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Serpukhovian and early Bashkirian (Carboniferous) nautiloids (Cephalopoda) of the Donets Basin (Ukraine)

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Серпуховські та ранньобашкирські наутилоїдеї (Cephalopoda) Донецького басейну (Україна)

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Ключові слова: Nautilida, серпуховський ярус, башкирський ярус, Донбас.

Serpukhovian (?*Pseudorthoceras* spp., *Gzheloceras aisenvergi* Dernov, 2021, *G. sp.*, and *Catastroboceras* sp.) and early Bashkirian (*Orthoceras* indet., *Pseudogzheloceras* spp., *Millkoninckioceras udovichenkoi* Dernov, 2018, *Catastroboceras* sp., and *Imonautilus* sp.) nautiloid assemblages are described from the Samara, Kalmius, Amvrosiyivka, and Mandrykyne formations (Prokhorivskian-Blagodatnean horizons) of the Donets Basin, eastern Ukraine. These low-diverse associations are quite similar in systematic composition to the Serpukhovian and Bashkirian nautiloid assemblages of Western Europe and North America.

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Introduction

The first study of Carboniferous nautiloids from the Donets Basin was conducted by Gurov (1873, 1877), who described several species-level taxa from the Pennsylvanian portion of the sedimentary succession. Subsequent research (e.g., Lebedev, 1932; Librovitch, 1939, 1946; Shimansky, 1967) further explored nautiloids in the region. However, only a few species, notably *Pseudogzheloceras donetzense* (Kruglov in Librovitch, 1939) have gained acceptance in the scientific literature.

In recent years, the author of this study has described several species of coiled nautiloids from the Serpukhovian, Bashkirian, Moscovian, and Kasimovian stages of the Donets Basin (Dernov, 2018, 2021a, b, 2025). While only *Gzheloceras aisenvergi* Dernov, 2021 and *Millkoninckioceras udovichenkoi* Dernov, 2018 has been formally described from the Serpukhovian and lower Bashkirian deposits of the Donets Basin, available collections reveal a significantly greater taxonomic diversity.

This paper presents two low-diverse assemblages of Serpukhovian and early Bashkirian nautiloids from the Donets Basin, eastern Ukraine. The findings contribute to the palaeontological characteristics of the Serpukhovian and lower Bashkirian deposits in the region.

Material and methods

This study investigates thirteen specimens, primarily consisting of poorly preserved limestone moulds, conchs, and conch impressions (collections IGS NASU-26, NMNHU-G 2594, and NMNHU-G 8637; Table 1). The specimens are housed in the Department of Stratigraphy and Palaeontology of

Palaeozoic Sediments, Institute of Geological Sciences of the NAS of Ukraine (IGS NASU), and in the Department of Geology, National Museum of Natural History of the NAS of Ukraine (NMNHU-G), both located in Kyiv. The material was collected by Drs David Aisenverg and Vladyslav Poletaev (IGS NASU), Dr. Mykola Udovychenko (Luhansk Taras Shevchenko National University, Poltava), and the author.

Abbreviations used in species descriptions include: dm = conch diameter, wh = whorl height, ww = whorl width, ah = apertural height, uw = umbilical width; whorl expansion rate (WER) = $(dm_1/dm_2)^2$ or $[dm_1/(dm_1-ah)]^2$, imprint zone rate (IZR) = wh_1-ah/wh_1 or $(wh_1-(dm_1-dm_2))/wh_1$ (Korn, 2010; Klug et al., 2015).

Unfortunately, due to the poor preservation of the material, accurate conch measurements and calculation of WER and IZR values were not possible for many of the specimens described here. Most of the fossils are preserved in hard limestone or unweathered carbonate nodules, making mechanical preparation particularly challenging. Prior to photography, the fossils were coated with ammonium chloride (NH₄Cl).

Geological setting

The NAUTILOIDS described in this study were collected from four localities (Fig. 1) and from four distinct lithostratigraphic units, all within the Prokhorivskian-Blagodatnean horizons (Nemyrovskia, Yefimenko, 2013; Poletaev, Vdovenko, 2013) (Fig. 2).

Novobesheve: Ukraine, Donetsk Oblast, right bank of the Berestova River near the village of Novobesheve. A single specimen of *Gzheloceras aisenvergi* Dernov, 2021a was found in the Samara Formation

Table 1. Material examined in the present study

Taxa	Specimens	Fossil sites
? <i>Pseudorthoceras</i> spp.	2 specimens: NMNHU-G 8637/80 and 8637/81	Zhelvakova Ravine
<i>Gzheloceras aisenvergi</i> Dernov, 2021a	1 specimen: IGS NASU-02/4108	Novobesheve
<i>Gzheloceras</i> sp.	2 specimens: IGS NASU-26/04 and 26/07	Zhelvakova Ravine
<i>Pseudogzheloceras</i> sp. A	1 specimen: IGS NASU-26/05	Chorna Skelya
<i>Millkoninckioceras udovichenkoi</i> Dernov, 2018	1 specimen: NMNHU-G 2594/01	Volnukhyne
<i>Catastroboceras</i> sp.	3 specimens: IGS NASU-26/02, 26/03 and 26/06	Zhelvakova Ravine, Chorna Skelya
<i>Imonutilus</i> sp.	3 specimens: IGS NASU-26/08 to 26/10	Chorna Skelya

