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LATE BASHKIRIAN AMMONOIDS FROM THE MOSPYNE FORMATION OF THE DONETS BASIN, UKRAINE

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Abstract: Eleven late Bashkirian ammonoid taxa (*Anthracoceratites* sp., *Cymoceras* sp., *Melvilloceras rotaii* (Librovitch in Popov, 1979), *Gastrioceras angustum* Patteisky, 1964, *G. lupinum* Popov, 1979, *G. kutejnikovense* Popov, 1979, ?*Agastrioceras* sp., *Bisatoceras* sp., ?*Owenoceras* sp., *Branneroceras* sp. A, and *Branneroceras* sp. B), are described from the Mospyne Formation of the Donets Basin, eastern Ukraine. Representatives of the genera *Cymoceras*, *Agastrioceras*, *Bisatoceras* are first recorded from the Carboniferous of the Donets Basin. Early Westphalian (G2 ammonoid zone, Langsettian) ammonoids *Gastrioceras listeri*, *G. angustum* and *Branneroceras* spp. indicate the attribution of the Mospyne Formation to the *Gastrioceras*-*Branneroceras* Genozone.

Key words: ammonoids, Donets Basin, Ukraine, Mospyne Formation, late Bashkirian

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Introduction

Ammonoids are an important group for the biostratigraphy of Carboniferous marine sediments due to their high rate of evolution, wide geographical distribution and occurrence in various marine sediments. The Carboniferous sections of the Donets Basin (Ukraine) have important sratigraphic significance, especially regarding the correlation of marine and nonmarine sediments. However, the Carboniferous ammonoid assemblages of the Donets Basin have been only poorly studied so far.

Late Bashkirian ammonoids in the Donets Basin are known from the Mospyne, Smolyanynivka, Belaya Kalitva and basal part of the Kamenskaya formations (Librovitch 1939, 1946, 1947, Popov 1979, Dernov 2021a, 2022a). The Bashkirian and Moscovian ammonoid assemblages in the Donets Basin are strongly endemic: approximately 80 % of the early and middle Pennsylvanian ammonoid species described by Popov (1979) are local. This makes it difficult to correlate the Bashkirian and Moscovian of eastern Ukraine with Carboniferous sections of other regions (e.g., Western Europe, Urals, NE Asia, US Midcontinent). Nevertheless, stratigraphically and geographically important, widespread Western European species are present in the Donets Basin (e.g., *Politoceras* cf. *politum* (Shumard), *Reticuloceras reticulatum* (Phillips), *Bilinguites superbilinguis* (Bisat), *Cancelloceras cancellatum* (Bisat), *Gastrioceras listeri* (Sowerby), etc.) (Popov 1979).

Here, I describe the late Bashkirian ammonoids *Anthracoceratites* sp., *Cymoceras* sp., *Melvilloceras rotaii* (Librovitch in Popov), *Gastrioceras angustum* Patteisky, *G. lupinum* Popov, *G. kutejnikovense* Popov, ?*Agastrioceras* sp., ?*Owenoceras* sp., *Bisatoceras* sp., *Branneroceras* sp. A and *Br*. sp. B from the Mospyne Formation in the south part of Luhansk Region (Ukraine). The results of the study clarify the correlation of the Donets Basin Bashkirian.

Geological setting

The study area is located in the southern part of Luhansk Region in the central part of the Donets Basin, eastern Ukraine (Text-fig. 1a–c). The studied ammonoids were collected from eight stratigraphic levels in the section of the Mospyne Formation (also Mospino or Mospinka Fm.) which belongs in the early part of the late Bashkirian (see Text-fig. 2). This section of the Mospyne Formation was predominantly studied in the Sukha Ravine, 2 km E of Makedonivka (Luhansk District; coordinates: 48.2412, 39.3351). Stratigraphic levels 3–6 which contain ammonoids are exposed at the mouth of this ravine (Text-fig. 2d–f), stratigraphic levels 7 and 8 are exposed in its upper reaches (Text-fig. 2c). Stratigraphic level 1 is exposed in small ditches 1 km N of Zelenodilske (Roven'ky District; coordinates: 48.2326, 39.2129). Stratigraphic level 2 is studied at an outcrop 1 km NE of Rebrykove (Rovenky District; coordinates: 48.2212, 39.3031). The stratigraphic levels containing ammonoids are described below.

