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New Devonian Palliocerida (Cephalopoda, Astrovioidea)

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Abstract—Eight new species of Ostreioceratidae are described from the Lower and Upper Devonian of Novaya Zemlya, Lower Devonian of the Pechora River basin, North Ural Mountains, and the Zeravshan Range: *Ostreioceras admotum, O. simile, O. abruptum, O. sobolevi, Plagiostomoceras kuzmini, P. adumbratum, P.? acerbum*, and *P. vinogradovi.* A new family Bogoslovskyidae is established in the order Palliocerida.

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INTRODUCTION

Astrovioidea is one of the most interesting groups of ectocohliate orthoconic cephalopods. This relatively large lineage that appeared in the Middle Ordovician and continued until at least the Permian showed a tendency to weakening of the rigid siphonal wall by partial or complete destruction of the connecting rings, and intrusion of soft cameral tissue into the siphon to form calcareous deposits. In the early (Ordovician) Astrovioidea the connecting rings were only partially destroyed (order Lituitida), whereas in the Silurian and younger representatives they were apparently completely destroyed or never appeared (order Palliocerida). Previous studies (Collins, 1969; Kolebaba, 1999; Zhuravleva and Doguzhaeva, 2004; and others) showed that Palliocerida is a large taxonomically diverse cephalopod group that was widespread in the Paleozoic. At present, this group includes more than 30 species of 16 genera and six families. In some families the cameral tissue, after having filled the cameral cavity with deposits, sometimes protrudes into the siphonal cavity to form a uniform longitudinal cover, and secretes a layer of metacameral deposits above the cameral deposits (Flowerinidae, Plicatoceratidae). Additionally, in other representatives, in the absence of connecting rings, the soft tissue of the siphonal cord secreted in the opposite direction to ectosiphonal deposits into the cameral cavity (Astroviidae, ? Lamellorthoceratidae). Palliocerids are found in Silurian and Devonian beds of more than 20 localities in Europe, North Africa, Asia, and North America.

This paper deals with the results of the study of new material and literature, which allowed the taxonomic composition of the order to be amended and its stratigraphic and geographical range to be increased.

As a result of reexamination of the collection. eight new palliocerid species were established and described. These species belong to two genera of the family Ostreioceratidae, *Ostreioceras* and *Plagiostomoceras*, from the Lower and Upper Devonian of Novaya Zemlya, the middle reaches of the Pechora River basin, the eastern slopes of the North Ural Mountains, and the Zeravshan Range. Three additional taxa of Ostreioceratidae, the generic and specific affinities of which have not yet been established, have been discovered in the Emsian and Givetian of Novaya Zemlya and the Dalejean of the Zeravshan Range. They are figured in Plate 5 as *O.*? sp. 1 (Pl. 1, fig. 5), *O.*? sp. 2 (Pl. 1, fig. 6), and *O.*? sp. 3 (Pl. 1, fig. 12), respectively.

Additionally, the taxonomy of the genus *Bogoslovskya* is reassessed. This genus was established by the author to include five species from the Devonian of the Ural Mountains, and was assigned to the subfamily Michelinoceratinae of the order Orthocerida (Zhuravleva, 1978). Among genera with an orthoconic shell with an empty, eccentric siphuncle, this genus was distinguished by the very narrow and very thin septal necks, compared to the septum with a thickening on the edge, and by the absence of connecting rings. The origin of the thickening of the neck remained unknown. Such a thickening on the edge of the neck in *B. mira* Zhuravleva was at the time interpreted by the author as a fragment of the destroyed connecting ring, but this interpretation is now subject to serious doubt. At that time cameral deposits were not found.

Three further species of *Bogoslovskya* were subsequently described from the younger (Middle Carboniferous and Carboniferous–Permian) beds of Japan (Niko et al., 1995; Niko and Ozawa, 1997; Niko, 2001). In contrast to the Devonian species, these shells are not smooth but possess transverse ornamentation of lirae or thin riblets. The authors wrote that they had not discov-

Fig. 1. *Bogoslovskya perspicua* Zhuravleva, 1978; specimen PIN, no. 2669/369, median section of the siphuncle, ×34.5: extremely thin (compared to the septum) funnel-shaped septal necks widening toward the thickened (turned outwards) edge; Aktyubinsk Region, Chernyi Yar River, right bank, 6 km west of the village of Sukhinovka; Upper Devonian, Famennian, *Prolobites–Platyclymenia* Genozone.

ered cameral deposits, but indicate the presence of a small ring of auxiliary calcareous deposits in the septal foramen of all three species; they did not illustrate a transverse section through the septal foramen showing this ring.

At the same time, a longitudinal sections of these species made through the siphuncle show the presence of epi- and hyposeptal layers of calcite composed of elongated crystalline structures, which embrace part of the septum and septal neck. For instance, the section through the siphuncle of *B. aklyoshiensis* (Niko et al., 1995, text-fig. 1, figs. 13, 14) shows that a thin layer of the episeptal calcareous deposits enters the septal neck from the ventral and dorsal sides, whereas the hyposeptal layer embraces the entire neck from the adapical end. A similar pattern is observed in the section of the siphuncle of *B. micharanoroensis* (Niko and Ozawa, 1997, text-fig. 1, fig. 1) and in *B. omiensis* (Niko, 2000, text-fig. 1, fig. 8). These calcareous layers are most similar in their position and shape to the cameral deposits in the palliocerid genus *Ostreioceras* and, in my opinion, may be interpreted as recrystallized cameral deposits. In this case the thin calcite ring in the septal foramen that was noted by the above authors may be a continuation of episeptal cameral deposits that entered the septal neck.