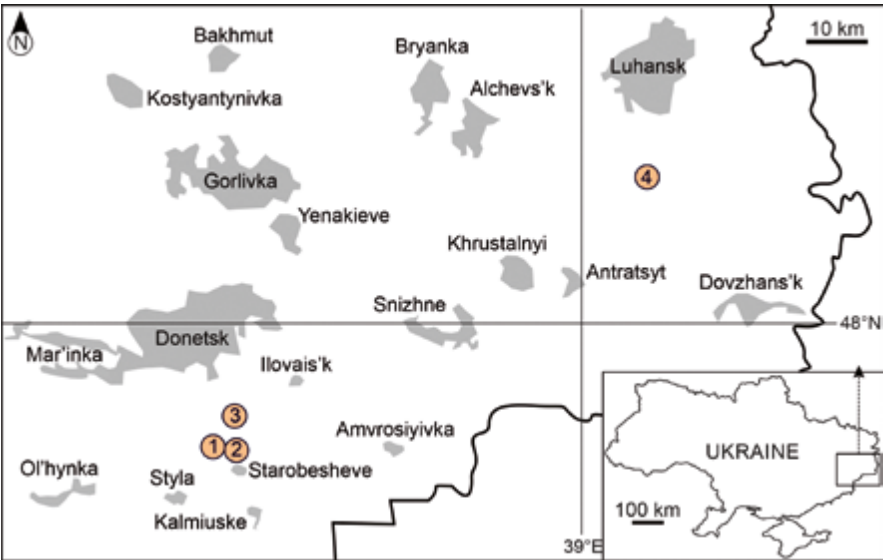


Fig. 1. Geographical location of the nautiloid-bearing fossil sites

System	Subsystem	Stage	Horizon	Lithostratigraphic unit	Nautiloid localities
CARBONIFEROUS	PENNSYLVANIAN	Gzhelian	Vyskrivian	Kartanash Fm. (part)	
			Luhanian	Araukarytova Fm.	
			Troitskian		
			Klyuchovian		
		Kasimovian	Svitlanovian	Avilovka Fm.	
			Kartanashian		
			Sanzharivkian	Isayivka Fm.	
		Moscovian	Sabivkian	Gorlivka Fm.	
			Mar'ivkian	Almazna Fm.	
			Kam'iankian	Kamensk Fm.	
		Bashkirian	Krasnodonian	Belaya Kalitva Fm.	
			Makiivkian	Smolyanynivka Fm.	
			Zuyivkian	Mospyne Fm.	
			Blagodatnean	Mandrykyne Fm.	Volnukhyne
			Manuilivkian	Amvrosiyivka Fm.	
			Feninian		
			Voznessenskian		Chorna Skelya
		Serpukhovian	Zapaltyubean	Kalmius Fm.	Zhelvakova Ravine
			Novolyubivkian		
			Prokhorivkian		
			Samarian	Samara Fm.	Novobesheve
	MISSISSIPPIAN	Visean	Mezhovian	Mezhova Fm.	
			Donetsian	Mokra Volnovakha Group	
			Stylian		
		Tournaisian	Sukhylian		
			Glybokynian		
			Dokuchaivian		
			Karpivian		
			Volnovakhian		
			Karakubian		
			Bazaliivkian		

Fig. 2. Stratigraphic position of the nautiloid-bearing localities in the Carboniferous succession of the Donets Basin

by Dr. Aisenverg. This stratigraphic interval belongs to the *Hypergoniatites-Ferganoceras* or *Uralopronorites-Cravenoceras* genus zones (Popov, 1979).

Zhelvakova Ravine: Donetsk Oblast, Zhelvakova Ravine near the town of Starobesheve. Nautiloids *?Pseudorthoceras* spp. (Fig. 3), *Gzheloceras* sp., and *Catastroboceras* sp. were found in small oncolites within a 1-m-thick shale.

These oncolites form an interbed (referred to as the “nodular horizon” in previous studies by (Aisenverg et al., 1987; Poletaev et al., 1988)) located four meters above the D_5^7 limestone in the Serpukhovian portion of the Kalmius Formation. The oncolites harbor a diverse and well-preserved marine biota, which includes cyanobacteria, calcareous algae, foraminiferans, corals, conulariids, bivalves, gastropods, ammonoids, ostracods, conodonts, and fishes. The nautiloid-bearing shale belongs to the uppermost part of the *Fayettevillea-Delepinoceras* genus zone (Popov, 1979; Astakhova, 1983).

Chorna Skelya: Donetsk Oblast, left bank of the mouth of the Berestova River, which flows into the Kalmius River, north of the town of Starobesheve. In this section, a succession of terrigenous rocks with several limestones is exposed and belongs to the lower part of the Amvrosiyivka Formation (Aisenverg, 1958; Yefimenko, 2006). This succession contains terrestrial plants, calcareous algae, foraminiferans, corals, conulariids, brachiopods, bryozoans, bivalves, gastropods, ammonoids, crinoids,

ostracods, conodonts, and trace fossils (Aisenverg et al., 1987; Poletaev et al., 1988). The nautiloids *Orthocerida* indet., *Pseudogzheloceras* sp. A, *Catastroboceras* sp., and *Imonautilus* sp. were found in argillaceous limestone lenses or large carbonate concretions, which contain a well-preserved and diverse marine community. This interbed is laterally replaced by the E_1^{Lower} limestone of the Amvrosiyivka Formation (Yefimenko, 2006). The nautiloid-bearing level belongs to the uppermost part of the *Reticuloceras-Bashkortoceras* genus zone (Popov, 1979).

