rostrum, and in a more straight-line course of cauda which is more distinctly bent posteriorly.



Fig. 20

*Liza ramada* (RISSO, 1826): a present-day specimen, left sagitta (redrawn from: STEURBAUT 1981, Pl. 29, Fig. 23), taken from inner side; scale bar as for Text-fig. 22

**Suborder Sphyraenoidei**  
**Family Sphyraenidae**  
**Genus *Sphyraena* SCHNEIDER, 1801**  
*Sphyraena dentata* sp. n.  
 (Text-fig. 21 and Pl. 2, Figs 5—6)

1978. *Sphyraena hansfuchsi* SCHUBERT, 1906; T. SMIGIELSKA, p. 314, Text-fig. 17 and Pl. 4, Fig. 7.

1981. *Sphyraena* sp. 2; E. STEURBAUT, p. 105, Pl. 30, Figs 1—3.

**HOLOTYPE:** The specimen presented in Text-fig. 21 (item 1) and Pl. 2, Fig. 5.

**TYPE LOCALITY:** Mt. Lysa at Korytnica, 24 km SSW of Kielce, southern slopes of the Holy Cross Mountains, Central Poland.

**TYPE HORIZON:** Middle Miocene (Badenian).

DERIVATION OF THE NAME: Latin adjective *dentata*, after the general appearance of the anterior margin.

MATERIAL: 7 specimens with rostral part damaged, except of one fully preserved.

DIMENSIONS (in mm):

Figured in:				
Pl. 2	Text-fig. 21	L	H	T
Fig. 5	Item 1	12	4	0.8
Fig. 6	Item 2	—	2.3	0.7
—	Item 3	—	3	0.7

DIAGNOSIS: Otoliths much elongated; inner side convex; posterior and ventral margins smooth and slightly convex; anterior margin provided with large, lanceolate rostrum, deep excisura, and large, sharp antirostrum; sulcus acusticus horizontal, divided into large, oval ostium; and long, deep cauda; long and deep area present above caudal crista superior; ventral groove well developed; outer side concave.

DESCRIPTION: Otoliths much elongated, with dorsal and ventral margins smooth and slightly convex. Posterior margin is also slightly convex, and sometimes becomes undulated. Anterior margin provided with large, lanceolate rostrum, deep excisura, and large, sharp antirostrum. Sulcus acusticus is horizontal, divided into large, oval ostium, and long, deep cauda which posteriorly bends slightly

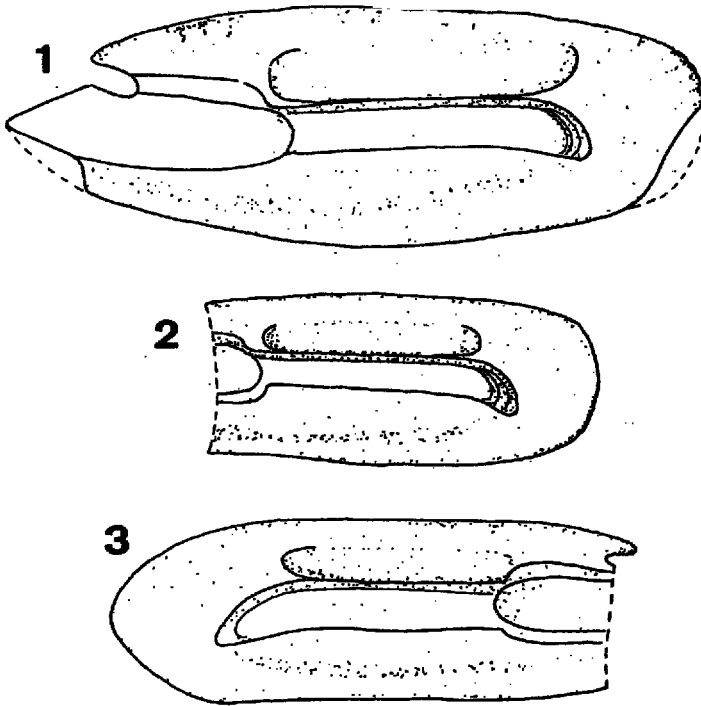


Fig. 21. *Sphyræna dentata* sp. n.

1 — holotype (right sagitta), inner side; 2-3 — paratypes (2 right sagitta, 3 left sagitta), inner side; scale bar 1 mm

towards ventral margin. Colliculi are well developed. Long and deep area develops above caudal crista superior. Ventral groove is well developed. Outer side is concave.

REMARKS: The investigated otoliths, especially featured by their general outline and structure of sulcus acusticus, are close to the present-day species *Sphyaena sphyaena* (LINNAEUS, 1758), from which they differ (see Text-fig. 22)

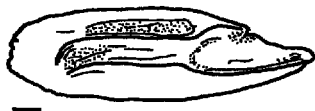


Fig. 22

*Sphyaena sphyaena* (LINNAEUS, 1758): a present-day specimen, left sagitta (redrawn from: STEURBAUT 1981, Pl. 30, Fig. 4), taken from inner side; scale bar 1 mm

in the more pronouncedly developed antirostrum and excisura, in the broader ostium, and in the more strongly bent crista superior and crista inferior at the ostium/cauda junction.