A more detailed study of the shell of *B. perspicua* Zhuravleva essentially supplemented the knowledge of its internal structure. Photographs of medial sections of the shell through the siphuncle (both optical and SEM) show the auxiliary layer on the edge of the septal neck that most of all resembles the very edge of the neck turned outwards. In its composition and structure, although changed, this layer is not distinguished from the neck (Pl. 1, fig. 13; Figs. 1, 2a–2c). A similarly turned edge of the neck is observed in some palliocerids; for instance, in *Ostreioceras riphaeum* (Zhuravleva) (Fig. 2d).

The presence in *Bogoslovskya* of cameral deposits that entered the septal foramen is supported by our material. For instance, the longitudinal section in one fragment of the shell of *B. perspicua* clearly shows that the episeptal calcareous deposits in two chambers enter the septal neck, whereas in the adjacent chamber, the hyposeptal deposits completely embrace the thin septal neck (Pl. 1, fig. 14). In another fragment, a trace of "pseudoseptum" may be observed between the epi- and hyposeptal calcareous deposits, which indicates the lifetime origin of these deposits (Pl. 1, fig. 13).

The above characters of the shell observed in the genus *Bogoslovskya*, i.e., a thickened edge of the septal neck, apparently turned outwards; cameral deposits that entered the septal foramen from the septa, and the absence of any traces of connecting rings, suggest lifetime destruction of the connecting rings in the siphonal wall in this genus, which makes it similar to palliocerids and suggests that these taxa were related. Consequently, it seems more reasonable to move the genus *Bogoslovskya* from the order Orthocerida to the order Palliocerida, and assign it to a new family, Bogoslovskyidae.

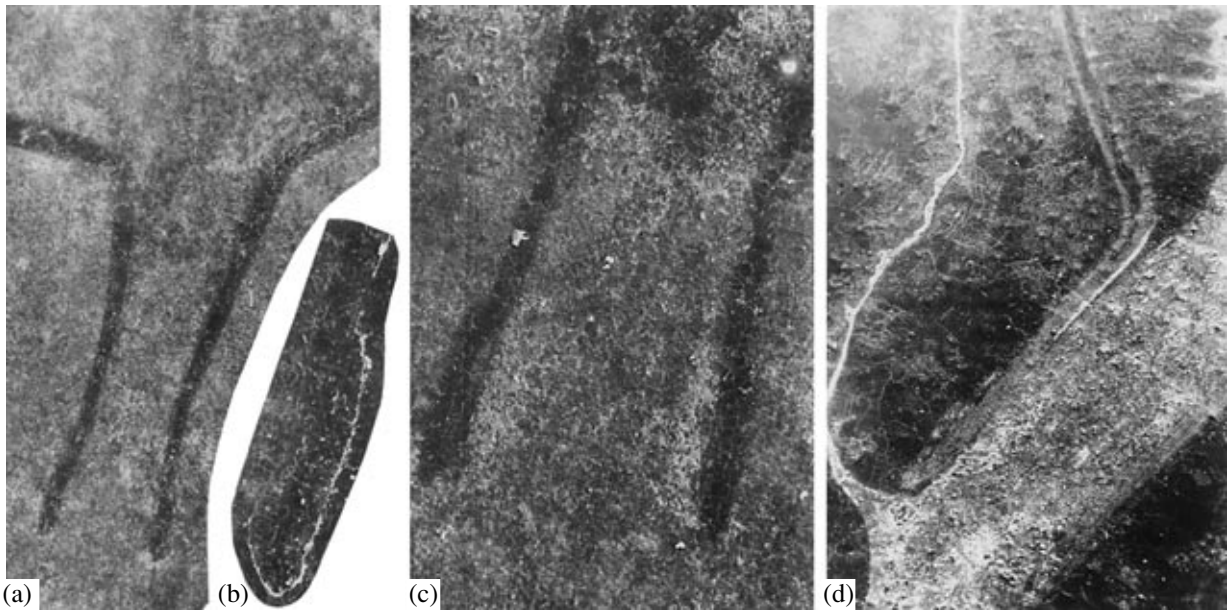


Fig. 2. The septal necks of the Ostreioceratidae (SEM photograph): (a–c) *Bogoslovskya perspicua*; specimen PIN, no. 1359/1007, septal neck: (a) funnel-shaped neck, slightly widening toward the thickened edge, ×30, (b) end of the septal neck, right side, the edge of the neck is turned outwards, ×86, (c) end of another neck, widening to the edge turned outwards, ×74; Aktyubinsk Region, Chernyi Yar River, 6 km from the village of Sukhinovka; Upper Devonian, Famennian, *Prolobites–Platyclymenia* Genozone; (d) *Ostreioceras riphaeum* (Zhuravleva, 1978; specimen PIN, no. 1359/145, part of the segment of the siphuncle in the median section, ×20: part of the septum and neck with the edge turned outwards, embraced in the episeptal and hyposeptal cameral deposits; Sverdlovsk Region; left bank of the Bobrovka River, 400 m south-southwest of the cupola furnace at the village of Pokrovskoe; Middle Devonian, Lower Eifelian.