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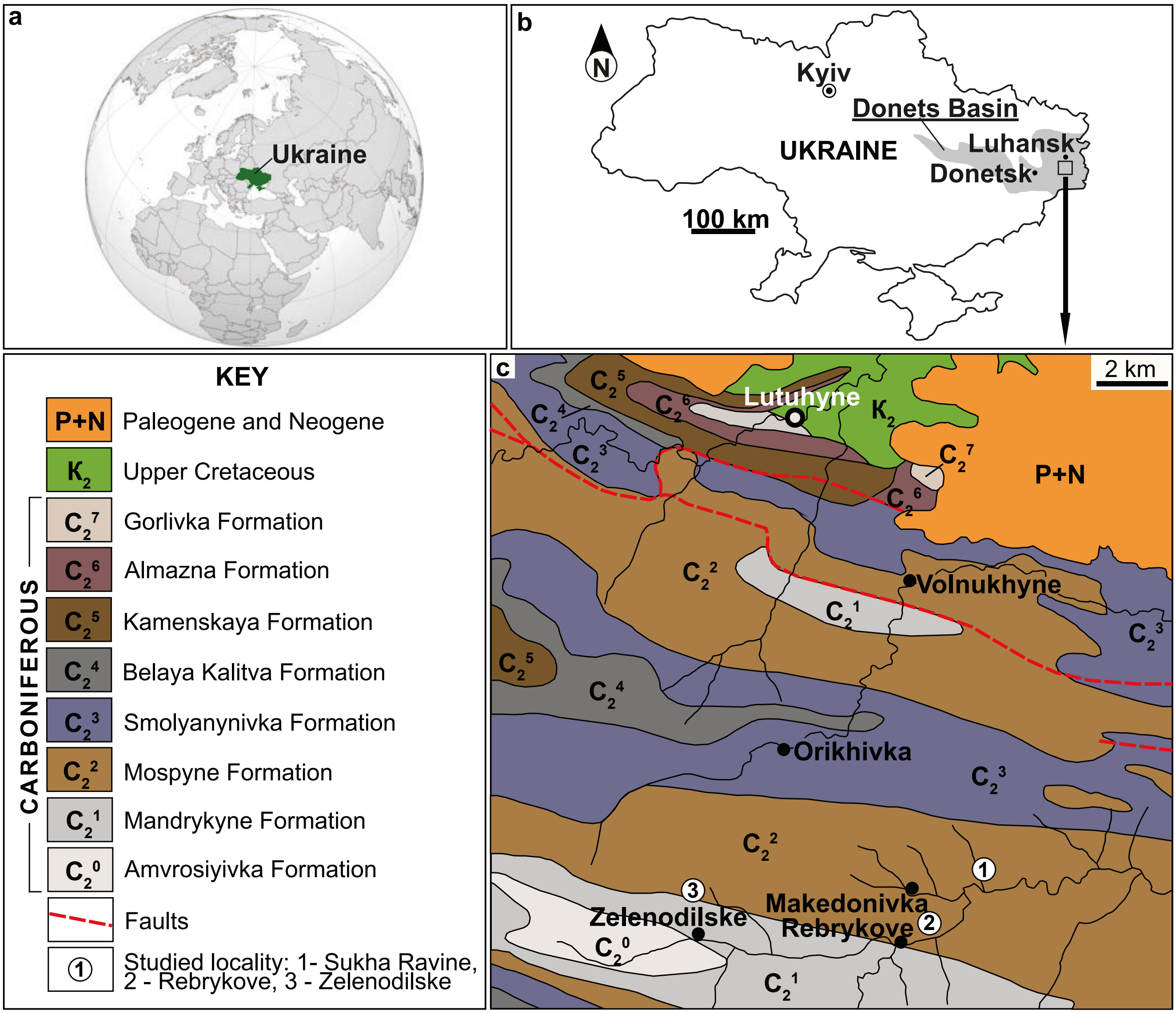
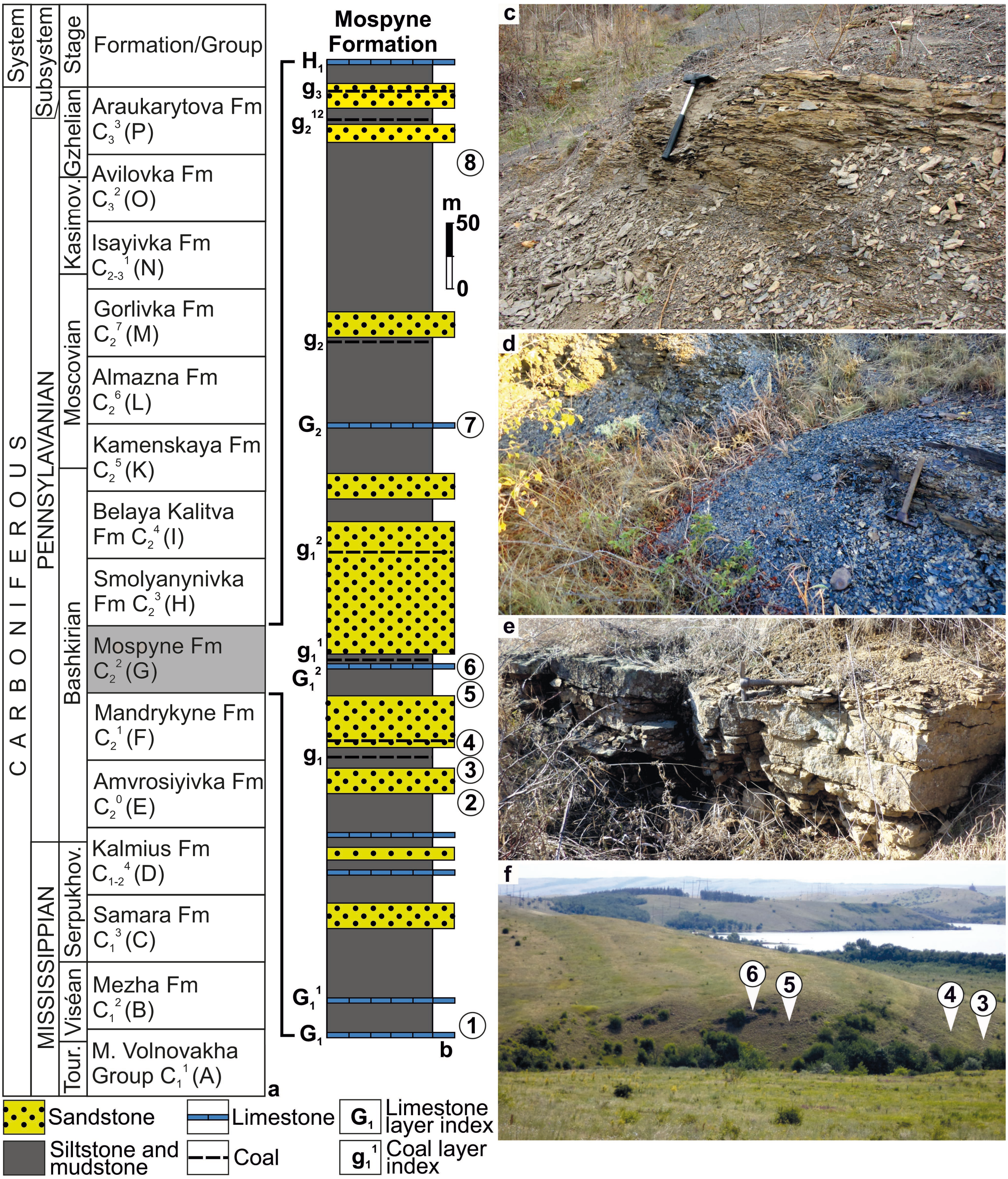


Text-fig. 1. Map indicating general and detailed location of the studied localities.

(1) Siltstones above the G_1 limestone layer with remains of terrestrial plants *Calamites* cf. *cistii* Brongn., *Paripteris gigantea* (Sternb.) Gothan and *Artisia approximata* (Brong. ex Lindl. et Hutton) Corda, as well as the bivalves *Posidoniella* sp., *Nuculavus* sp., *Parallelodon* sp., *Phestia* sp., coiled nautiloids *Gzheloceras* sp., and trace fossils *Planolites* Nicholson and *Chondrites* Sternberg. The siltstones also contain crushed ammonoid specimens ?*Gastrioceras* sp. (not described) and ?*Owenoceras* sp.

(2) Black shale below the g_1 coal layer. Remains of bivalves (*Phestia* Chernyshev, *Solenomorpha* Hind, *Palaeoneilo* Hall et Whitfield), terrestrial plants (*Eusphenopteris* sp.), fish scales, indeterminate ammonoids and trace fossils were found in these black shales. The interlayer of large siderite nodules with remains of macroproblematics, bivalves and the ammonoid *Melvilloceras rotaii* (Librovitch in Popov, 1979) is in the lower part of the black shale. Above this shale lies a thin layer (1.5 m) of sandstone with remains of terrestrial plants *Calamites* sp., *Lepidophloios laricinum* (Sternb.) Sternb., and rhizophores and appendices of *Stigmaria ficoides* (Sternb.) Brongn. in situ.