The newly established species, *Sphyaena dentata* sp. n., has formerly been known from the Korytnica Basin and reported by ŚMIGIELSKA (1979) as "*Sphyaena hansfuchsi* SCHUBERT, 1906". The latter designation is however erroneous, because all the specimens illustrated by ŚMIGIELSKA (1979) are much different from those figured by SCHUBERT (1906, Pl. 18, Figs 40—42), especially in the general outline of sagitta, and in the shape of anterior margin.

To the synonymy of the new species included are also the specimens from the Miocene deposits of Aquitaine, reported by STEURBAUT (1981) as "*Sphyaena* sp. 2". Although incomplete, these specimens are regarded as conspecific with the newly established species, *Sphyaena dentata* sp. n.

#### ECOLOGICAL REMARKS

An ecological analysis of the fish taxa to which the investigated otoliths belonged, indicates the dominance of littoral forms typical of tropical and/or subtropical climatic zones, as evidenced primarily by the presence of such genera as *Platycephalus*, *Cepola*, *Liza*, and *Sphyaena*. The same conclusion is also apparent when studying the whole assemblage of fishes from the Korytnica Basin (see ŚMIGIELSKA 1979, RADWAŃSKA 1982).

All the herein established new taxa are attributable either to the species closely related to the present-day species (see Table 1), or to the species still extant, as exemplified by *Cepola macrophthalmia* (LINNAEUS, 1758).

A close relation of the investigated Middle Miocene (Badenian) forms to the modern fish taxa evidences old phylogenetic lineages of the Korytnica species. On the other hand, such relationships allow to recognize better the ecological adaptations and environmental requirements of the ancient forms (cf. ZEI 1963, STEURBAUT 1981, RUTKOWICZ 1982).

Table 1

The newly established species of fish otoliths from the Middle Miocene (Badenian) deposits of the Korytnica Basin and the relatable present-day species

Middle Miocene species from Korytnica	Recent species
<i>Ariosoma longicaudatum</i> sp. n.	<i>Ariosoma balearicum</i> (DELAROCHE, 1809)
<i>Echelus arcuatus</i> sp. n.	<i>Echelus myrus</i> (LINNAEUS, 1758)
<i>Platycephalus fusiculus</i> sp. n.	<i>Platycephalus cirronasus</i> RICHARDSON, 1848
{ <i>Argyrosomus incisus</i> sp. n.	{ <i>Argyrosomus regius</i> (ASSO, 1801)
{ <i>Argyrosomus polonicus</i> sp. n.	{ <i>Argyrosomus hololepidotus</i> (LACÉPÈDE, 1802)
<i>Cepola multicrenata</i> sp. n.	<i>Cepola macrophthalma</i> (LINNAEUS, 1758)
<i>Liza steurbauti</i> sp. n.	<i>Liza ramada</i> (RISSO, 1826)
<i>Sphyraena dentata</i> sp. n.	<i>Sphyraena sphyraena</i> (LINNAEUS, 1758)

Of the present-day species comparable to the Korytnica taxa (Table 1), *Ariosoma balearicum* (DELAROCHE, 1809), *Argyrosomus regius* (ASSO, 1801), *A. hololepidotus* (LACÉPÈDE, 1802), and *Sphyraena sphyraena* (LINNAEUS, 1758), are characterized by their wide geographic extent, ranging from the Mediterranean and western Europe and Africa coast to the tropical Atlantic, and having been regarded as typical of the open-sea regions. All these however often migrate shorewards, especially during the breeding seasons. The remaining present-day species (see Table 1), *Echelus myrus* (LINNAEUS, 1758), *Platycephalus cirronasus* RICHARDSON, 1848, *Cepola macrophthalma* (LINNAEUS, 1758), and *Liza ramada* (RISSO, 1826) are exclusively confined to the shorezone, that dismembered and/or featured with lagoons including, and they often enter the river mouths.

The trophic conditions of the discussed present-day taxa are diversified. Some species are typically carnivorous, feeding upon other fish and small invertebrates (*Ariosoma*, *Argyrosomus*), or exclusively on fish, mainly on the clupeids (*Sphyraena*). The species *Cepola macrophthalma* (LINNAEUS, 1758) feeds on small invertebrates, such as crustaceans and benthic mollusks. The species *Liza ramada* (RISSO, 1826) feeds, on the other hand, upon phyto- and zooplankton (similarly as the other mugilids) which is filtered by specifically adapted gills; this species is known as a fast-swimmer, and it often shoots out even several feet above the water surface.

Some of the discussed present-day fishes are more or less confined to the definite bottom conditions. The genus *Argyrosomus* prefers rocky and sandy habitats, whereas *Platycephalus* takes muddy floor to dwell in. One species, *Cepola macrophthalma* inhabits seagrass meadows, a bio-

tope which is recognizable in the investigated shorezone facies of the Korytnica Basin (see Text-fig. 1B; cf. also BAŁUK & RADWAŃSKI 1977).