SYSTEMATIC PALEONTOLOGY

CLASS CEPHALOPODA

Superorder Astrovioidea Zhuravleva et Doguzhaeva, 2004

Order Palliocerida Marek, 1998

Family Ostreioceratidae Zhuravleva, 2004

Diagnosis. Shell orthoceraconic, longiconic, rounded or laterally compressed. Surface smooth, or with thin transverse ornamentation. Suture straight or with dorsal and ventral saddles. Siphuncle narrow and eccentric. Septal necks orthochoanitic. Connecting rings unknown. Endo- and ectosiphonal deposits absent. Cameral deposits entering siphonal cavity through septal neck and in spaces between necks. Metacameral deposits absent.

Composition. Genera *Ostreioceras* Zhuravleva, 2004 and *Plagiostomoceras* Teichert et Glenister, 1952 from Upper Silurian (Ludlow–Upper Devonian (Frasnian–Famennian) of the Czech Republic, Great Britain, Australia, Canada, Russia, and Tajikistan (Zeravshan Range).

Genus *Ostreioceras* Zhuravleva, 2004

Ostreioceras: Zhuravleva and Doguzhaeva, 2004, p. 28.

Type species. *Sinoceras riphaeum* Zhuravleva, 1978; Middle Devonian, Lower Eifelian; eastern slope of the Middle Ural Mountains, Gornyi Altai.

Diagnosis. Shell smooth and usually rounded in cross section. Suture straight-transverse or straight-oblique. Septal necks relatively long, often with thickened edge. Cameral deposits protruding in siphonal cavity through septal necks and between necks. At later ontogenetic stages mural deposits often separated from episeptal deposits.

Species composition. Eight species: *O. riphaeum* (Zhuravleva, 1978), *O. superplenum* (Collins, 1969), *O. thomsoni* (Barrande, 1866), *O. komiense* (Zhuravleva, 1978), *O. admotum* sp. nov., *O. simile* sp. nov., *O. abruptum* sp. nov., and *O. sobolevi* sp. nov. from the Silurian of Great Britain, Lower Devonian (Emsian) of Novaya Zemlya, North Ural Mountains, middle reaches of the Pechora River, ?Zeravshan Range, Middle Devonian (Eifelian) of the Middle Ural Mountains, Gornyi Altai, northern Canada, Middle Devonian (Givetian)–Upper Devonian (Frasnian–Famennian) of Novaya Zemlya.

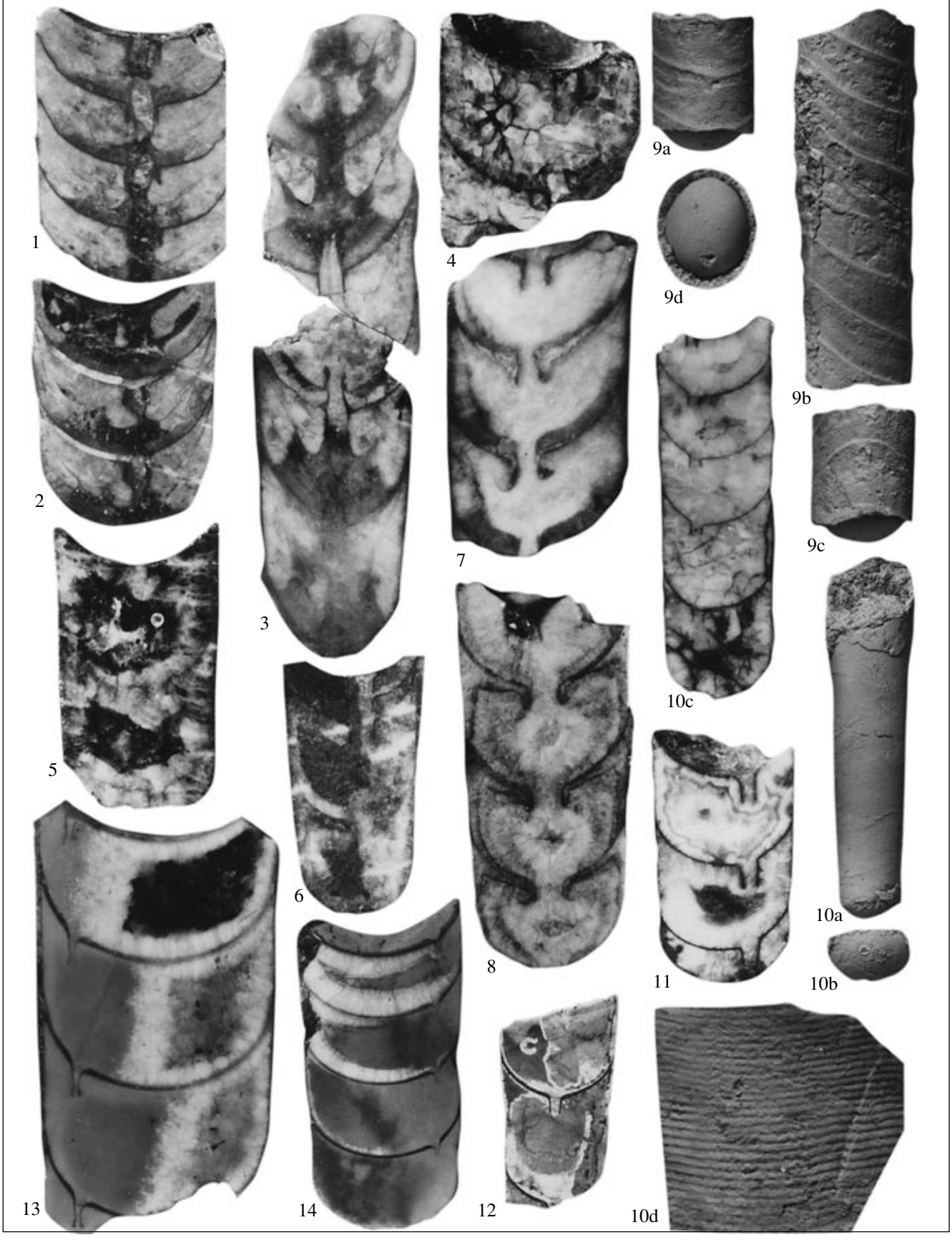
***Ostreioceras admotum* Zhuravleva, sp. nov.**

Plate 1, figs. 1 and 2

Etymology. From the Latin *admotus* (close).