Volnukhyne: Luhansk Oblast, an old quarry 1.5 km west of the village of Volnukhyne. The fossil-bearing rocks consist of bioclastic and algal limestones (F_1 limestone, the basal bed of the Mandrykyne Formation) and a calcareous siltstone above the limestone. Numerous fossils have been found within this limestone, including calcareous algae (Ogar, 2012), corals (Ogar, 2012; Fedorowski, 2017; Fedorowski, Ohar, 2019), brachiopods, bivalves, gastropods, the coiled nautiloid *Pseudogzheloceras* sp. B (not figured), rostroconchs, juvenile ammonoids, echinoids, crinoids, and conodonts (Nemyrovska, 1999). Bivalves, gastropods, nautiloids (*Millkoninckioceras udovichenkoi*, *Pseudogzheloceras* sp. C [not figured]), ammonoids (*Bilinguites superbilinguis* (Bisat, 1924), *Cancelloceras* sp. [cf. *C. solidum* Popov, 1979]), and echinoids were found in the carbonate nodules within the siltstone above the F_1 limestone. The nautiloid-bearing level belongs to the uppermost part of the *Bilinguites-Cancelloceras* genus zone (Popov, 1979).

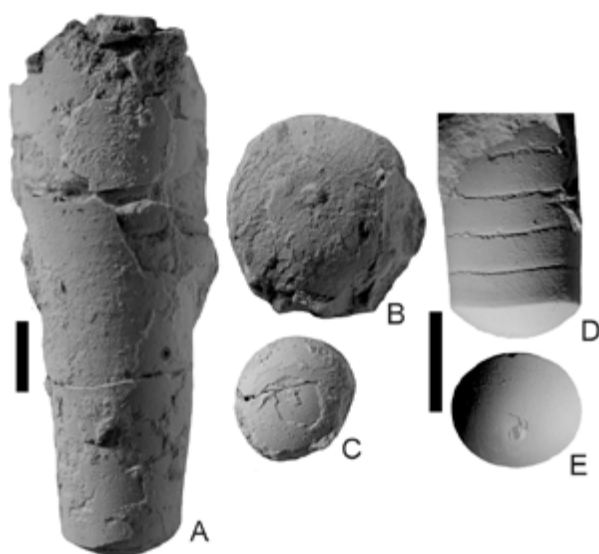


Fig. 3. *?Pseudorthoceras* spp. from the Zhelvakova Ravine fossil site. A–C – *?Pseudorthoceras* sp. A (A – lateral view of the conch mould, B, C – septal views of the adapertural and the adapical parts of the mould, respectively), specimen NMNH-G 8637/80; D, E – *?Pseudorthoceras* sp. B (D – lateral view, E – septal view), specimen NMNH-G 8637/81. Scale bars = 5 mm

Systematic palaeontology

Class Cephalopoda Cuvier, 1797

Subclass Nautiloidea Agassiz, 1847

Order Nautilida Agassiz, 1847

Superfamily Tainoceratoidea Hyatt, 1883

Family Tainoceratidae Hyatt, 1883

Genus *Gzheloceras* Ruzhencev and Shimansky, 1954

Type species: *Gzheloceras uralense* Ruzhencev and Shimansky, 1954; by original designation.

Gzheloceras aisenvergi Dernov, 2021a (Fig. 4 A, B)

2021a *Gzheloceras aisenvergi* sp. nov.: Dernov, p. 61, figs 2 C, 3 D, E.

Holotype. Specimen IGS NASU-02/4108 illustrated in Fig. 4 A, B.

Type locality and stratigraphic horizon. Berestova River, near the village of Novobesheve, Kalmius Raion, Donetsk Oblast, Ukraine; early Serpukhovian, Samara Formation.

Other material. Not available.

Diagnosis. Species of the genus *Gzheloceras* characterized by an extremely discoidal, subevolute conch ($ww/dm \sim 0.35$), a moderately wide umbilicus ($uw/dm \sim 0.35$), and a weakly compressed, ellipsoidal whorl profile ($ww/wh \sim 0.70$). The species has a moderately wide, strongly convex venter, a broadly rounded ventrolateral shoulder bearing a longitudinal ridge, and very convex flanks with transverse ribs. The umbilical margin is broadly rounded.

Description. Holotype IGS NASU-02/4108 is a fragment of a limestone mould, c. 32.0 mm in diameter, representing an extremely discoidal, subevolute conch ($ww = 11.0$ mm, $wh = 16.0$ mm, $uw = 11.0$ mm, $ww/dm \sim 0.35$, $uw/dm \sim 0.35$) with a weakly compressed, ellipsoidal whorl profile ($ww/wh = 0.69$). The conch features a moderately wide, strongly convex venter, a

broadly rounded ventrolateral shoulder, wide, convex flanks, and a broadly rounded umbilical margin. The umbilicus is moderate in width ($uw/dm \sim 0.35$). The surface of the conch bears long, thin, slightly oblique transverse ribs approximately 1.0 mm wide, spaced about 2.0 mm apart. A longitudinal ridge, about 1 mm thick, is located along the ventrolateral shoulder, with a barely discernible wide groove running along its length. Fine growth lines are visible on the preserved shell fragment of the umbilical area, though their exact form remains unclear.

Remarks. *Gzheloceras aisenvergi* is morphologically similar to *G. pulcher* (Crick, 1904) particularly in the presence of a longitudinal ridge on the ventrolateral shoulder. However, *G. aisenvergi* can be distinguished from *G. pulcher* by its laterally compressed whorl profile. The ventrolateral shoulder of *G. aisenvergi* also has a faint, scarcely distinguishable groove, which is more reminiscent of those found in *G. memorandum* Shimansky, 1967.

Occurrence. Donetsk Basin (Ukraine); Serpukhovian, Samara Formation.