The shorezone habitats of some present-day fishes, the adult specimens of which enter the lagoons and river mouths, does not speak about such very conditions in places where the investigated littoral facies developed in the Korytnica Basin. The associated fauna, both at Mt. Lysa and Korytnica-Plebania, comprises typical marine mollusks (chitons, bivalved gastropods, cuttlefish), corals, brachiopods, cirripedes, and echinoderms (cf. BAŁUK & RADWAŃSKI 1977, RADWAŃSKA 1982, RADWAŃSKA & RADWAŃSKI 1984, BAŁUK 1984), and it is devoid of any taxa indicative of brackish, fresh-water (and/or hypersaline) conditions.

The investigated assemblages of fish otoliths, when compared with those reported by ŚMIGIELSKA (1979) from the basinal facies of the Korytnica Clays, display evidently a greater amount of species typical of the littoral zone, and a total absence of species recognized by ŚMIGIELSKA (1979) as bathybenthic and bathypelagic.

The comparable present-day species are characteristic of the Atlantic bioprovince. An exception is offered by the genus *Platycephalus* which is confined to the Indo-Pacific bioprovince, and whose presence in the Korytnica material is regarded as supplementing the previous data on the Indo-Pacific affinities of many organic communities of this Middle Miocene (Badenian) basin (cf. BAŁUK & RADWAŃSKI 1977, RADWAŃSKA & RADWAŃSKI 1984).

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#### REFERENCES

- BAŁUK, W. 1984. Additional data on chitons and cuttlefish from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geol. Polon.*, 34 (3—4) [this issue]. Warszawa.
- & RADWAŃSKI, A. 1977. Organic communities and facies development of the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geol. Polon.*, 27 (2), 85—123. Warszawa.
- BASSOLI, G. G. 1906. Otoliti fossili terziari dell'Emilia. *Riv. Ital. Paleont.*, 12, 36—56. Perugia.
- CHAINED, J. & DUVERGIER, J. 1928. Sur des Otolithes fossiles de la Pologne. *Rocz. P. T. Geol. (Ann. Soc. Géol. Pologne)*, 5, 190—204. Kraków.
- FRIEDBERG, W. 1924. Études sur le miocène de la Pologne, Partie III. *Kosmos, Ser. A*, 49, 564—567. Lwów.
- JONET, S. 1973. Étude des otolithes des téléostéens (Pisces) du Miocène des environs de Lisbonne. *Com. Serv. Geol. Portugal*, 56, 107—294. Lisboa.
- LAWLEY, R. 1876. Nuovi studi sopra ai Pesci, ed altri vertebrati fossili delle Colline Toscane. *Tipografia dell'Arte della Stampa*, p. 78. Firenze.
- NOLF, D. 1977. Les Otolithes des Téléostéens de L'Oligo-Miocène Belge. *Ann. Soc. R. Zool. Belg.*, 7 (1), 3—119. Bruxelles.

- 1981. Révisions des types d'Otolithes de poissons fossiles décrits par R. SCHUBERT. *Verh. Geol. B. A.*, 2, 133—183. Wien.
- & CAPETTA, H. 1980. Les Otolithes de Téléostéens du Miocène de Montpeyroux (Hérault, France). *Palaeovertebrata*, 10-1, 1—28. Montpellier.
- & STEURBAUT, E. 1979. Les Otolithes de Téléostéens des Faluns salomaciens d'Orthez et de Sallespisse (Miocène Moyen d'Aquitaine Meridionale, France). *Palaeontographica*, A, 164 (1—3), 1—23. Stuttgart.
- RADWAŃSKA, U. 1982. Non-mollusk fauna of the oyster shellbed at Korytnica; its facies and stratigraphical significance. [In Polish]. *Unpublished M. Sc. thesis*; Institute of Geology, University of Warsaw.
- & RADWAŃSKI, A. 1984. A new species of inarticulate brachiopods, *Disciniscia polonica* sp. n., from the Korytnica Basin (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geol. Polon.*, 34 (3—4) [this issue]. Warszawa.
- RUTKOWICZ, S. 1982. Encyklopedia ryb morskich, pp. 6—663. *Wydawnictwo Morskie*; Gdańsk.
- SCHUBERT, R. J. 1906. Die Fischotolithen des österr.-ungar. Tertiärs. *Jb. K. K. Geol. Reichsanst.*, 56, 623—706. Wien.
- STEURBAUT, E. 1981. De Teleostei-Otolieten uit het Oligo-Mioceen van Aquitaine (Zuidwest-Frankrijk). Deel I: Evaluatie van de fauna biostratigrafie. Deel II: Systematiek. *Fakulteit der Wetenschappen, Rijksuniversiteit Gent*.
- & JONET, S. 1981. Révision des Otolithes de Téléostéens du Miocène Portugais. *Bull. Belg. Ver. voor Geologie*, 90 (3), 191—229. Brussel.
- SMIGIELSKA, T. 1966. Otoliths of fishes from the Tortonian of southern Poland. *Rocz. P. T. Geol. (Ann. Soc. Géol. Pologne)*, 36 (3), 205—275. Kraków.
- 1979. Fish otoliths from the Korytnica Clays (Middle Miocene; Holy Cross Mountains, Central Poland). *Acta Geol. Polon.*, 29 (3), 295—337. Warszawa.
- SULC, J. 1932. Preliminary report on the otoliths from the Miocene of Karlice, at Náměšt, Moravia. *Vestn. Statn. Geol. Ustavu Cesk. Repub.*, 8, 168—174. Praha.
- WEILER, W. 1942. Die Otolithen des rheinischen und nordwestdeutschen Tertiärs. *Abh. Reichsamts Bodenforsch., N. F.*, 206, 6—140. Berlin.
- 1943. Die Otolithen aus dem Jungtertiär Süd-Rumäniens. 1: Buglow und Sarmat. *Senckenbergiana*, 26 (1—3), 87—115. Frankfurt a.M.
- 1950. Die Otolithen aus dem Jung-Tertiär Süd-Rumäniens. 2: Mittel-Miozän, Torton, Buglow und Sarmat. *Senckenbergiana*, 31 (3—4), 209—258. Frankfurt a.M.
- ZEI, M. 1963. Klasse: Osteichthyes (Knochenfische). In: R. RIEDL (Ed.), *Fauna und Flora der Adria*, pp. 507—565. *Parey*; Hamburg und Berlin.