Holotype. PIN, no. 3822/838; Novaya Zemlya, Yuzhnyi Island, between Kozlova and Selezneva Bays, 2.3 km west of the Selezneva Cape and 1.3 km northeast of the Perevesinskii Cape; Lower Devonian, ?Emsian.

Plate 1



Description. The shell is slowly expanding, and possibly laterally compressed in transverse section. The expansion angle is about 3°–4°. The suture is apparently straight-transverse. The chambers are short. Their length is 0.3–0.4 of the phragmocone diameter. The septa are concave for a distance of approximately the length of one chamber.

The siphuncle is slightly displaced from the center, apparently toward the ventral side. Its diameter in the septal foramen is about 0.2 of the median diameter of the phragmocone. The septal necks slightly expand toward the margin. Their length is about 0.25–0.30 of the length of the chamber. Connecting rings are absent.

The cameral deposits almost entirely fill the cavity of the chamber in the adapical part of the phragmocone. The mural-episeptal deposits become separated into thin episeptal deposits and thicker mural deposits as the shell grows. The episeptal deposits on one side run through the septal neck and become fused with the hyposeptal deposits of the previous chamber that embrace the edge of the neck, and on another side become thicker to form a high adoral ring around the siphon. The mural deposits are somewhat behind the epi- and hyposeptal deposits on their way to the siphuncle. At the late growth stages, the hyposeptal deposits are almost in contact with the mural deposits. In places thin-layered structures may be observed in the mural and episeptal deposits. Closer to the siphuncle, the episeptal deposits in places show columnar structure. Part of the siphonal cavity free from cameral deposits is often filled with amorphous white calcite.

Comparison. This species is distinguished from *O. superplenum* by the shorter septal necks, slightly expanding toward the margin, and by the configuration of the hyposeptal deposits. Additionally, it differs from *O. riphaeum* and *O. simile* in the shorter chambers.

Remarks. All six short fragments, which probably belong to no more than two shells, are distorted to varying extents, preventing precise identification of their transverse section. Therefore, the measurements above are not quite accurate.

Material. Holotype and five fragments (coll. by G.I. Kharitonovichev, 1975, sample no. 77/2).

***Ostreioceras simile* Zhuravleva, sp. nov.**

Plate 1, fig. 3

Etymology. From the Latin *similis* (similar).

Holotype. PIN, no. 2438/24; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Explanation of Plate 1

Figs. 1 and 2. *Ostreioceras admotum* sp. nov., ×2.5; (1) holotype PIN, no. 3822/838, (2) paratype PIN, no. 3822/839; Novaya Zemlya, Yuzhnyi Island, between the Kozlov and Seleznev Bays, 2.3 km west of the Seleznev Cape and 1.3 km northeast of the Pereves-inskii Cape; Lower Devonian, ?Emsian.

Fig. 3. *Ostreioceras simile* sp. nov.; holotype PIN, no. 2438/24, almost median section, ventral side on the right, ×3; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Fig. 4. *Ostreioceras abruptum* sp. nov.; holotype PIN, no. 1819/119, median section, ventral side on the right, ×3; eastern slope of the North Ural Mountains, Zabolotnaya River (left tributary of the Volchanka River), near the mouth of the Khlebopashenskii Valley; Lower Devonian, Upper Emsian.

Fig. 5. *Ostreioceras* ? sp. 1; specimen PIN, no. 3822/820, median section of two chambers, ×2.5: hyposeptal cameral deposits embrace the edge of the septal neck; Novaya Zemlya, Yuzhnyi Island, Tisengausen Cape; Middle Devonian, Givetian, Chernogub-skii Horizon.

Fig. 6. *Ostreioceras* ? sp. 2; specimen PIN, no. 3822/1259, median section, ×5: edge of the septal necks is thickened, cameral deposits extend into the siphonal cavity; Novaya Zemlya, Yuzhnyi Island, Kabanii Peninsula; Lower Devonian, Emsian, Sinelninskii Horizon, *Gracilites svetlanae* Zone.

Fig. 7. *Plagiostomoceras adumbratum* sp. nov.; holotype PIN, no. 2438/37, almost median section, ventral side on the left, ×3.5: episeptal deposits extend through the septal neck; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Fig. 8. *Plagiostomoceras ? acerbum* sp. nov.; holotype PIN, no. 2438/26, median section of a phragmocone fragment, ×6.3; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Fig. 9. *Plagiostomoceras kuzmini* sp. nov.; holotype PIN, no. 3822/890: (9a) ventral side, ×2.9, (9b) lateral side, ventral side in on the right, ×2.3; (9c) dorsal side, ×2.9; (9d) septal view, ×2.9; Novaya Zemlya, Yuzhnyi Island, Kalvits Bay; Lower Devonian, Emsian, Sinelninskii Horizon, *Ljudmilispirifer latihumerus–Biconostrophia kabaniensis.*

Fig. 10. *Plagiostomoceras vinogradovi* sp. nov.; holotype PIN, no. 1645/63: (10a) body chamber from the lateral side, ventral side on the left, ×1, (10b) septal view, ventral side on the left, ×3, (10c) median section of the phragmocone, ×4, (10d) ornamentation on the lateral side, ×8; Zeravshan Range, Chukalik Sai; ?Lower Devonian, Dalejean.