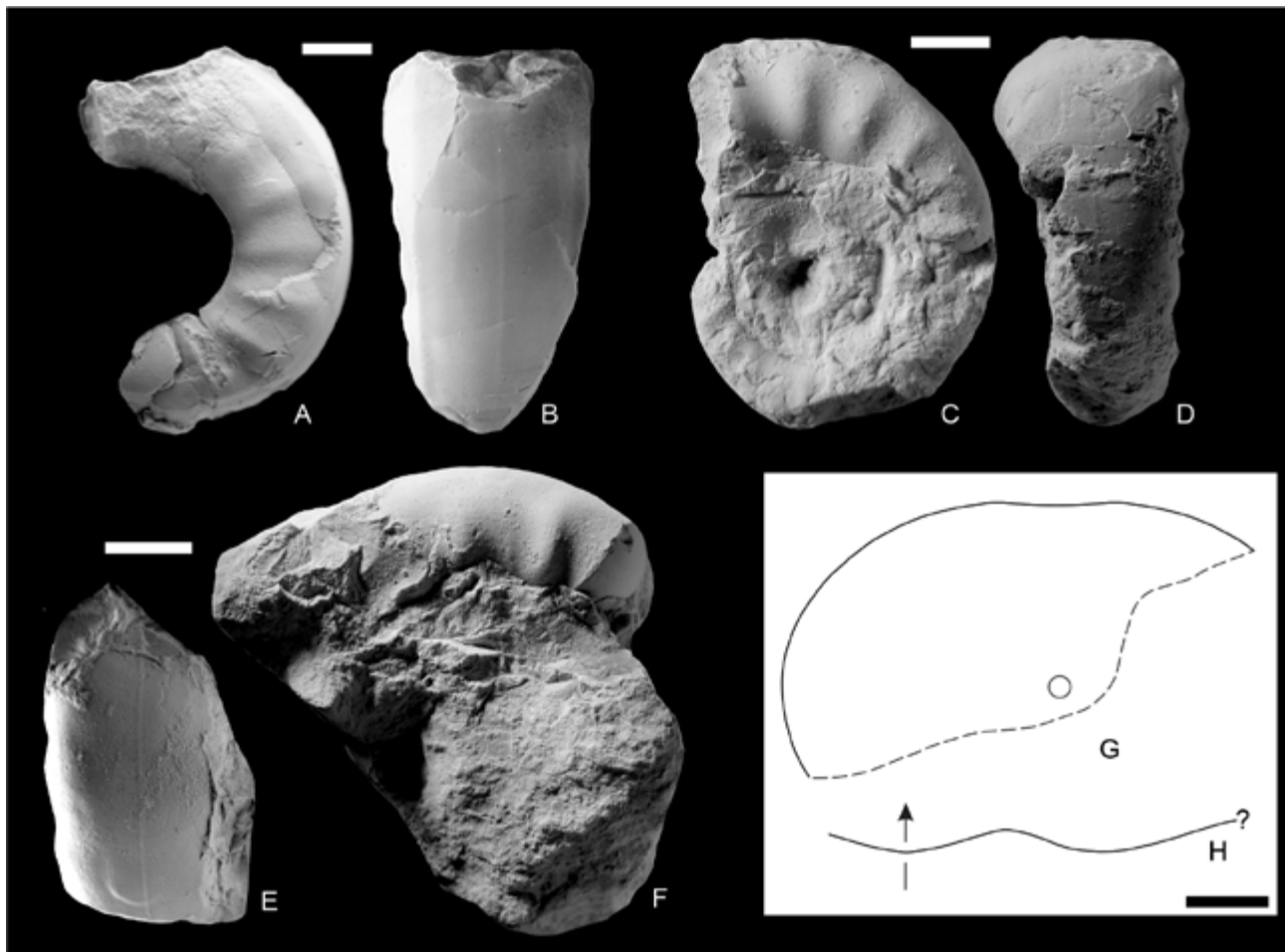


Fig. 4. Serpukhovian nautiloids from the Donets Basin. A, B – *Gzheloceras aisenvergi* Dernov, 2021 (IGS NASU-02/4108; A – lateral view, B – ventral view). C–H – *Gzheloceras* sp. (C, D – IGS NASU-26/04, E–H – IGS NASU-26/07; C, F – lateral view, D, E – ventral view, G – whorl profile, H – suture line at $ww \sim 14.0$ mm). Scale bars = 5 mm

Gzheloceras sp.

(Fig. 4 C–H)

Material. Two poorly preserved moulds (specimens IGS NASU-26/04 and IGS NASU-26/07) from the Zhelvakova Ravine fossil site.

Description. Specimen IGS NASU-26/04 (Fig. 4 C, D) is a limestone mould, 27.0 mm in diameter, representing a thickly discoidal and subevolute conch (ww ~ 13.5 mm, wh = 14.2 mm, uw = 10.0 mm, ww/dm ~ 0.50, uw/dm = 0.37) with a weakly compressed whorl profile (ww/wh ~ 0.95). The venter is broad, flattened or slightly convex; a ventrolateral shoulder is broadly rounded, while the flanks are broad, narrow, and slightly convex, gently converging towards the umbilical margin. The umbilicus is moderately wide (uw/dm = 0.37); the umbilical margin and the umbilical wall are not preserved. Ornamentation on the conch surface consists of short, transverse lateral ribs, 1.5–2.0 mm wide. A small portion of the shell preserved on the venter of the mould reveals very fine (approximately 0.1 mm thick) growth lines, which likely form a ventral sinus. The suture line has a broad, shallow ventral lobe and a shallow lateral lobe.

Specimen IGS NASU-26/07 (Fig. 4 E–H) is a fragment of a limestone mould of the body chamber, exhibiting an ellipsoidal whorl profile (ww ~ 14.0 mm, wh ~ 10.0 mm, ww/wh ~ 1.4). It has a very slightly concave, broad venter; a ventrolateral shoulder is broadly rounded, and the flanks are narrow and convex (Fig. 4 G). A narrow longitudinal ridge, approximately 0.5 mm thick, is present along the median part of the venter. The flanks are ornamented with massive, short, transverse ribs, approximately 1.5 mm thick. The siphuncle is subcentral. A U-shaped depression, 5 mm wide (possibly a muscular imprint; Fig. 4 E) is located on the posterior part of the mould, near the middle of the venter. The suture line exhibits a broad, shallow ventral lobe and a shallow lateral lobe (Fig. 4 H).