(3) Brownish-grey, fine-grained, quartz and feldspathic, calcareous, strongly bioturbated sandstone (about 1 m in thickness) 55 m below the G_1^2 limestone layer. Numerous fossils such as terrestrial plants (*Calamites* Suckow, *Sigillaria* Brongn.), bryozoans, brachiopods (*Alphachoristites kschemyshensis* (Semichatova), *Alph.* cf. *pseudobisulcatus* (Rotai), *Alph.* cf. *medovensis* (Rotai), *Brachythyrina* ex. gr. *proba* (Rotai), *Br.* sp., *Echinaria* sp., *Parajuresania* sp., *Linoproductus* sp., lingulids, etc.), scaphopods, gastropods, bivalves (*Phestia* Chernyshev, *Sanguinolites* M'Coy, *Palaeoneilo* Hall et Whitfield, etc.), nautiloids (*Gzheloceras* sp., *Planetoceras yefimenkoi* Dernov (Dernov 2021b), *Paradomatoceras applanatum* Delépine, *Megaglossoceras* sp.), ammonoids (*Melvilloceras rotaii* (Librovitch in Popov), *Gastrioceras angustum* Patteisky, *Branneroceras* sp. A), crinoids, trilobites (*D.* (*Carniphillipsia*) *kumpani* (Weber)), fishes (*Listracanthus* Newberry et Worthen, *Lagarodus* Jaekel, etc.) and trace fossils (*Crescentichnus* Romano et Whyte, *Planolites* Nicholson, *Zoophycos* Massalongo, and fish coprolites) have been collected from this stratigraphic horizon.



Text-fig. 2. Geological setting of the studied sites. a: Stratigraphic position of the Mospyne Formation in the Carboniferous succession of the Donets Basin. b: Stratigraphic position of the studied locality of ammonoids (numbers in circles to the right of the lithological column). c–f: Some studied localities, c – stratigraphic level with ammonoids No. 8, d – stratigraphic level No. 4, e – stratigraphic level No. 3, f – part of the section of the Mospyne Formation in Sukha Ravine and the position of stratigraphic levels with ammonoids. Abbreviations: Tour. – Tournaisian, Serpukhov. – Serpukhovian, Kasimov. – Kasimovian.

(4) Black shale situated directly above the sandstone described previously with remains of cnidarians *Sphenothallus* Hall, brachiopods *Orbiculoidea* d'Orbigny, gastropods, bivalves (*Phestia* Chernyshev, *Sanguinolites* M'Coy, *Palaeoneilo* Hall et Whitfield, *Nuculopsis* Girty, *Solenomorpha* Hind, *Posidoniella* Koninck, *Euchondria* Meek, etc.), orthocerids, nautiloids, ammonoids (*Anthracoceratites* sp., Neodimorphoceratidae indet. (Text-fig. 7d, e), *Branneroceras* sp. A and fragments of the ammonoid jaw apparatus), phyllocarids *Dithyrocaris* Scouler, terrestrial

plants (*Cyperites* Lindl. et Hutton, *Lepidostrobophyllum* Hirmer, *Stigmaria* Brongn., *Calamites* Sternb., *Cordaites* Unger, *Mariopteris* Zeiller, and *Neuralethopteris* Cremer) and trace fossils (*Chondrites* Sternberg, *Phycosiphon* (Fischer-Ooster), *Planolites* Nicholson, and bromalites).

(5) Dark grey mudstone with siderite nodules below the G_1^2 limestone layer. The ammonoid assemblage comes from an interlayer of siderite nodules 1.5 m below the G_1^2 limestone layer (stratigraphic level 5b) and black shale 40 m below the G_1^2 limestone layer (stratigraphic level 5a). This mudstone contains brachiopods (lingulids, *Parajuresania* sp. and other productids), gastropods, bivalves (*Phestia* Chernyshev, *Sanguinolites* M'Coy, *Palaeoneilo* Hall et Whitfield, *Solenomorpha* Hind, etc.), orthocerids, nautiloids (*Liroceras* sp., *Metacoceras perelegans* Girty, *Peripetoceras* sp.), allochtonous terrestrial plants (*Calamites* Suckow, *Lepidostrobophyllum* Hirmer, *Lepidodendron* Sternb. and *Cordaites* Unger), problematics *Coleolus* Hall, and trace fossils (*Chondrites* Sternberg, *Cyclopuncta* Elias, fecal pellets and bromalites). Ammonoids *Melvilloceras rotaii* (Librovitch in Popov), *Branneroceras* sp. B, *Gastrioceras* sp. (not described; Text-fig. 10) and remains of ammonoid jaws have been found in the mudstone of stratigraphic level 5a. *Cymoceras* sp., *Melvilloceras rotaii* (Librovitch in Popov), *Branneroceras* sp. A, *Gastrioceras* sp. (not described), and *Bisatoceras* sp. come from stratigraphic level 5b.

A tempestite interlayer (0.2 m) of detrital and biomorphic sandy limestone with pebbles, plant debris and fragments of conical calcareous tubes *Coleolus* Hall, bivalves and gastropods is in the lower part of the layer (ca. 1.2 m above the base of the black shale bed). This tempestite is laterally replaced by a thin interlayer of siltsone with rare shell debris.

(6) The G_1^2 limestone layer with stromatolites (Dernov 2017) and rare rugose corals, bryozoans, brachiopods (*Orthotetes* sp., *Echinoconchus* sp., *Parajuresania* sp., etc.), gastropods, bivalves, nautiloids (*Ephippioceras wildi* Hind) (Dernov 2018), ammonoids (*Melvilloceras rotaii* (Librovitch in Popov), *Branneroceras* sp. A), crinoids, fishes (*Lagarodus* Jaekel) and trace fossils (*Zoophycos* Massalongo and *Phycosiphon* (Fischer-Ooster)).

(7) The G_2 limestone layer and black shale directly above it. The limestone layer contains rugose corals, brachiopods, trilobites (*Brachymetopus* (*Acutimetopus*) cf. *edwardsi spinicauda* Gandl and *Ditomopyge* (*Carniphillipsia*) *kumpani* (Weber)) (Mychko and Dernov 2019), rare ammonoids (?*Gastrioceras* sp.; not described – Text-fig. 4j), coiled nautiloids, and trace fossils *Zoophycos* Massalongo. The black shale above the G_2 limestone layer contains the remains of bivalves (*Solenomorpha* Hind, *Palaeoneilo* Hall et Whitfield), gastropods, ammonoid *Gastrioceras* sp. (not described) and other indeterminate ammonoids, enigmatic fossils *Coleolus* Hall, rare terrestrial plants and trace fossils.

(8) Black shale with siderite and siltstone interlayers in the upper part of the Mospyne Formation. This siderite interlayer is apparently laterally replaced by the G_4 limestone layer, from which Popov (1979) described the ammonoids *Anthracoceratites tchernyshewi* Librovitch in Popov, *Gastrioceras listeri* (Sowerby), *Lutuginoceras rotaii* Librovitch in Popov (= *Melvilloceras rotaii* (Librovitch in Popov)), and *Eoparalegoceras orlovkense* Popov (= *Phaneroceras orlovkense* (Popov)).