Fig. 11. *Ostreioceras sobolevi* sp. nov.; holotype PIN, no. 3822/804a, median section, ventral side on the right, ×3: episeptal deposits extend through the septal neck, hyposeptal deposits embrace a slightly thickened edge of the septal neck; Novaya Zemlya, Kostin Shar Strait, Vypuklyi Peninsula; Upper Devonian, Frasnian–Famennian, Val'kovskaya Group.

Fig. 12. *Ostreioceras*? sp. 3; specimen PIN, no. 1645/33, funnel-shaped necks, connecting rings are absent, ×1.5; Zeravshan Range, left slope of the Chukhalib Sai; ?Lower Devonian, Dalejean.

Figs. 13 and 14. *Bogoslovskya perspicua* Zhuravleva, 1978; (13) specimen PIN, no. 2669/399, median section showing thin funnel-shaped septal necks expanding toward the thickened edge, ×10; Aktyubinsk Region, Chernyi Yar River, 6 km west of the village of Sukhinovka, Upper Devonian, Famennian, *Prolobites–Platyclymenia* Genozone; (14) specimen PIN, no. 1482/387, median section, ×2.6: in the third chamber the episeptal cameral deposits extend into the septal neck, and in the next chamber the hyposeptal deposits embrace the septal neck; the same age and locality.

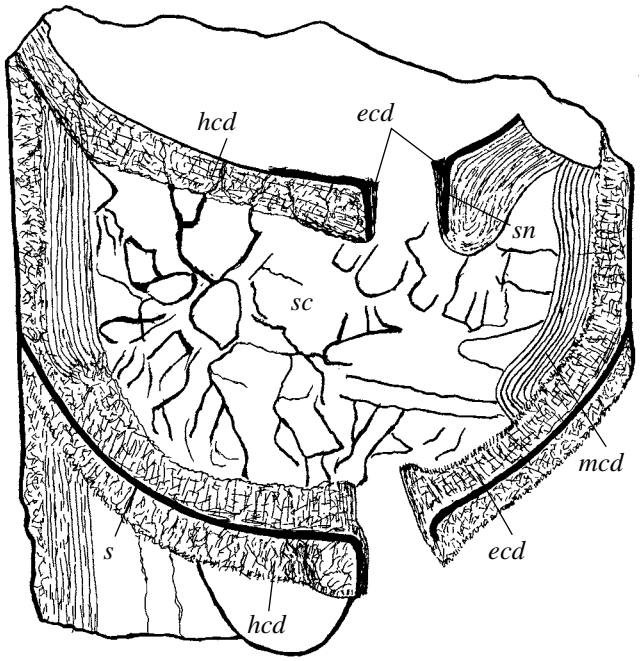


Fig. 3. *Ostreioceras abruptum* sp. nov.; specimen PIN no. 1819/119, median section of the part of the phragmocone, ×6; episeptal cameral deposits extend into the septal neck, hyposeptal deposits embrace edge of the septal neck, mural deposits lie on the episeptal and are behind them on the way to the siphuncle; eastern slope of the North Ural Mountains, Zabolotnaya River (left tributary of the Volchanka River), near the mouth of the Khlebopashenskii Valley; Lower Devonian, Upper Emsian. Explanations: (*sc*) siphonal cavity, (*s*) septum, (*sn*) septal neck, (*ecd*) episeptal cameral deposits, (*hcd*) hyposeptal cameral deposits, and (*mcd*) mural cameral deposits.

D e s c r i p t i o n. The shell is circular in transverse section, or possibly slightly compressed laterally. The length of the chamber is 0.8–1.0 of the phragmocone diameter and decreases toward the aperture. The septa are concave for a distance of approximately half the chamber length. The suture is apparently slightly inclined to the ventral side of the shell.

The siphuncle is narrow, slightly displaced ventrally. Its diameter in the septal foramen varies from 0.12 to 0.16 of the phragmocone diameter. The septal necks are orthochoanitic, short, as long as 0.18–0.20 of the length of the chamber. The connecting rings are unknown. The intrasiphonal deposits characteristic of other cephalopod groups are absent. However, the cavity formed in place of the destroyed soft siphuncle and bounded by the inner surface of the cameral deposits contains a thick, tube-shaped calcareous layer lacking any definite structure.

Cameral deposits on the siphonal side of the shell (apparently the ventral side) are more strongly developed. The episeptal deposits are relatively thin, embrace the soft siphuncle to form a low ridge near it, whereas the hyposeptal deposits only slightly protrude beyond the edge of the septal neck. Mural deposits are noticeably behind the hyposeptal deposits on their way to the siphuncle. The mural and hyposeptal deposits are adjacent to each other and are separated by a thin "pseudoseptum."