Remarks. The described specimens closely resemble the holotype of the early Bashkirian *Gzheloceras faticanum* Shimansky, 1967 from Kazakhstan. However, the poor preservation of the material prevents a detailed comparison. Nevertheless, key morphological characteristic, such as the form of the conch and whorl profile, the ornamentation, and the suture line are very similar between the specimens from the Donets Basin and those from Kazakhstan.

Genus *Pseudogzheloceras* Dernov, 2021b

Type species: *Pleuromutilus costatus* Hind, 1905; by original designation.

Pseudogzheloceras sp. A

(Fig. 5 A)

Material. One poorly preserved conch fragment (specimen IGS NASU-26/05) from the Chorna Skelya fossil site.

Description. The only available specimen is a deformed fragment of a discoidal conch, approximately 38.0 mm in diameter. The flanks are ornamented with thick, wedge-shaped transverse ribs (c. 3 mm in maximum thickness), which broaden towards the ventrolateral shoulder. Additionally, fine growth lines are present, forming a ventral sinus.

Remarks. The ornamentation of specimen IGS NASU-26/05 clearly indicates its assignment to the genus *Pseudogzheloceras*. However, due to the poor preservation of the specimen, precise species-level identification is not possible. Representatives of *Pseudogzheloceras*, including *P. donetzense* (Kruglov in Librovitch, 1939), *P. costatum* (Hind, 1905), *P. falcatum* (Sowerby in Prestwich, 1840), and *P. postcostatum* (Bisat, 1930), are widely distributed in Pennsylvanian deposits of the Donets Basin (Librovitch, 1939; Dernov, 2021b; and author's unpublished data). The specimen under consideration differs notably from *P. donetzense* by its much more massive lateral ribs. However, due to the limited preservation, a reliable comparison with the other listed species cannot be made.

Family Koninckioceratidae Hyatt in von Zittel, 1900

Genus *Millkoninckioceras* Kummel, 1963

Type species: *Koninckioceras konincki* Miller and Kemp, 1947; by subsequent designation of Kummel (1963).

Millkoninckioceras udovichenkoi Dernov, 2018

(Fig. 5 B–D)

2018 *Millkoninckioceras udovichenkoi* sp. nov.: Dernov, p. 5, fig. 3.1.

Holotype. Specimen NMNHU-G 2594/01 figured in Fig. 5 B–D.

Type locality and stratigraphic horizon. An old quarry near the village of Volnukhyne, Luhansk Raion, Luhansk Oblast, Ukraine; late early Bashkirian (*Bilinguites-Cancelloceras* genus zone), Mandrykyne Formation, shale above the F₁ limestone.

Other material. Not available.

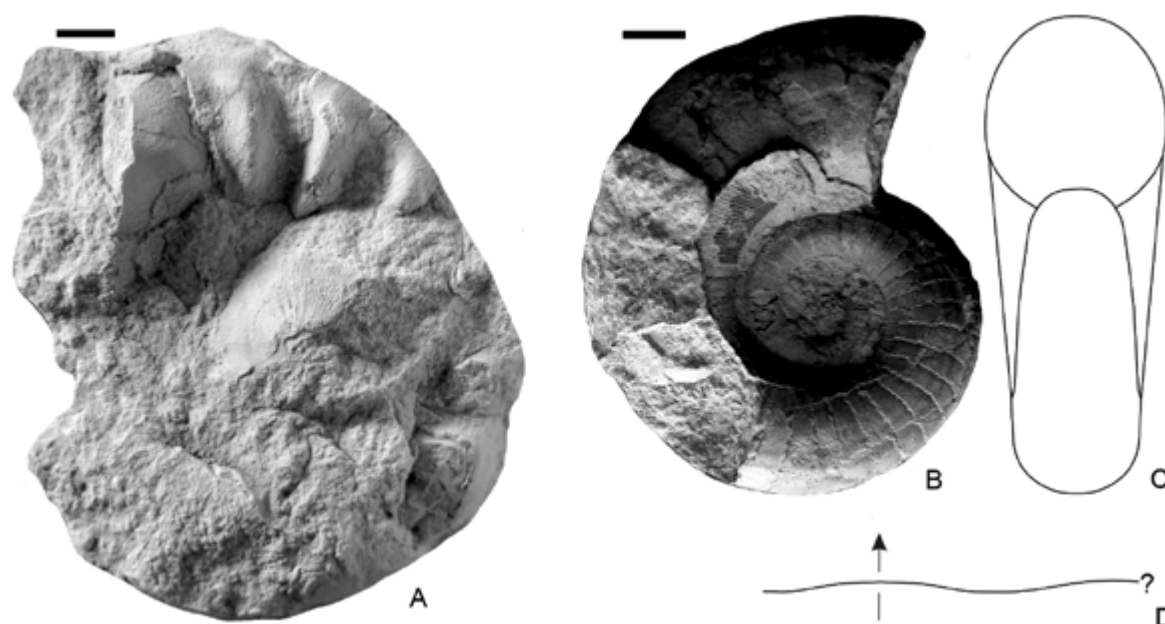


Fig. 5. Early Bashkirian nautiloids from the Donets Basin. A – *Pseudogzheloceras* sp. A with a valve of a chonetidine brachiopod (IGS NASU-26/05; lateral view). B–D – *Millkoninckioceras udovichenkoi* Dernov, 2018 (NMNHU-G 2594/01; B – lateral view, C – apertural view, D – suture line at 37.0 mm conch diameter). Scale bars = 5 mm

Diagnosis. Species of the genus *Millkoninckioceras* with a thinly discoidal and subevolute conch ($ww/dm \sim 0.40$, $uw/dm \sim 0.35$), with a weakly depressed, weakly embracing whorl profile ($ww/wh \sim 0.95$, $IZR \sim 0.10$) with a weakly convex venter, rounded ventrolateral shoulder bearing longitudinal narrow ridge, weakly convex flanks and broadly rounded umbilical margin; the suture line is almost straight on the venter and has a very shallow lobe on a flank.