U. RADWAŃSKA

## NOWE OTOLITY RYB Z FACJI LITORALNEJ IŁÓW KORYTNICKICH

## (Streszczenie)

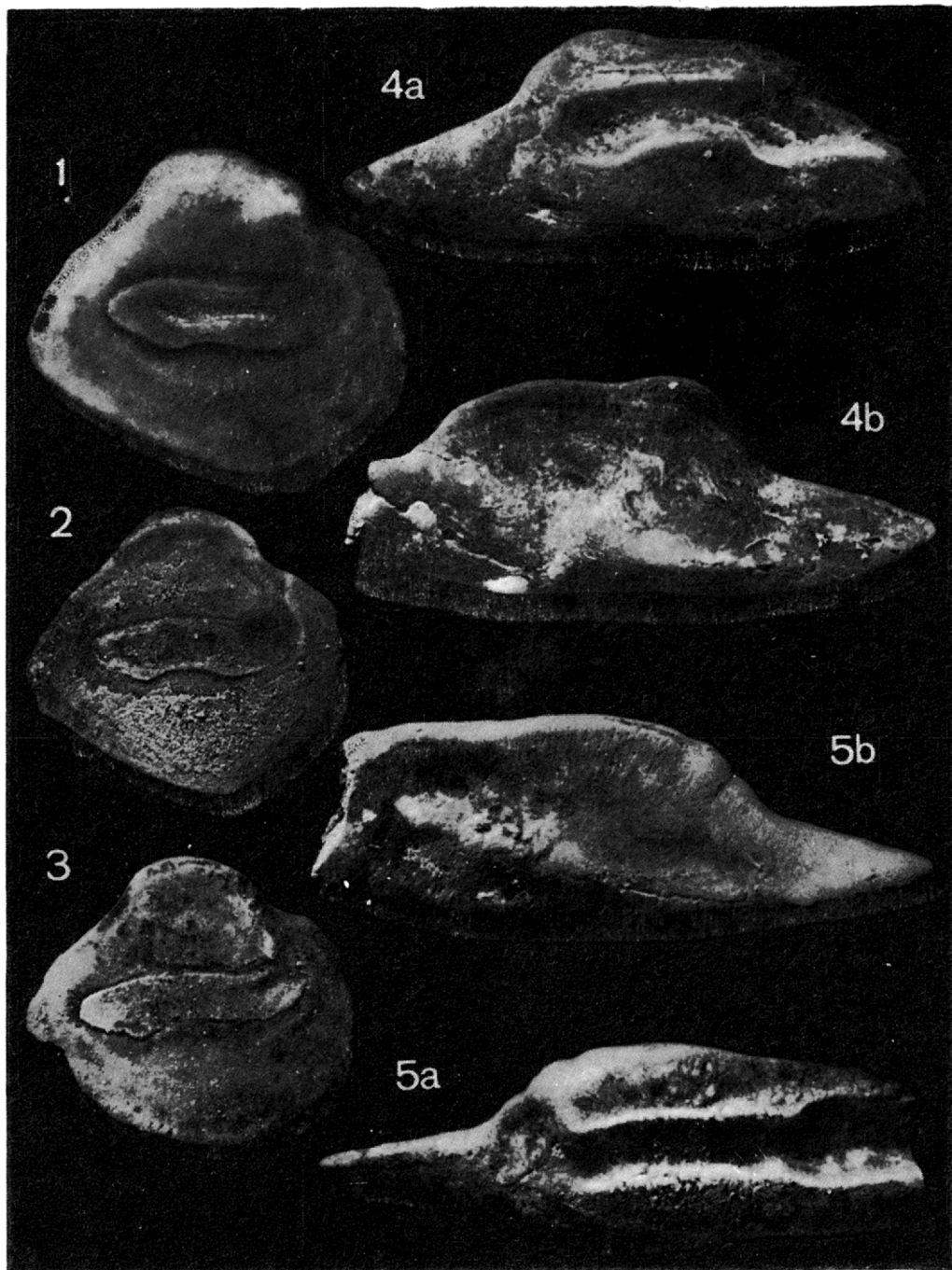
W zespole otolitów pochodzących z facji litoralnej iłów w Basenie Korytnicy (patrz fig. 1) stwierdzono obecność (patrz fig. 2—22 oraz pl. 1—5) ośmiu gatunków nowych dla nauki: *Ariosoma longicaudatum* sp. n., *Echelus arcuatus* sp. n., *Platycephalus fusciculus* sp. n., *Argyrosomus incisus* sp. n., *A. polonicus* sp. n., *Cepola multicrocata* sp. n., *Liza steurbauti* sp. n., oraz *Sphyræna dentata* sp. n. Trzy rodzaje (*Echelus*, *Platycephalus*, *Liza*) nie były dotąd znane ani z Basenu Korytnicy ani z innych stanowisk miocenu w Polsce. Wskazać należy, że wszystkie nowo-ustanowione gatunki wykazują znaczne podobieństwa do odpowiednich gatunków dzisiejszych (patrz tab. 1).