C o m p a r i s o n. This species is distinguished from *O. riphaeum* by the small shell, shorter septal necks (0.18–0.20 instead of 0.30–0.33 of the chamber length), and less strongly developed mural deposits. It differs from *O. superplenum* in the longer chambers, short septal necks (0.10–0. 25 instead of 0.55–0.70 of the chamber length) and less developed hyposeptal deposits, which do not contact episeptal deposits. It is different from *O. admotum* in having longer chambers (1.0–0.8 instead of 0.3–0.4 of the shell diameter), shorter necks (0.18–0.20 instead of 0.25–0.30 of the chamber length), and in the less strongly developed hyposeptal deposits.

M a t e r i a l. Holotype, a fragment 400 mm long and 11 mm wide, and five short phragmocone fragments (coll. by I.A. Pershina in 1964, Outcrop 2, Bed 21, Sample 22).

***Ostreioceras abruptum* Zhuravleva, sp. nov.**

Plate 1, fig. 4

E t y m o l o g y. From the Latin *abruptus* (abrupt).

H o l o t y p e. PIN, no. 1819/119; eastern slope of the North Ural Mountains, Zabolotnaya River (left tributary of the Volchanka River), near the mouth of the Khlebopashenskii Valley; Lower Devonian, Upper Emsian.

D e s c r i p t i o n (Fig. 3). The shell is slightly compressed laterally, with a lateral diameter/dorsoventral diameter ratio of 1.07–1.09. The surface of the mold is small. The chamber length is 0.47–0.52 of the phragmocone diameter. The septa are concave for a distance of approximately half of the chamber length.

The siphuncle width is 0.12–0.13 of the phragmocone diameter. The siphuncle is strongly displaced from the center and occurs at a distance of 0.28 of the phragmocone diameter from one wall (apparently ventral) and at a distance of 0.53 of the phragmocone diameter from another wall. The septal necks are short and orthochoanitic. Their length is 0.14 of the chamber length. The connecting rings and intrasiphonal deposits are absent.

The cameral deposits are more strongly developed on the siphonal side. A thin layer of episeptal deposits enters the septal foramen. These deposits, first thinly layered, become columnar in structure nearer to the siphuncle. A thin layer of mural deposits directly overlay the episeptal deposits but are significantly behind those on the way to the siphuncle. The mural deposits partly preserve their structure of thinly undulating layers. The hyposeptal deposits extend slightly into the siphonal cavity and embrace the edge of the septal neck.

C o m p a r i s o n. This species is distinguished from the two above species in the weakly developed mural

deposits, which are not separated from the episeptal deposits by empty space.

Material. Holotype, a fragment of a phragmocone 13 mm in diameter, composed of 1.2 chambers. Specimen no. 1819/191 (fragment of a phragmocone 35 mm long with an adapical diameter of 4 mm and consisting of 12 chambers) possibly also belongs to this species (Coll. by N.S. Lisov in 1959, Outcrop 1787, Sample 1787 and B.I. Bogoslovsky in 1960, Sample 112/1).

Ostreioceras sobolevi Zhuravleva, sp. nov.

Plate 1, fig. 11

Etymology. In honor of the geologist N.N. Sobolev.

Holotype. PIN, no. 3822/804a; Novaya Zemlya, Yuzhnyi Island, Kostin Shar Strait, Vypuklyi Peninsula; Upper Devonian, Upper Frasnian–Famennian, Val'kovskaya Group.

Description. The shell expands at an angle of 4°–5°, slightly compressed laterally in transverse section. The lateral diameter/dorsoventral diameter ratio is 1.04–1.08. The wall is thin. The surface is smooth. The chambers are long, 0.64–0.65 of the phragmocone diameter. The septa are concave for a distance of about half of the chamber length and are perpendicular to the longitudinal axis of the shell.

The siphuncle diameter in the septal foramen is 0.10–0.12 of the phragmocone diameter. It is at a distance of one-quarter of the phragmocone diameter from the closest wall. The length of the septal necks is 0.30–0.32 of the chamber length. They become narrower towards the slightly thickened margin. The connecting rings and intrasiphonal deposits are absent.

The episeptal and hyposeptal cameral deposits are present. The episeptal deposits extend through the septal neck and are fused with the hyposeptal deposits of the previous chamber that embrace the edge of the septal neck.

Comparison. This species is distinguished from *O. abruptum* by the longer chambers (0.64–0.65 instead of 0.47–0.52 of the phragmocone diameter), longer septal necks having a slightly thickened edge (0.30–0.32 instead of 0.14 of the chamber length). In addition, it differs from the other above species by the weakly developed mural cameral deposits.

Material. Holotype (fragment of phragmocone 15 mm long, with an adoral diameter of 7 mm), and three or four short fragments of shell in rock matrix (Coll. by N.N. Sobolev in 1982, Sample 8204-4 f).

Genus *Plagiostomoceras* Teichert et Glenister, 1952

Plagiostomoceras: Teichert and Glenister, 1952, p. 741; Balashov and Zhuravleva, 1962, p. 83; Sweet, 1964, p. 226; Kuzmin, 1965, p. 9; Zhuravleva, 1978, p. 44; Kolebaba, 1999, p. 9.

Type species. *Orthoceras pleurotomum* Barrande, 1866; Upper Silurian, Ludlow; Barrandian.

Diagnosis. Shell laterally compressed in transverse section. Surface usually with transverse ornamentation inclined towards ventral side and reflecting shape of aperture. Siphuncle narrow, occurring closer to ventral wall than to dorsal wall. Septal necks orthochoanitic, often with thickened edge. Connecting rings unknown. Cameral deposits, both mural-episeptal and hyposeptal, extending into siphonal cavity. Hyposeptal deposits embracing edge of septal neck.