Description. Holotype NMNHU-G 2594/01 is a nearly complete conch, 37.5 mm in diameter, thinly discoidal and subevolute in shape ($ww = 14.0$ mm, $wh = 15.0$ mm, $uw = 12.5$ mm, $ah = 13.7$ mm, $ww/dm = 0.37$, $uw/dm = 0.33$). The whorl profile is weakly depressed and nearly circular ($ww/wh = 0.93$), with a weakly embracing coiling ($IZR = 0.09$) and an exceptionally high whorl expansion rate ($WER = 2.50$). The venter of the phragmocone is broadly rounded; the ventrolateral shoulder is also broadly rounded; and the flanks are broad and convex. The umbilical margin is also broadly rounded, while the umbilical wall is weakly convex, relatively wide, and inclined at approximately 45° to the plane of symmetry of the conch. The umbilicus is moderately wide ($uw/dm = 0.33$). The imprint zone is narrow and weakly concave. The ventrolateral shoulder bears two longitudinal narrow ridges, separated by a groove approximately three times the width of each ridge. The conch surface displays fine, convex growth lines

with a shallow ventral sinus; these lines are approximately 0.1 mm wide and spaced about 0.1 mm apart. The suture line is nearly straight across the venter and bears a very shallow lateral lobe (Fig. 5 D).

Remarks. The genus *Millkoninckioceras* was originally diagnosed as follows: “Evolute, widely umbilicate, smooth conch; whorl section depressed, elliptical, venter broadly rounded, flanks also rounded; dorsal impressed zone slight; umbilicus large and perforate. Suture essentially straight; siphuncle small, subcentral” (Kummel, 1964: p. K424). *Millkoninckioceras udovichenkoi* does not fully conform to this diagnosis, as it exhibits fine ornamentation and longitudinal ridges on the ventrolateral shoulder, and possesses a very shallow lateral lobe. However, *Millkoninckioceras* remains a poorly studied genus with an incompletely resolved species composition. Therefore, these minor deviations in the morphology of *M. udovichenkoi* from the generic diagnosis do not preclude its assignment to *Millkoninckioceras*, especially given the absence of other genera within the family Koninckioceratidae that show closer morphological similarity.

Millkoninckioceras udovichenkoi is morphologically quite similar to the type species of the genus, *M. konincki*, particularly in overall conch form and the general outline of the suture line. The presence of ventrolateral ridges, discernible growth lines, and an almost circular whorl profile distin-

guish *M. udovichenkoi* from *M. konincki*. It is also worth noting that the diameter of the holotype of *M. udovichenkoi* is approximately 30% smaller than that of *M. konincki*.

The group of species from the Pennsylvanian of the USA and tentatively assigned to *Millkoninckioceras* by Shimansky (1967), namely *M. jewetti* (Newell, 1936) *M. wyandottense* (Newell, 1936) and *M. eliasi* (Newell, 1936) differs markedly from *M. udovichenkoi* in several morphological features. These include the presence of a deeper lateral lobe, a distinct ventral lobe, low and wide whorls, and the absence of longitudinal ridges on the ventrolateral shoulder. *Millkoninckioceras udovichenkoi* also differs from the Permian species *M. bibbi* (Miller and Kemp, 1947) in possessing a circular whorl profile; in contrast, *M. bibbi* exhibits rather low and wide, transversely elliptical whorls. Furthermore, the conch diameter of *M. bibbi* is nearly seven times greater than that of *M. udovichenkoi*.

Occurrence. Donets Basin; late early Bashkirian (*Bilinguites-Cancelloceras* genus zone), Mandrykyne Formation.

Superfamily Trigonoceratoidea Hyatt, 1884

Family Trigonoceratidae Hyatt, 1884

Genus *Catastroboceras* Turner, 1965

Type species: *Nautilus quadratus* Fleming, 1828; by original designation.

Catastroboceras sp.

(Fig. 6 A–E, J, L; Table 2)

Material. Three poorly preserved specimens (IGS NASU-26/02, 26/03, 26/06) from the Zhelvakova Ravine and Chorna Skelya fossil sites.

Description. Specimen IGS NASU-26/06 (Fig. 6 A, B) is a fragment of a limestone mould of a small (dm = 19.6 mm), thinly discoidal and evolute conch (ww/dm = 0.37; uw/dm = 0.53) with an exceptionally high coiling rate (WER = 2.82). The whorl profile is weakly compressed, subquadrate, and non-embracing (ww/wh = 0.91; IZR = 0.0), with a flattened venter, angular ventrolateral shoulders, and flanks that are wide and weakly convex near the umbilical margin and weakly concave near the ventrolateral shoulder (Fig. 6 J). The umbilical margin and umbilical wall are angular and inclined ~

45° to the conch's plane of symmetry; no contact groove is present. The siphuncle is positioned almost ventrally (Fig. 6 I). The ornamentation consists of two thin longitudinal ventral ridges, c. 0.5 mm thick, between which there is a barely visible thin median groove, which is probably present only on the mould. On the body chamber, approximately in the middle of the flank, there is a longitudinal low and wide (1.5–1.8 mm) ridge, which corresponds to a very narrow (0.5 mm) ridge on the surface of the phragmocone. Between these ridges and the ventrolateral shoulder of the phragmocone are very short, broad, oblique ribs, c. 1 mm wide, separated by 0.8 mm wide spaces. On the surface of the steinkern of the body chamber, these ribs are very weakly expressed only in its posterior part, gradually disappearing towards the aperture. The umbilical margin bearing a narrow longitudinal ridge 0.5 mm wide. The surface of the flanks of the phragmocone is covered with very thin (c. 0.05 mm) growth lines, which form a very deep, narrow lateral sinus, the apex of which is located on the lateral ridge. The umbilical-dorsal surface is smooth, with only two narrow furrows, which are the marks of the ventral ridges of the previous whorl.