This black mudstone, siltstone and siderite interlayers contain rugose corals, bivalves (*Palaeoneilo* Hall et Whitfield, *Phestia* Chernyshev), gastropods, nautiloids (*Gzheloceras* Ruzhencev et Shimansky, *Metacoceras* Hyatt), ammonoids (*Gastrioceras lupinum* Popov, *G. angustum* Patteisky) and trace fossils *Chondrites* Sternberg.

The Mospyne Formation (C_2^2 or G) consists of a succession of sandstones, siltstones, mudstones, coals and limestones (Text-fig. 2b). The thickness of this formation varies from 315 m in the NW part of the Donets Basin to 730 m in the SE part of the Donets Basin. The Mospyne Formation corresponds to the Zuyivkian Horizon (lower half of the Kayalian Regional Stage) of the Regional stratigraphic scheme of the Dnipro-Donets Downwarp (Nemyrovska and Yefimenko 2013). The lower part of the Mospyne Formation (below the g_1 coal layer) in the study area is replaced by flyschoid sediments, which are very poor in fossils. Apparently, this part of the section of the Mospyne Formation should be referred to the Dyakove Group (late Viséan – late Bashkirian).

Sediments of the Mospyne Formation contain remains of typical Langsettian terrestrial plants (*Neuralethopteris rectinervis* (Kidst.) Laveine, *N. schlehanii* (Stur) Cremer, *Paripteris gigantea* (Sternb.) Gothan, *Neuropteris* cf. *obliqua* (Brongn.), *Lyginopteris hoeninghausii* (Brongn.) Gothan, *Karinopteris acuta* (Brongn.) Boersma, etc.) (Novik 1974, Dernov and Udovychenko 2019), non-marine bivalves of the upper part of the *lenisulcata* Zone and lower part of the *communis* Zone (e.g., *Carbonicola rectilinearis* Trueman et Weir, *C. limax* Wright, *C. obtusa* (Hind), *Curvirimula trapeziforma* (Dewar), and *C. tesselata* (Jones)) (Dernov 2022b), the conodonts *Declinognathodus noduliferus* (Ellison et Graves) s.l., ?*D. pseudolateralis* Nemyrovska, *Idiognathodus praedelicatus* Nemyrovska, *Id. primulus* Higgins, *Id. sinuosus* Ellison et Graves, *Idiognathoides lanei* Nemirovskaya (Nemyrovska 1999), and other marine and terrestrial biota, e.g. miospores, foraminifers, corals, bryozoans, brachiopods, scaphopods, gastropods, horseshoe crabs, millipedes, insects, etc.

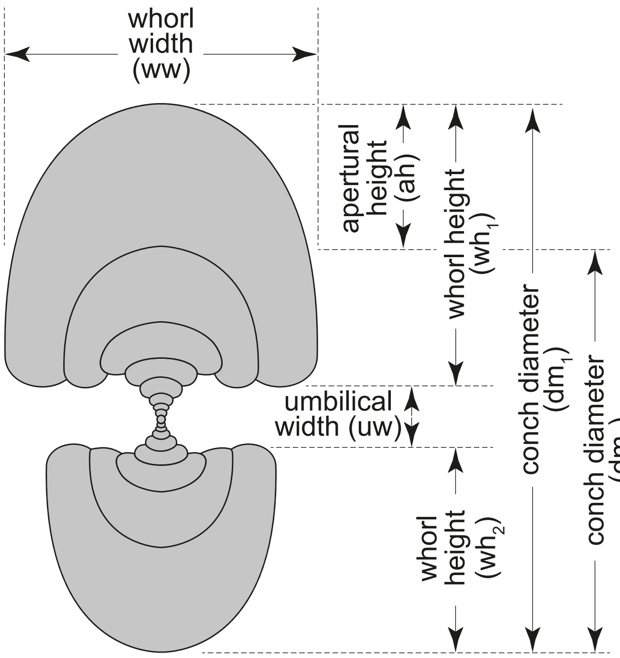
Material and methods

I investigated about 60 specimens (Tab. 1) of mostly poorly preserved limonitized conchs, steinkerns and conch impressions in this study (collections IGSU-4 and IGSU-7). These collections are stored in the Department of Stratigraphy and Palaeontology of Palaeozoic Sediments in the Institute of Geological Sciences (National Academy of Sciences of Ukraine, Kyiv). The key for description of Palaeozoic ammonoid species proposed in Korn's publications (2010, 2017) is used here.

The abbreviations used in the species description are (Text-fig. 3): A lobe – adventive lobe, E lobe – external lobe, E/A saddle – ventrolateral saddle (between external lobe and adventive lobe), dm – conch diameter, wh – whorl height, ah – apertural height, ww – whorl width, 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, Korn and Klug 2012).

Table 1. Number of specimens described.

Taxon	Number of specimens
Anthracoceratites sp.	1
Cymoceras sp.	1
Melvilloceras rotaii	13
Gastrioceras angustum	6
Gastrioceras lupinum	11
Gastrioceras kutejnikovense	3
?*Agastrioceras* sp.	1
Bisatoceras sp.	2
?*Owenoceras* sp.	1
Branneroceras sp. A	22
Branneroceras sp. B	3



Text-fig. 3. Conch dimensions used in the systematic descriptions (after Korn 2017).

Unfortunately, poor preservation of the material did not allow us to accurately measure the conchs and calculate WER and IZR values for many of the described ammonoids. Many ammonoid specimens cannot be photographed ventrally due to their poor preservation.

Taphonomy and palaeoecology

Most of the studied ammonoids were found in black shales (mainly mudstones) with siderite nodules, framboidal pyrite and small pyrite concretions. These rocks were formed in a dysaerobic environment at depths below the wind-wave base but above the storm-wave base (20–40 m) where there was a low rate of sedimentation. This conclusion is based on the presence of siderite concretions, framboidal pyrite, the black color of the rocks and its clayey composition, the presence of thin tempestite interlayers (detrital and biomorphic sandy limestone and siltstone), bioturbation *Chondrites* Sternberg, etc.

The black shale contains remains of mature ammonoids and, more rarely, their embryonic conchs. Conchs are usually limonitized (oxidized pyrite) (Text-fig. 4j), sideritized, or completely dissolved, and presented as steinkerns or its fragments (Text-fig. 4k). Small clusters of crushed mollusk shells on the layer surface can be interpreted as ruined bromalites of sclerophagous fishes such as bradyodonts; clusters of almost undamaged shells seem to have formed as a result of irregular storms (e.g., interlayer of siderite concretions of stratigraphic level 5b).