Species composition. Eight species: *P. pleurotomum* (Barrande, 1866), *P. thomasi* Teichert et Glenister, 1952, *P. calvicense* Kuzmin, 1965, *P. devingtale* Zhuravleva, 1978, *P. kuzmini* sp. nov., *P. vinogradovi* sp. nov., *P. adumbratum* sp. nov., *P.? acerbum* sp. nov. from the Upper Silurian (Ludlow)–Upper Devonian (Frasnian) of the Czech Republic, Australia, Novaya Zemlya, North Ural Mountains (Niz'va River), middle reaches of the Pechora River basin.

Comparison. This genus is distinguished from *Ostreioceras* by the shell laterally compressed in transverse section, with transverse ornamentation and cameral deposits, of which the mural deposits are less developed than the episeptal deposits and are not separated from the latter.

Remarks. In the holotype of the type species *P. pleurotomum*, the inner structure of the shell is unknown. Cameral deposits were found by I. Kolebaba in several topotypes, which he assigned to this genus. The longitudinal dorsoventral and transverse sections of the adapical parts of apparently small shells show the presence of mural-episeptal deposits (Kolebaba, 1999, pl. 3). The longitudinal sections show hyposeptal deposits, which extend into the siphonal cavity and embrace the thickened edge of the septal necks. Interestingly, the cameral deposits in these shells are more massive on the side opposite the siphonal side (Kolebaba, 1999, pl. 3, figs. 4–6).

Plagiostomoceras kuzmini Zhuravleva, sp. nov.

Plate 1, fig. 9

Etymology. In honor of the geologist A.M. Kuzmin.

Holotype. PIN, no. 3822/890; Novaya Zemlya, Yuzhnyi Island, Kalvits Bay; Lower Devonian, Emsian, Sinelninskii Horizon, *Ljudmilispirifer latihumerus–Biconostrophia kabaniensis* Zone.

Description. The shell expands towards the aperture at an angle of 2.5°–3.0° and is oval and laterally compressed in cross section. The ratio of the lateral to dorsoventral diameters is 1.19–1.20. The shell surface possesses very thin widely spaced ribs, strongly oblique toward the ventral side where they form a broad sinus. On the dorsal side the ribs form a high, narrow ridge. A distance of shell equal to the median diameter contains 2.5–3.0 ribs.

Weak, smooth rings parallel to the ribs and hardly noticeable densely spaced longitudinal striae are

observed in wide spaces between the ribs. The length of the chambers is approximately half the length of the median diameter. The septa are concave for a distance of about half the chamber length. The suture has weak dorsal and ventral saddles.

The siphuncle diameter is 0.08–0.10 of the median phragmocone diameter, occurring at a distance of 0.20–0.23 of this diameter from the ventral wall. The length of the septal necks is 0.2 of the chamber length. They are symmetrical and slightly narrowing towards the edge. The connecting rings and intrasiphonal deposits were not observed. The cameral deposits are apparently recrystallized.

Comparison. This species is distinguished from the other species of this genus by the ornamentation of widely spaced ribs separated by wide spaces with smooth low rings and weak, thin longitudinal striae.

Remarks. The shell is black, with a recrystallized interior. Therefore, the septa and septal necks are hardly visible under the optical microscope. Unfortunately, they are not visible on the photograph. Apparently, for the same reason Kuzmin (1965, pl. 1) did not illustrate the details of the interior of the shell in his species *P. calvicense.*

Material. Holotype (part of the shell 110 mm long, with an adoral diameter of 9.5 mm, and adapical diameter of 6.5 mm, separated into seven pieces) (Coll. by S.V. Cherkesova and A.M. Kuzmin in 1961–1963, Outcrop 133, Sample 3).

***Plagiostomoceras adumbratum* Zhuravleva, sp. nov.**

Plate 1, fig. 7

Etymology. From the Latin *adumbratus* (obscured in shadows).

Holotype. PIN, no. 2438/37; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Description. The shell slowly expands toward the aperture and is apparently compressed laterally in transverse section. The surface of the mold is smooth. The shell wall is poorly preserved. No traces of ornamentation were observed. The chambers are of medium length, approximately half of the phragmocone diameter. The septa are concave for a distance of approximately half of the chamber length and are inclined towards the ventral side. The suture is inclined ventrally.

The siphuncle in the septal foramen has a diameter of 0.10–0.12 of the phragmocone diameter. It is displaced ventrally to a distance of 0.06 of the phragmocone diameter. The septal necks are orthochoanitic, with a thickened edge. Their length is about 0.2 of the chamber length. Connecting rings were not observed. Intrasiphonal deposits are absent.

The cameral deposits are more strongly developed on the siphonal (probably ventral) side. The mural deposits gradually transit into the episeptal deposits, which extend in a thin layer through the septal neck and adjoin the hyposeptal deposits of the preceding chamber that embraces the neck edge. The episeptal deposits have partly retained their original structure.

Comparison. This species is distinguished from the type species *P. pleurotomum* by the larger shell with relatively shorter chambers and by the cameral deposits in which the episeptal deposits are not interrupted approaching the siphuncle but extend through the septal neck to meet the hyposeptal deposits of the preceding chamber.

Remarks. The holotype is slightly distorted. Therefore, some of the measurements given in the description are approximate.