Specimen IGS NASU-26/02 (Fig. 6 C, D) is a limestone mould of a small conch (dm = 17.9 mm), thinly discoidal and evolute (ww/dm = 0.41, uw/dm = 0.51), with a weakly depressed whorl profile (ww/wh = 1.12). The venter is narrow and flattened; the ventrolateral shoulder is angular; the flanks are flat and nearly parallel; the umbilical margin is angular; and the umbilical wall is wide, flat, and inclined at ~45° to the conch's plane of symmetry. No transverse ornamentation is preserved on the venter; on the flanks, at about 66% of the distance from the ventrolateral shoulder to the umbilical margin, there is a low longitudinal ridge (1.0–1.2 mm wide). Very fine growth lines (~0.05 mm thick) are visible on the flanks and umbilical wall, forming shallow sinuses. On the umbilical margin, these growth lines are more pronounced. Two low and narrow (~0.5 mm) longitudinal ridges are preserved on the venter. The suture line consists of a broad, shallow ventral lobe, a high, narrow ventrolateral saddle, and a broad, shallow lateral lobe (Fig. 6 L).

Table 2. Conch dimensions (in mm) and ratios of *Catastroboceras* sp.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGS NASU-26/02	17.9	7.4	6.6	9.2	–	0.41	1.12	0.51	–	–
IGS NASU-26/06	19.6	7.2	7.9	10.3	7.9	0.37	0.91	0.53	2.82	0.0

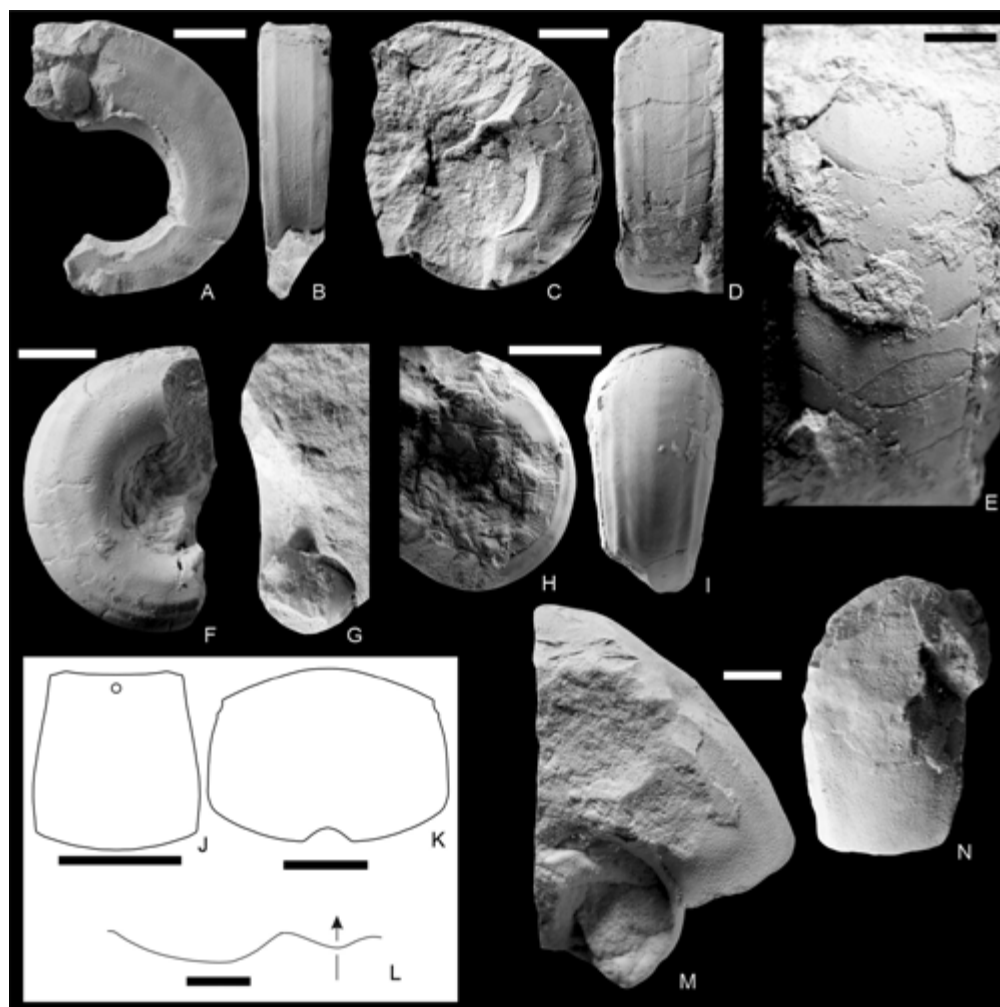


Fig. 6. Serpukhovian and early Bashkirian nautiloids from the Donets Basin. A–E, J, L – *Catastroboceras* sp.: A, B, J – IGS NASU-26/06 (A – lateral view, B – ventral view, J – whorl profile); C, D, L – IGS NASU-26/02 (C – lateral view, D – ventral view, L – suture line at 17.9 mm conch diameter). F–I, K, M, N – *Imonautilus* sp.: F, G – IGS NASU-26/08 (F – lateral view, G – ventral view), H, I – IGS NASU-26/09 (H – lateral view, I – ventral view); K, M, N – IGS NASU-26/10 (K – whorl profile, M – lateral view, N – ventral view). Scale bars = 5 mm

Genus *Imonautilus* Niko and Mapes, 2007

Type species: *Imonautilus meeki* Niko and Mapes, 2007; by original designation.