Some ammonoid conchs from stratigraphic levels 3 and 8 bear traces of damage, apparently caused by fishes (Text-fig. 4g). The Carboniferous ichthyofauna of the Donets Basin has been only poorly studied and to date, the only known genera from here are *Erismacanthus* M'Coy, *Listracanthus* Newberry et Worthen, *Lagarodus* Jaekel, *Venustodus* St. John et Worthen, *Helodus* Agassiz, *Symmorium* Cope, *Glikmanius* Ginter et al., *Ctenacanthus* Agassiz, *Gyracanthus* Agassiz, *Rhizodopsis* Young, etc. (Ginter et al. 2005, Dernov 2016, 2019 and unpublished author's data). Apparently, ammonoids were often preyed upon by cartilaginous fishes, such as *Listracanthus* Newberry et Worthen, *Lagarodus* Jaekel, *Venustodus* St. John et Worthen, *Symmorium* Cope and others.

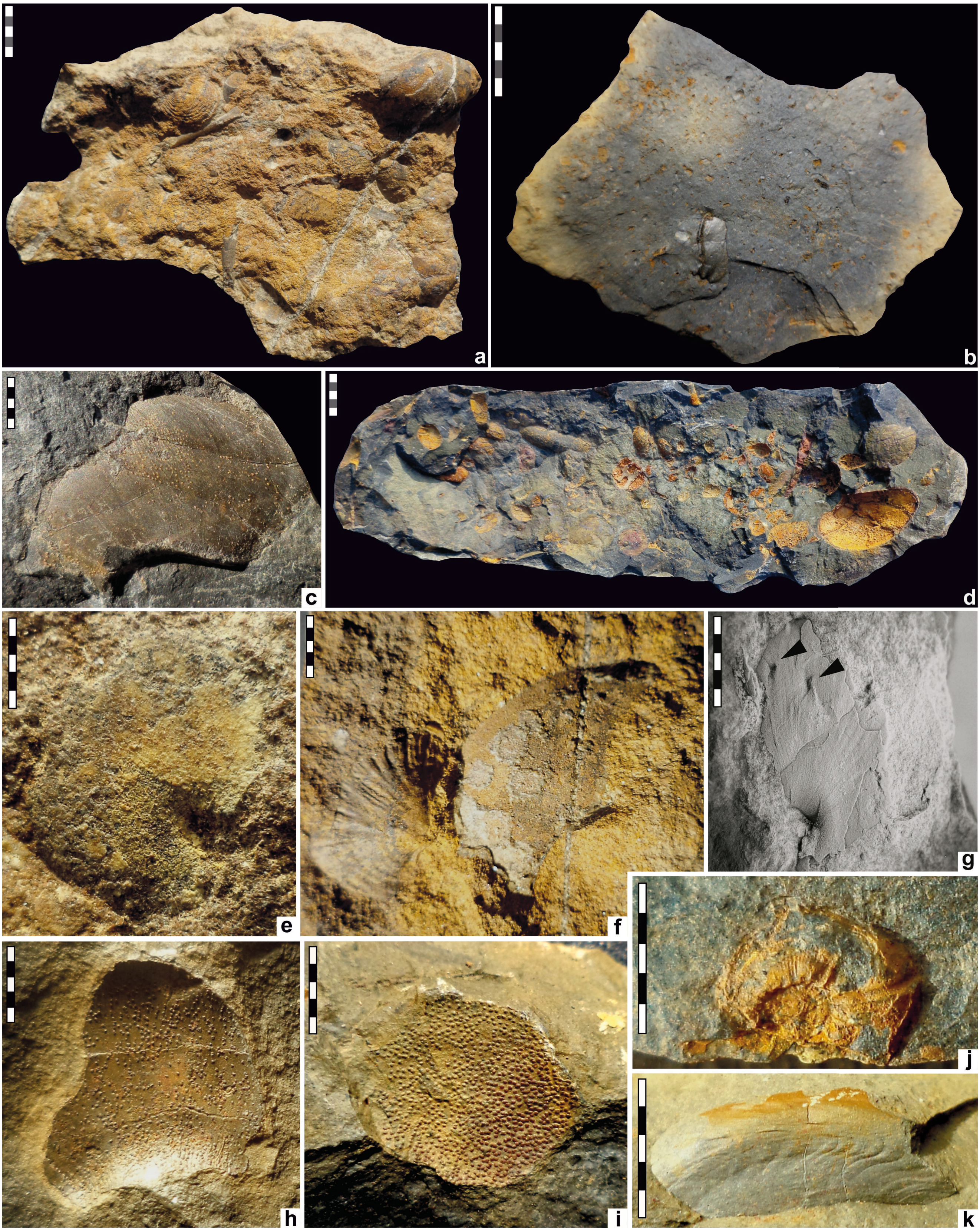
The surfaces of some ammonoid conchs from stratigraphic levels 5a and 5b bears trace fossil *Cyclopuncta girtyi* Elias, 1958 (Text-fig. 4h, i) and enigmatic epibionts (Text-fig. 4c), possibly fungi or algae. Similar epibionts are present on the surface of the ammonoid conch figured by Delépine (1937: pl. 2, fig. 8) from Westphalian strata of the Netherlands.

Cyclopuncta girtyi consists of small rounded depressions 0.4–0.8 mm in diameter, which are concentrated in large groups on the outer surface of conchs of orthocerids, coiled nautiloids, and ammonoids. The shape of their intersection in the direction perpendicular to the conch surface is semicircular. These trace fossils appear as hemispherical limonitized tubercles in the impressions of the surfaces of cephalopod conchs (Text-fig. 4i).