Analiza ekologiczna rozważanego zespołu wykazała, iż dominują w nim otolity ryb strefy litoralnej klimatu subtropikalnego i tropikalnego. Ryby z rodzajów *Ariosoma*, *Argyrosomus* oraz *Sphyræna* obecnie mają duży zasięg geograficzny, obejmujący Morze Śródziemne oraz zachodnie wybrzeża Oceanu Atlantyckiego, od strefy umiarkowanej do tropikalnej. Rodzaj *Platycephalus*, związany ściśle ze strefą litoralną, stanowi w tym zespole element indo-pacyficzny.

Ryby, do których należały badane otolity, zamieszkiwały obszary o urozmaconym dnie, od skalistego do piaszczysto-mulastego, często porośniętego trawami morskimi. Obecność otolitów ryb związanych bardziej ze strefą morza otwartego wskazuje na okresową migrację ryb w kierunku brzegu w czasie rozrodu.

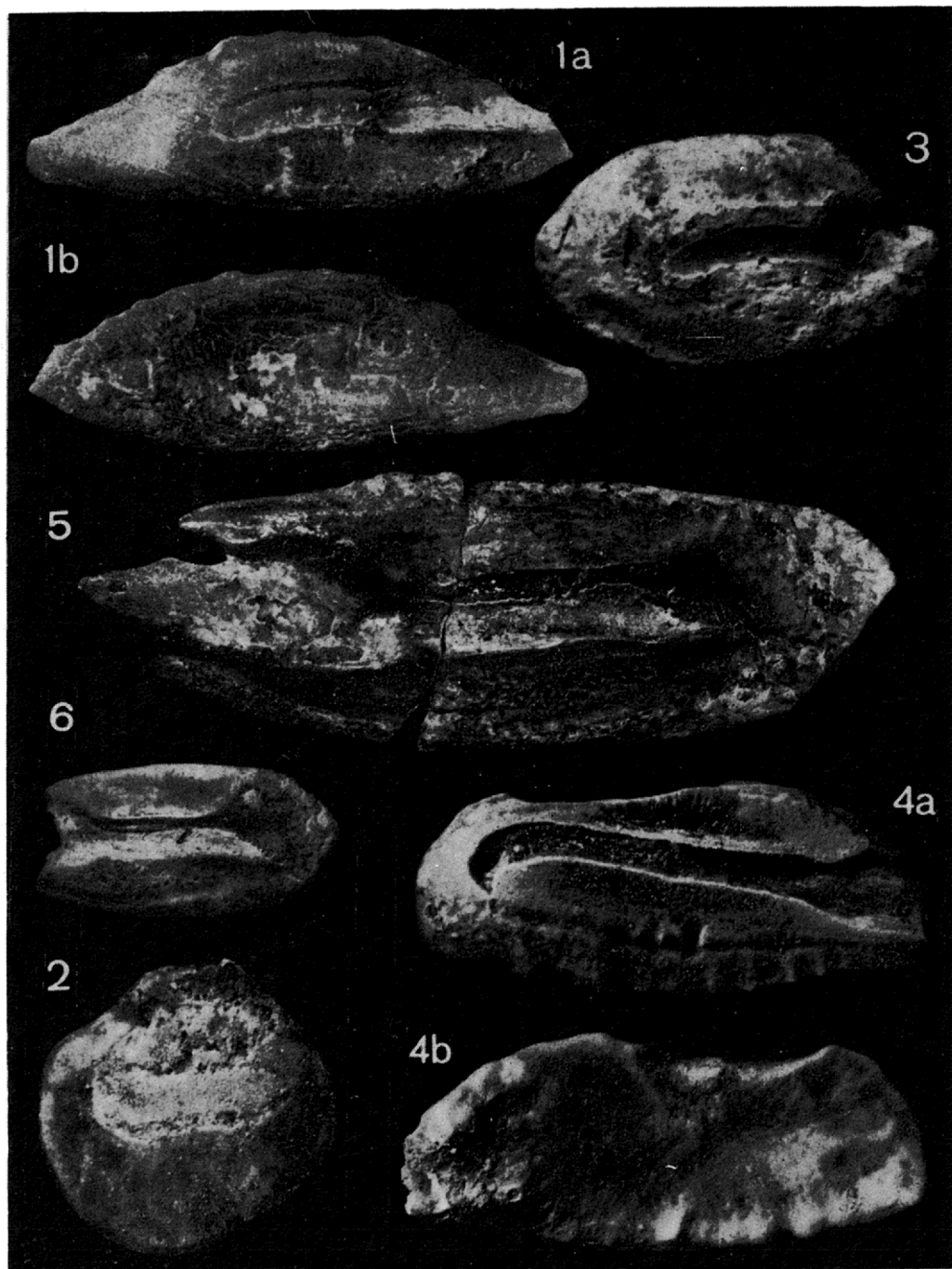
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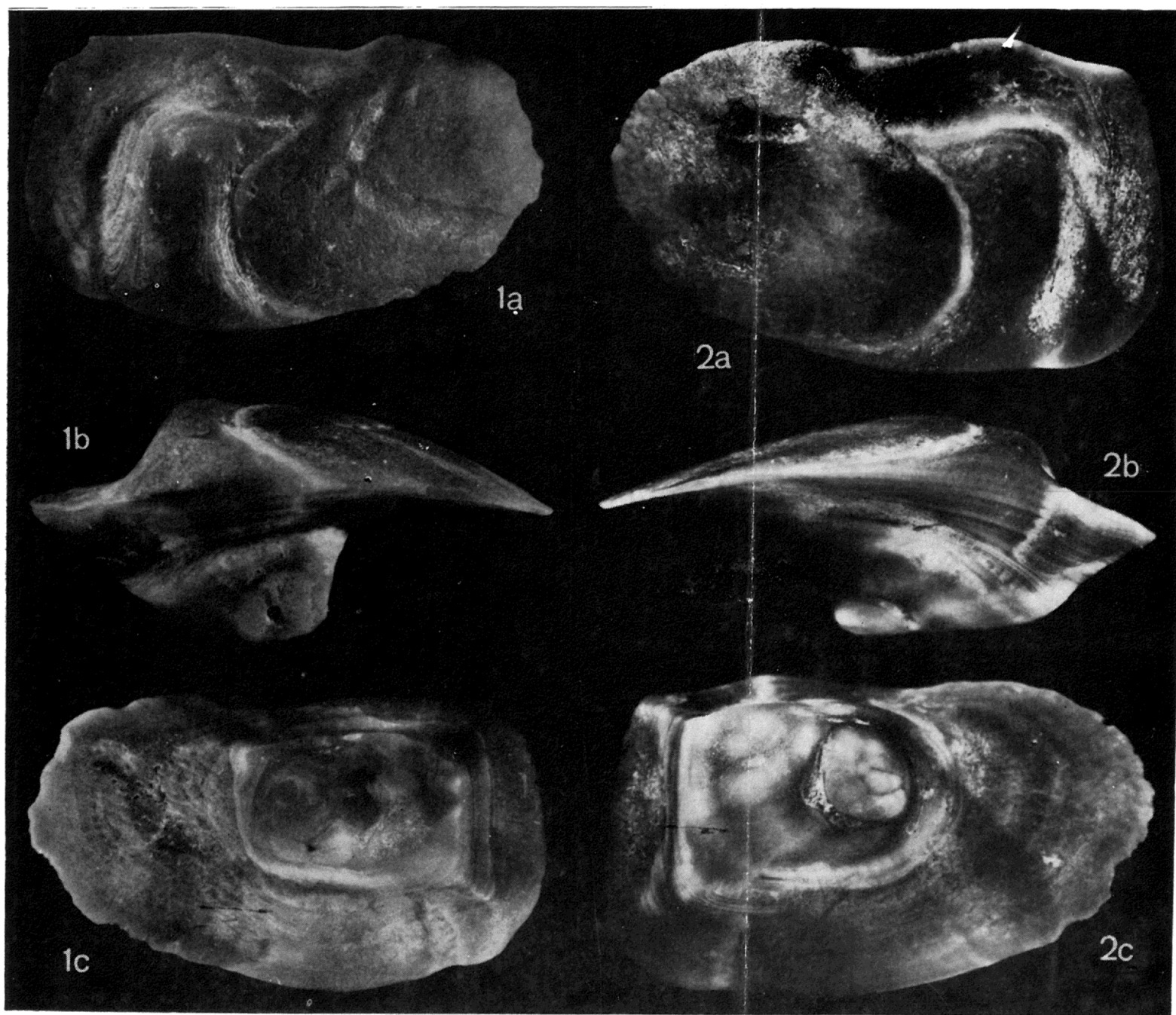
1-3 — *Ariosoma longicaudatum* sp. n.: 1 — holotype (left sagitta), inner side; 2-3 — paratypes (left sagitta), inner side; all  $\times 10$   
 4-5 — *Platycephalus fusiculus* sp. n.; 4 — holotype (left sagitta): 4a inner side, 4b outer side; 5 — paratype (left sagitta): 5a inner side, 5b outer side; all  $\times 15$

Photos taken by L. ŁUSZCZEWSKA, M. Sc.