Imonautilus sp.

(Fig. 6 F–I, K, M, N; Table 3)

Material. Three poorly preserved moulds (IGS NASU-26/08 to IGS NASU-26/10) from the Chorna Skelya fossil site.

Description. Specimen IGS NASU-26/08 (Fig. 6 F, G) is a fragment of a limestone mould representing a small conch (dm = 18.2 mm) with an ellipsoidal, nearly circular whorl profile (ww/wh ~ 0.87). The venter is broad and convex; the flanks are narrow and convex; the ventrolateral shoulder is broadly rounded. The umbilical margin is broadly rounded, transitioning into a broadly convex umbilical wall. The umbilicus is of moderate width (uw/dm = 0.34). Ornamentation includes three thin longitudinal ridges (~0.3–0.4 mm thick): one weak ridge

on the umbilical margin and two more prominent ones on the ventrolateral shoulders. The suture line is straight.

Specimen IGS NASU-26/09 (Fig. 6 H, I) is a fragment of a limestone mould comprising part of the body chamber and several chambers of the phragmocone, with partially preserved shell material (dm = 14.6 mm). The venter is wide and convex; the ventrolateral shoulder is rounded; the flanks are narrow and weakly convex; and the umbilicus is relatively wide (uw/dm = 0.53). Ornamentation consists of two thin longitudinal ridges (~0.3 mm thick) on the ventrolateral shoulders, and an additional ridge located along the median line of the venter. Growth lines are preserved on parts of the shell, forming a ventral sinus; on the flanks, they appear straight.

Specimen IGS NASU-26/10 (Fig. 6 K, M, N) is a mould fragment of a weakly embracing (IZR = 0.09), weakly depressed (ww/wh = 1.36) body chamber,

Table 3. Conch dimensions (in mm) and ratios of *Imonutilus* sp.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGS NASU-26/09	14.6	5.0	–	7.7	–	0.34	–	0.53	–	–
IGS NASU-26/08	18.2	~6.0	6.9	6.1	–	~0.33	~0.87	0.34	–	–
IGS NASU-26/10	–	13.2	9.7	–	8.8	–	1.36	–	–	0.09

including half of the penultimate whorl. The venter is broad and convex; the ventrolateral shoulder is broadly rounded; the flanks are narrow and slightly convex; the umbilical margin is broadly rounded; and the umbilical wall is broad and slightly convex, inclined at approximately 45° to the plane of symmetry of the conch. A weakly concave contact groove, about 3.5 times narrower than the venter, is present (Fig. 6 K). Ornamentation on the body chamber consists of two thin (~0.6 mm wide) longitudinal ridges on each ventrolateral shoulder. The aperture shows a broad and shallow ventral sinus (Fig. 6 N).

Remarks. The nautiloid specimens described above most likely represent a new species, as they differ significantly from *Imonutilus meeki*, the only previously known species of this genus. Key morphological differences include finer longitudinal ridges in *I. meeki*, as well as a more pronounced imprint zone in the specimens assigned here to *Imonutilus* sp. It is important to note, however, that the available material consists only of adult individuals, making comparisons with juvenile forms of *I. meeki* impossible. A distinctive morphological feature of the described specimens is the presence of a weak longitudinal ridge on the umbilical margin of the phragmocone and its absence on the body chamber.

Discussion and concluding remarks

In addition to the nautiloid taxa described above, the studied collection includes several conch mould fragments of unidentified orthocerids, which could not be identified due to their poor preservation. A fragment of a relatively large conch, assigned to *Pseudogzheloceras* sp. B, was recovered from the limestone at the Volnukhyne

fossil site. However, the fragment is too poorly preserved to permit a detailed description. Another specimen of *Pseudogzheloceras* (not figured) was found in carbonate nodules within shales above the F₁ limestone, but it is excluded from description due to its fragmentary and degraded state.

The two low-diversity nautiloid assemblages from the Serpukhovian (?*Pseudorthoceras* spp., *Gzheloceras aisenvergi* Dernov, 2021, *G. sp.*, and *Catastroboceras* sp.) and early Bashkirian (Orthocerida indet., *Pseudogzheloceras* spp., *Millkoninckioceras udovichenkoi* Dernov, 2018, *Catastroboceras* sp., and *Imonutilus* sp.), comprising six genera and ten species-level taxa, including two probably endemic forms, *Gzheloceras aisenvergi* and *Millkoninckioceras udovichenkoi*, are compositionally similar to coeval nautiloid assemblages from Western Europe (e.g., *Pseudogzheloceras*, *Catastroboceras*) and from the Late Mississippian and Pennsylvanian of North America (e.g., *Pseudorthoceras*, *Imonutilus*).

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Два комплекси серпуховських (?*Pseudorthoceras* spp., *Gzheloceras aisenvergi* Dernov, 2021, *G. sp.* і *Catastroboceras* sp.) та ранньобашкирських (Orthocerida indet., *Pseudogzheloceras* spp., *Millkoninckioceras udovichenkoi* Dernov, 2018, *Catastroboceras* sp. та *Imonutilus* sp.) наутилоїдей описані із самарської, кальміуської, амвросіївської та мандрикинської світ (прохорівський–благодатненський горизонти) Донецького басейну. За систематичним складом ці комплекси досить близькі до угруповань серпуховських і башкирських наутилоїдей Західної Європи та Північної Америки.

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