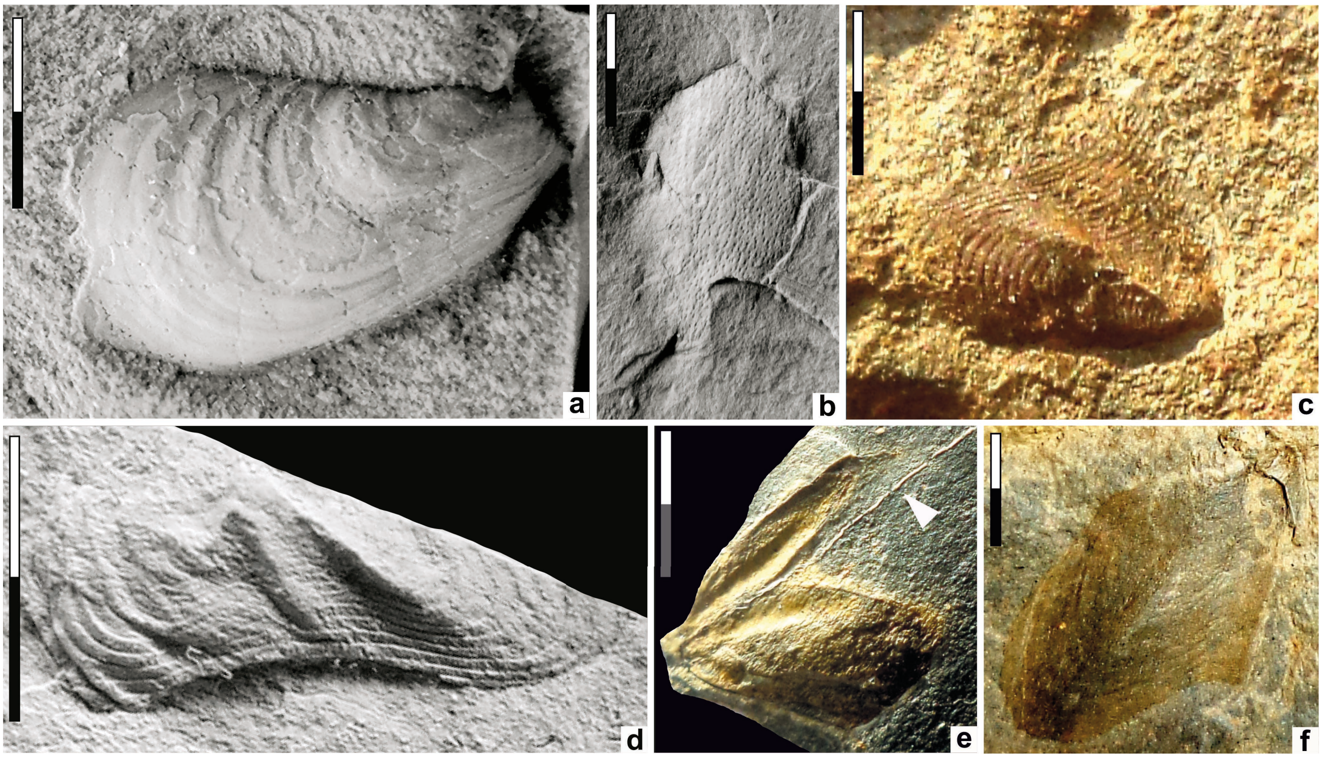
The trace fossils *Cyclopuncta girtyi* has been recognised by various researchers on the conchs of Ordovician tarphycerids (Pohle et al. 2019), Devonian orthocerids (Niko 1996), Mississippian bactritoids (Girty 1909) and ammonoids (Elias 1958). As I cannot yet make any educated guess as to the possible producers of these trace fossils. Elias (1958) considered *Cyclopuncta* as traces of infusorians in the conch wall; Hoare et al. (1980) suggested an inorganic origin of these small pits. It is possible that the epibionts figured in the Text-fig. 4c are the producers of these trace fossils, but this problem needs further investigation.

Specimens of ammonoids from sandstones and limestones are usually fragmentary (Text-fig. 4a, e, f). In the G_1^2 limestone layer, in which interlayers of stromatolites record episodes of reduced water salinity, rare remains of ammonoids are found on the surfaces of sedimentary breaks at the base of stromatolite biostromes, as well as in depressions on the upper surface of stromatolite biostromes along with very rare remains of bryozoans, chonetid brachiopods and crinoids.

In the black shales, along with remains of ammonoid conchs, there are remains of ammonoid jaw apparatus,



Text-fig. 4. Taphonomic features of the studied localities of ammonoids. a: Sandstone slab with fragmentary remains of productid and spiriferid brachiopods, orthocerids, coiled nautiloids and ammonoids (stratigraphic level No. 3). b: Shell debris cluster and fragment of crushed ammonoid conch (stratigraphic level No. 1). c: Epibionts on the surface of an ammonoid conch (stratigraphic level No. 5). d: Cluster of bivalves, gastropods and cephalopods remains in a siderite nodule (stratigraphic level No. 5). e: Fragment of an ammonoid conch (stratigraphic level No. 3). f: Fragment of an ammonoid conch (?) with terminal aperture and brachiopod valve (stratigraphic level No. 3). g: Specimen of ?*Anthracoceratites* sp. with conch injuries (shown by arrows) (stratigraphic level No. 8). h, i: Bioerosion trace fossils *Cyclopuncta girtyi* Elias, 1958 on the fragments of cephalopod conchs (stratigraphic level No. 5). j: Limonitized conchs of the ammonoid (stratigraphic level No. 7). k: Fragment of an ammonoid conch (stratigraphic level No. 5). Scale bars 10 mm.



Text-fig. 5. Remains of the jaw apparatus of ammonoids from the Mospyne Formation. a: Part of the upper jaw of an unknown ammonoid (stratigraphic level No. 5). b: Part of the jaw of an unknown ammonoid (stratigraphic level No. 5). c: Upper jaw of an unknown ammonoid (stratigraphic level No. 4). d: Part of the upper jaw of an unknown ammonoid (stratigraphic level No. 4). e: Lower (?) jaw of an unknown ammonoid (stratigraphic level No. 4); the arrow indicates the trace fossil. f: Part of the lower jaw of an unknown ammonoid (stratigraphic level No. 8). Scale bars 2 mm.

which can be attributed to several morphotypes (Text-fig. 5). All remains of ammonoid buccal apparatus come from black and grey mudstones and siltstones which were formed due to a lack of oxygen in the bottom layer of the water column. Apparently, parts of the jaw apparatus isolated from the conchs, and sometimes together with them, fell to the surface of the sea floor, and later sank into the semi-liquid clay mud. It should be noted that the jaw apparatus of Palaeozoic ammonoids was organic (possibly chitinous), only the rostrum was probably weakly mineralized (Doguzhaeva 1999). This is why its remains are quite rare. Probably, the taphonomic environments during the accumulation of black shales were favorable for the preservation of the buccal apparatus of Carboniferous ammonoids. Similar taphonomic features can also be observed in material from the Carboniferous of the USA (Mapes 1987) and the South Urals in Russia and Kazakhstan (Doguzhaeva 1999). The good quality preservation of the ammonoid jaw apparatus indicates their insignificant postmortem transportation.