Material. Holotype (slightly distorted fragment of three chambers from the middle part of a phragmocone, 20 mm long, with adapical diameter of 12 mm) (Coll. by A.I. Pershina in 1964, Outcrop 2, Sample 20).

***Plagiostomoceras? acerbum* Zhuravleva, sp. nov.**

Plate 1, fig. 8

Etymology. From the Latin *acerbus* (unripe).

Holotype. PIN, no. 2438/26; right tributary of the Pechora River in its middle reaches, Iordanskii Valley; Lower Devonian, Upper Emsian.

Description. The shell is circular in transverse section and expands at angle of 4°–5°. The surface is smooth. The chambers are of medium length, 0.54–055 the phragmocone diameter in its adapical part. The septa are concave for a distance of about 0.4 the chamber length and are perpendicular to the longitudinal axis of the shell. The suture in the adapical part is straight-transverse.

The siphuncle is almost central. Its diameter in the septal foramen is about 0.22–0.23 the phragmocone diameter. The septal necks are orthochoanitic, short, 0.20–0.22 the chamber length. Connecting rings were not observed. Intrasiphonal deposits are absent.

Cameral deposits, both mural-episeptal and hyposeptal are developed slightly better on one side of the phragmocone (probably ventral) than on the other. The first layer of mural-episeptal deposits is the most distinctly outlined. It becomes thinner towards the foramen and extends as a thin layer through the septal neck towards the hyposeptal deposits of the preceding chamber. The thicker first layer of the hyposeptal deposits also becomes slightly thinner, reaching the edge of the septal neck where it terminates. The second layer of both episeptal and hyposeptal deposits does not reach the edge of the septal neck. The third and fourth layers of both types of deposits completely embrace the septum and the neck together with the preceding layers. All deposits consist of elongated crystalline structures that are perpendicular to the layers.

Comparison. This species differs from the other species of this genus in the shell being rounded in cross section, in the almost central siphuncle, and in the configuration of the cameral deposits.

R e m a r k s. The unusual character of the cameral deposits, which almost completely fill the siphonal cavity, casts some doubts on the assignment of this species to the genus *Plagiostomoceras*.

M a t e r i a l. Holotype (fragment of the adapical part of the phragmocone, 12 mm long, with an adapical diameter of 4.5 mm, composed of 3.5 chambers) (Coll. by A.I. Pershina in 1964, Outcrop 2, Sample 19).

***Plagiostomoceras vinogradovi* Zhuravleva, sp. nov.**

Plate 1, fig. 10

E t y m o l o g y. In honor of the geologist P.D. Vinogradov.

H o l o t y p e. PIN, no. 1645/63; Zeravshan Range, Chukalik Sai; ? Lower Devonian, Dalejean.

D e s c r i p t i o n. The shell expands in a dorsoventral direction at an angle of 6°–7° and in a lateral direction at an angle of 4°–5°. The shell is oval in transverse section, laterally compressed, with a lateral diameter/dorsoventral diameter ratio of 1.13–1.19 in the adapical part and 1.23–1.25 in the adoral part. The surface possesses transverse ornamentation consisting of thin, densely spaced, distinct lirae forming a dorsal crest, a lower ventral crest, and a broad lateral sinus between them. The chambers are as long as 0.53–0.73 of the dorsoventral phragmocone diameter and decrease adorally. The septa are concave for a distance of approximately half of the chamber length and are perpendicular to the shell axis.

The siphuncle is narrow. Its width in the septal foramen is 0.09–0.10 of the median phragmocone diameter. The siphuncle is displaced from the center for a distance twice as long as its diameter. The septal necks are orthochoanitic, short, 0.13–0.14 the chamber length. The connecting rings were not observed. The intrasiphonal deposits are absent.

The cameral deposits, apparently mural-episeptal and hyposeptal (see the two last chambers in Pl. 1, fig. 10c), are recrystallized.

C o m p a r i s o n. This species is distinct from the type species and *P. calvicense* in the larger angle of the shell expansion (6°–7° and 4°–5° instead of 3°) and in the siphuncle being more strongly displaced from the center. It is additionally distinguished from *P. kuzmini*, by the ornamentation consisting of thin, densely spaced, distinct lirae.

M a t e r i a l. Together with the holotype (fragment of a phragmocone 18 mm long, with a maximum diameter of 6.2 mm, consisting of five chambers), four very short fragments of small shells and one almost complete body chamber of a relatively large shell were found (Coll. by P.D. Vinogradov in 1958, Outcrop 12, Sample 12a).

Family Bogoslovskyidae Zhuravleva, fam. nov.

D i a g n o s i s. Shell orthoceraconic, longiconic, slowly expanding, circular or laterally compressed in cross section. Surface smooth or with thin transverse ornamentation. Suture straight-transverse or oblique. Siphuncle very narrowly, mainly strongly displaced ventrally, sometimes marginal. Septal necks very narrow compared to septa, often relatively long, with thickened edge, probably turned downwards. Connecting rings and intrasiphonal deposits absent. Cameral deposits mural-episeptal and hyposeptal.

C o m p o s i t i o n. Genus *Bogoslovskya* Zhuravleva, 1978 from the Middle and Upper Devonian of the Ural Mountains, Carboniferous and Permian of Japan.

C o m p a r i s o n. This family is distinguished from the family Ostreioceratidae by the narrower siphuncle that is located nearer to the shell wall, by the narrow, very thin septal necks, which often widen toward the thickened (downward turned) edge, and generally by the less developed cameral deposits.

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