- 1 — *Platycephalus poyartinensis* STEURBAUT, 1981; left sagitta; 1a inner side, 1b outer side;  $\times 15$   
 2 — *Ariosoma* cf. *moravicum* (SULC, 1932); right sagitta, inner face;  $\times 15$   
 3 — *Echelus arcuatus* sp. n.: holotype (left sagitta); inner side;  $\times 15$   
 4 — *Liza steurbauti* sp. n.; holotype (left sagitta): 4a inner side, 4b outer side;  $\times 10$   
 5-6 — *Sphyraena dentata* sp. n.: 5 — holotype (right sagitta), inner side; 6 — paratype (right sagitta), inner side; both  $\times 10$

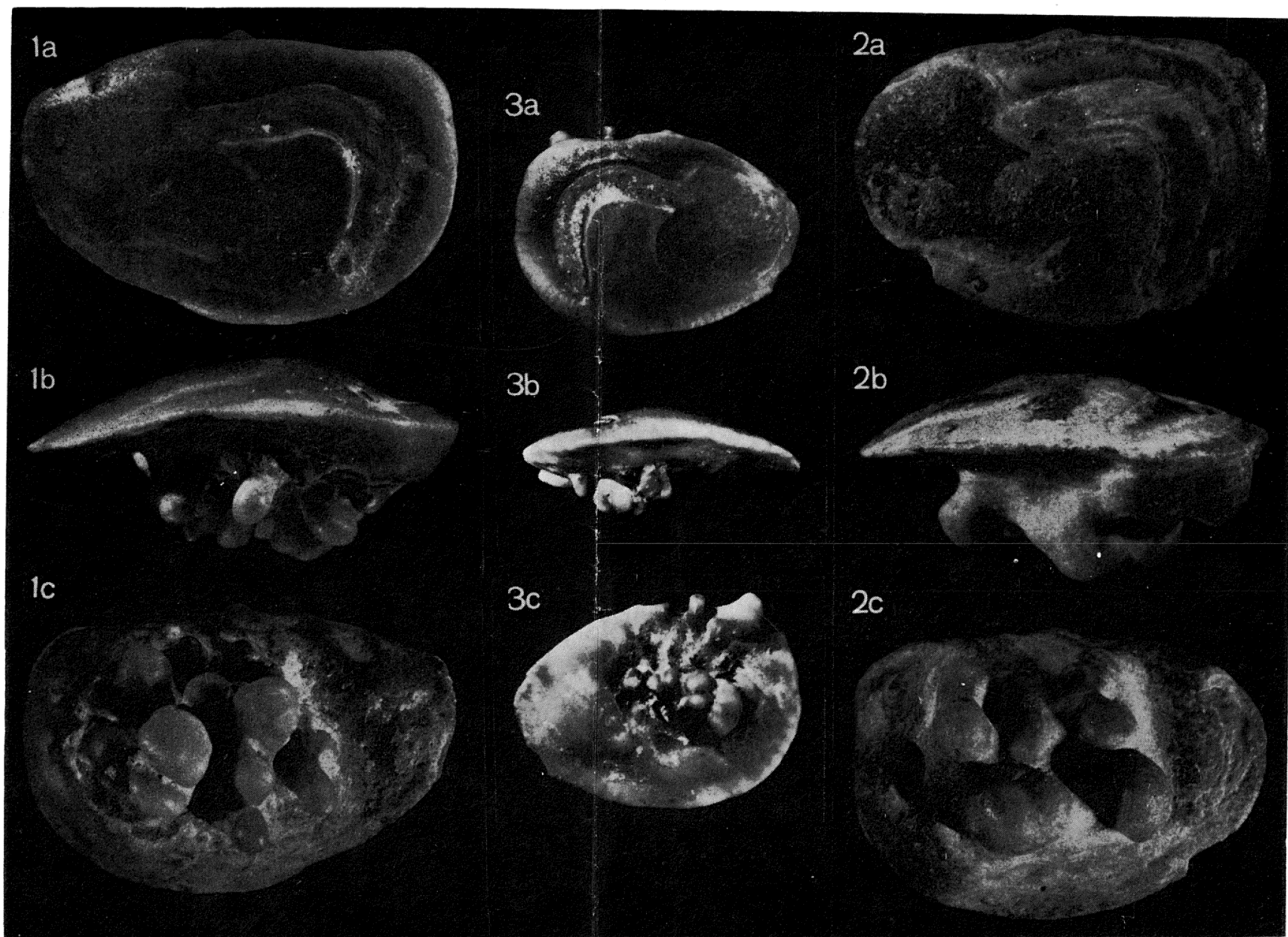
Photos taken by L. ŁUSZCZEWSKA, M. Sc.



*Argyrosomus incisus* sp. n.