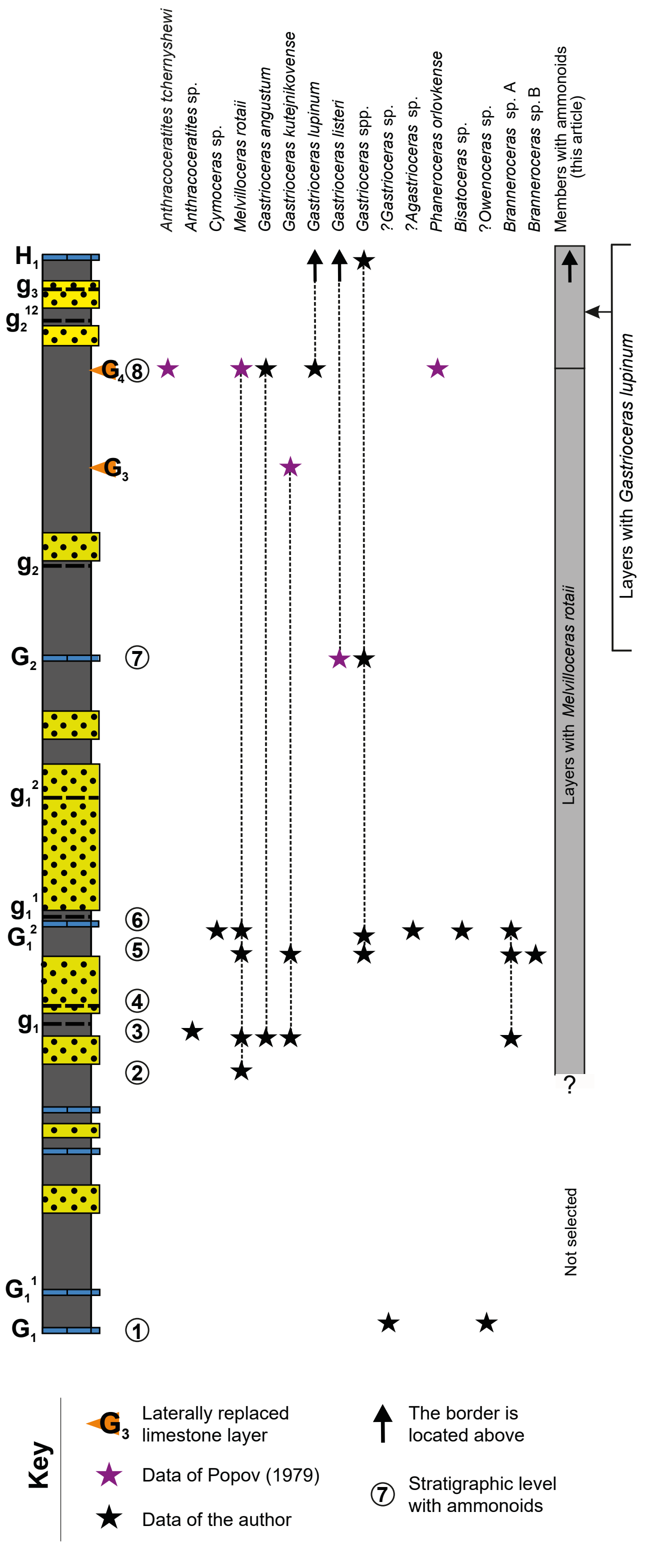
Biostratigraphy

The ammonoid taxa *Anthracoceratites tchernyshewi* Librovitch in Popov, 1979, *A*. sp., *Cymoceras* sp., *Melvilloceras rotaii* (Librovitch in Popov, 1979), *Gastrioceras listeri* (Sowerby, 1812), *G. angustum* Patteisky, 1964, *G. kutejnikovense* Popov, 1979, *G. lupinum* Popov, 1979, *Gastrioceras* spp., ?*Agastrioceras* sp., *Bisatoceras* sp., ?*Owenoceras* sp., *Phaneroceras orlovkense* (Popov, 1979), *Branneroceras* sp. A and *Br.* sp. B are known from the Mospyne Formation (Popov 1979, Dernov 2018, 2021a and this paper) (Text-fig. 6).

The taxonomic position of some ammonoids from the Mospyne Formation is uncertain, e.g. ammonoids apparently belonging to the family Neodimorphoceratidae (Text-fig. 7d, e) come from stratigraphic levels 3 and 4. Remains of indeterminate ammonoids with ornamentation similar to that of the genus *Christioceras* Nassichuk et Furnish, 1965 are often found in the Mospyne Formation. However, the conch venter of these ammonoids is convex, whereas the venter of *Christioceras* is concave. It is possible that these ammonoids from the Mospyne Formation belong to a new genus.

The genus *Cymoceras* McCaleb consists of two species: *C. miseri* McCaleb, 1964 and *C. otai* Nishida et Kyuma, 1982 (McCaleb 1964, Nishida and Kyuma 1982). *Cymoceras miseri* is described together with representatives of the genera *Branneroceras* Plummer et Scott, *Gastrioceras* Hyatt, and *Syngastrioceras* Librovitch and some others from the Brentwood Limestone of Arkansas (McCaleb 1964, 1968, Saunders et al. 1977); *Cymoceras otai*, together with representatives of the genera *Branneroceras* Plummer et Scott, *Gastrioceras* Hyatt, *Phaneroceras* Plummer et Scott, *Neoglaphyrites* Ruzhencev etc., is known from the *Pseudostafella antiqua* Zone of the Akiyoshi Limestone Group of Japan (Nishida and Kyuma 1982).

The type species of the genus *Melvilloceras* (*M. sabinensis* Nassichuk, 1975) is poorly understood; it is known from the Bloydian (= Langsettian) of the Canadian Arctic Archipelago, where it occurs together with



Text-fig. 6. Stratigraphic distribution of ammonoids in the Mospyne Formation. The lithological symbols are the same as in Text-fig. 2.

representatives of the genus *Branneroceras* Plummer et Scott (*Br. branneri* (Smith) and *Br. nicholasi* Nassichuk) (Nassichuk 1975).

Gastrioceras listeri (Sowerby) is typical of the base of the G2 ammonoid zone (Langsettian) of Great Britain (Yorkshire, Lancashire, and Devonshire), Belgium, Germany (Rhenish Massif), the Netherlands, and Poland (Upper Silesia, Lublin Coal Basin) (Korn 1997, 2007). *Gastrioceras angustum* Patteisky is known from the base of the G2 ammonoid zone of Germany (Rhenish Massif), southern Portugal, and probably from Great Britain (Yorkshire, Lancashire) (Korn 1997, 2007). The species *Gastrioceras kutejnikovense* Popov, 1979 and *G. lupinum* Popov, 1979 are endemics of the Donets Basin.

Agastrioceras Schmidt in Kukuk occurs in Yeadonian and Langsettian of England (Lancashire), Portugal, Belgium, the Netherlands, Germany (Rhenish Mountains), Poland, Kazakhstan and Kyrgyzstan (Nikolaeva 1994, Korn 1997, 2007).

The genus *Owenoceras* Miller et Owen consists of three species: *O. arcutum* Liang et Wang, *O. bellilineatum* Miller et Owen, and *O. orulganensis* Popow. The species *Owenoceras arcutum* Liang et Wang is described from the late Pennsylvanian (Kasimovian – Gzhelian) Shiqiantan Formation of China (Liang and Wang 1991). *O. orulganensis* Popow is known from Suorgan Formation (late Bashkirian to early Kasimovian (Grinenko and Baranov 2018–2019) or Kasimovian (Kutygin et al. 2016)) of the Orulgan Ridge in eastern Siberia, Russia (Popow 1960, 1970). *O. bellilineatum* Miller et Owen is described from the Cherokee Group (Desmoinesian, late Moscovian) of Missouri (Miller and Owen 1939). The presence of *Eoshumardites lenensis* (Popow) and *Yakutoglaphyrites involutus* (Popow) (Popow 1960, 1970) in the Suorgan Formation apparently indicates the Kasimovian age of this formation. Thus, *Owenoceras orulganensis* Popow is also of Kasimovian age. The ammonoid ?*Owenoceras* sp. from the Mospyne Formation is conventionally assigned to the genus *Owenoceras* as most morphologically similar, therefore there is no reason to think that this genus is also common in the Bashkirian.