1 — holotype (left sagitta): 1a — inner side, 1b — lateral view, 1c — outer side; 2 — paratype (right sagitta): 2a — inner side, 2b — lateral view, 2c — outer side

All photos  $\times 7.5$ ; taken by K. ZIELIŃSKA

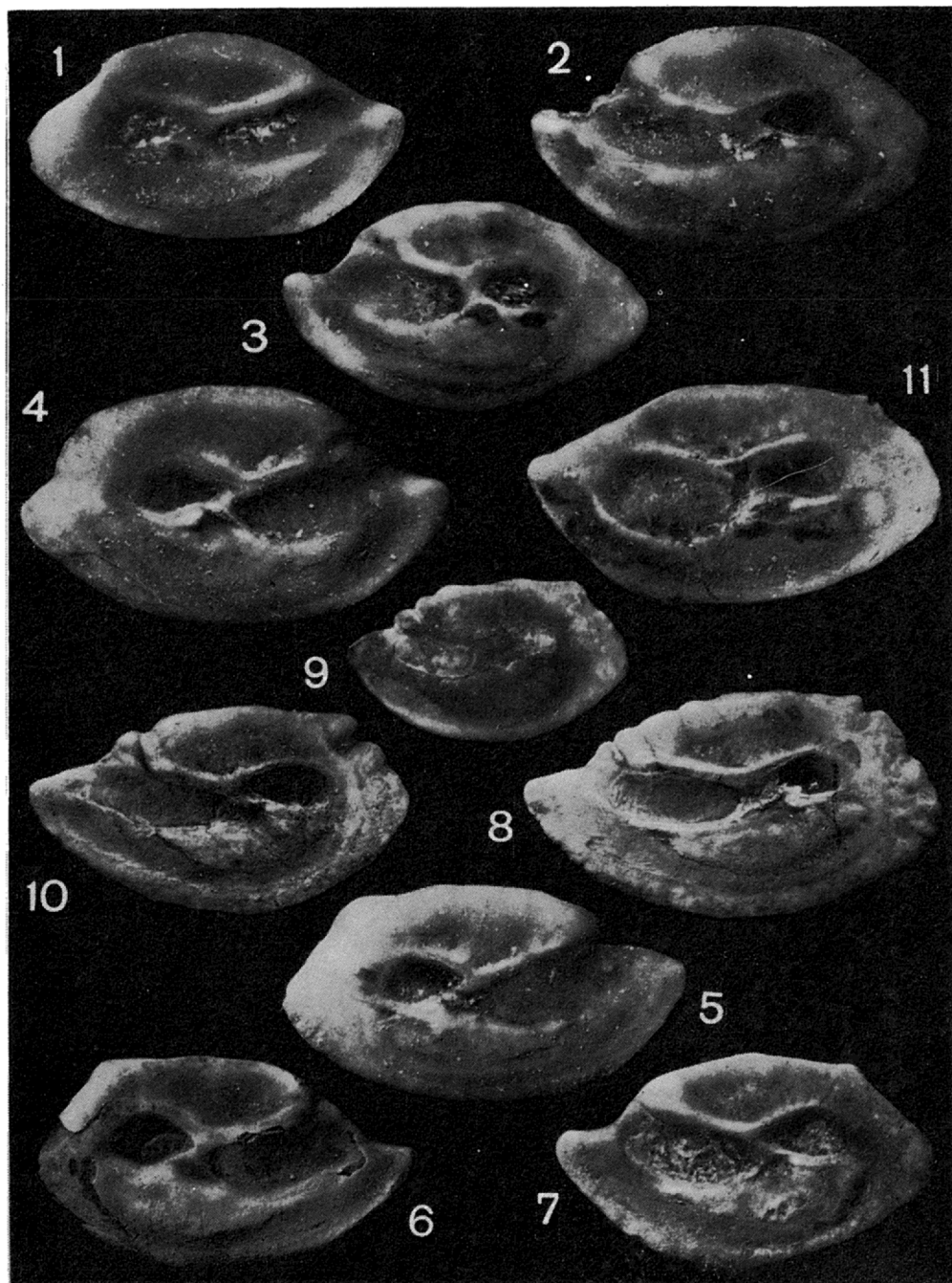


*Argyrosomus polonicus* sp. n.

1 — holotype (right sagitta): 1a — inner side, 1b — lateral view, 1c — outer side; 2 — paratype (right sagitta): 2a — inner side, 2b — lateral view, 2c — outer side; 3 — another paratype (left sagitta of a juvenile specimen): 3a — inner side, 3b — lateral view, 3c — outer side

All photos  $\times 7.5$ ; taken by K. ZIELIŃSKA





- 1-4 — *Cepola macrophthalma* (LINNAEUS, 1758); 1 and 4 — left sagitta, 2 and 3 — right sagitta; all inner side,  $\times 10$   
 5-7 — *Cepola yrieuensis* STEURBAUT, 1981; 5 and 6 — left sagitta, 7 — right sagitta; all inner side,  $\times 10$   
 8-10 — *Cepola multicrenata* sp. n.: 8 — holotype (right sagitta), inner side; 9 and 10 — paratypes (right sagitta), inner side; all  $\times 10$   
 11 — *Cepola* sp.; right sagitta; inner side,  $\times 10$

Photos taken by L. ŁUSZCZEWSKA, M. Sc.