In summary, in the Carboniferous section of the Donets Basin, the early Westphalian (G2 ammonoid zone; Langsettian) ammonoids *Branneroceras* spp., *Gastrioceras listeri* (Sowerby, 1812) and *G. angustum* Patteisky, 1964 indicate that the Mospyne Formation corresponds to the lower part of the *Gastrioceras-Branneroceras* Genozone. This Genozone was recognized by Popov (1979) between the G_1 limestone layer (basal bed of the Mospyne Formation) and the H_6 limestone layer (upper part of the Smolyanynivka Formation) of the Carboniferous succession of the Donets Basin. Ammonoids of the *Bilinguites-Cancelloceras* Genozone (e.g., *Bilinguites superbilinguis* (Bisat), *Cancelloceras cancellatum* (Bisat), *C. delicatum* Librovitch, *C. solidum* Popov, and *C. tenerum* Popov) were found in the Mandrykynka Formation below the Mospyne Formation (Text-fig. 2a). Thus, the Namurian-Westphalian boundary in the Carboniferous section of the Donets Basin is apparently at the base of the G_1 limestone layer.

Two regional layers with ammonoids can be distinguished in the Mospyne Formation based on the stratigraphic distribution of ammonoids: Layers with *Melvilloceras rotaii* and Layers with *Gastrioceras lupinum* (Text-fig. 6).

Layers with *Melvilloceras rotaii*

Index species. *Melvilloceras rotaii* (Librovitch in Popov, 1979).

A s s o c i a t e d a m m o n o i d s . *Cymoceras* sp., *Bisatoceras* sp., *Anthracoceratites tchernyshewi* Librovitch in Popov, *A.* sp., *Gastrioceras listeri* (Sowerby), *G. angustum* Patteisky, *G. kutejnikovense* Popov, *G.* spp., ?*Agastrioceras* sp., *Branneroceras* spp. (Popov 1979 and this paper).

S t r a t i g r a p h i c r a n g e . Between shale 100 m below the G_1^2 limestone layer and the G_4 limestone bed.

A g e a n d c o r r e l a t i o n . Layers with *Melvilloceras rotaii* correspond to the lower part of the *Gastrioceras-Branneroceras* Genozone, uppermost part of the *lenisulcata* Zone (non-marine bivalves) and lowest part of the *communis* Zone (lower Langsettian) of the Western Europe and the middle part of the *Neuralethopteris jongmansii* macrofloristic subzone of the Western Europe (Langsettian).

Layers with *Gastrioceras lupinum*

I n d e x s p e c i e s . *Gastrioceras lupinum* Popov, 1979.

A s s o c i a t e d a m m o n o i d s . *Gastrioceras listeri* (Sowerby) and *G. angustum* Patteisky (Popov 1979 and this paper).

S t r a t i g r a p h i c r a n g e . From the G_4 limestone layer to the base of the I_1 limestone bed (Belaya Kalitva Formation).

A g e a n d c o r r e l a t i o n . Layers with *Gastrioceras lupinum* correspond to the upper part of the *Gastrioceras-Branneroceras* Genozone, upper part of the *communis* Zone and lower *modiolaris* Subzone (late Langsettian) of the Western Europe and the uppermost part of the *Neuralethopteris jongmansii* and lower half of the *Laveineopteris loshii* macrofloristic subzones of Western Europe.

Systematic palaeontology

Order Goniatitida Hyatt, 1884
Suborder Goniatitina Hyatt, 1884
Superfamily Dimorphoceratoidea Hyatt, 1884
Family Anthracoceratidae Plummer et Scott, 1937

Genus *Anthracoceratites* Ramsbottom, 1970

T y p e s p e c i e s . *Anthracoceratites deansi* Ramsbottom, 1970; by original designation.

D i a g n o s i s . Genus of the family Anthracoceratidae with discoidal conch; umbilicus is closed. Ornamented with biconvex growth lines that form rather prominent ventrolateral projection. Suture line has a low median saddle; lobes have the tendency to become denticulate (after Ramsbottom 1970).

S p e c i e s i n c l u d e d . *A. arcuatilobus* (Ludwig, 1863), Rhenish Mountains (Germany); *A. augustevictoriae* (Patteisky, 1965), Rhenish Mountains (Germany); *A. deansi* Ramsbottom, 1970, Lancashire and Yorkshire (England); *A. lacerus* Korn, 1997, Praia das Quebradas (Portugal); *A. serratoides* (Termier, 1952), Béchar Province (Algeria); *A. serratum* (Delépine, 1941), Tafilalt (Morocco); *A. tchernyshewi* Popov, 1979, Donets Basin (Ukraine); *A. vanderbeckei* (Ludwig, 1863), Ruhr Basin (Germany).

S t r a t i g r a p h i c r a n g e . Yeadonian to Duckmantian / late early Bashkirian to terminal late Bashkirian.

***Anthracoceratites* sp.**
Text-fig. 7a

M a t e r i a l . One poorly preserved specimen from stratigraphic level 4 of the Mospyne Formation.

D e s c r i p t i o n . Specimen IGSU-4/3634 is a fragment of a fully sideritized specimen with ~16.2 mm diameter (Text-fig. 7a). The conch has a closed umbilicus, narrow and strongly convex venter; it merges imperceptibly into broad flattened flanks. The surface of the conch is covered with frequent and very thin growth lines. These run as a biconvex course and form a narrow, deep external sinus and a rather high projection on the ventrolateral shoulder. They form a shallow, broad sinus on the flank and a low projection near the umbilical margin. On the midflank the growth lines are spaced about 0.3 to 0.5 mm apart. The aperture has the same shape as the growth lines.

O c c u r r e n c e . Late Bashkirian, Mospyne Formation; Donets Basin (Ukraine).

Superfamily Neodimorphoceratoidea Furnish et Knapp, 1966
Family Neodimorphoceratidae Furnish et Knapp, 1966

Genus *Cymoceras* McCaleb, 1964

T y p e s p e c i e s . *Cymoceras miseri* McCaleb, 1964; by original designation.

D i a g n o s i s . Genus of the family Neodimorphoceratidae with extremely discoidal conch; umbilicus is closed. Ornamented with broad dichotomous biconvex transverse ribs, which form a ventral sinus and lateral projection. Suture line has a very wide ventral lobe with asymmetrical branches; flanks of median saddle curved (after McCaleb 1964).

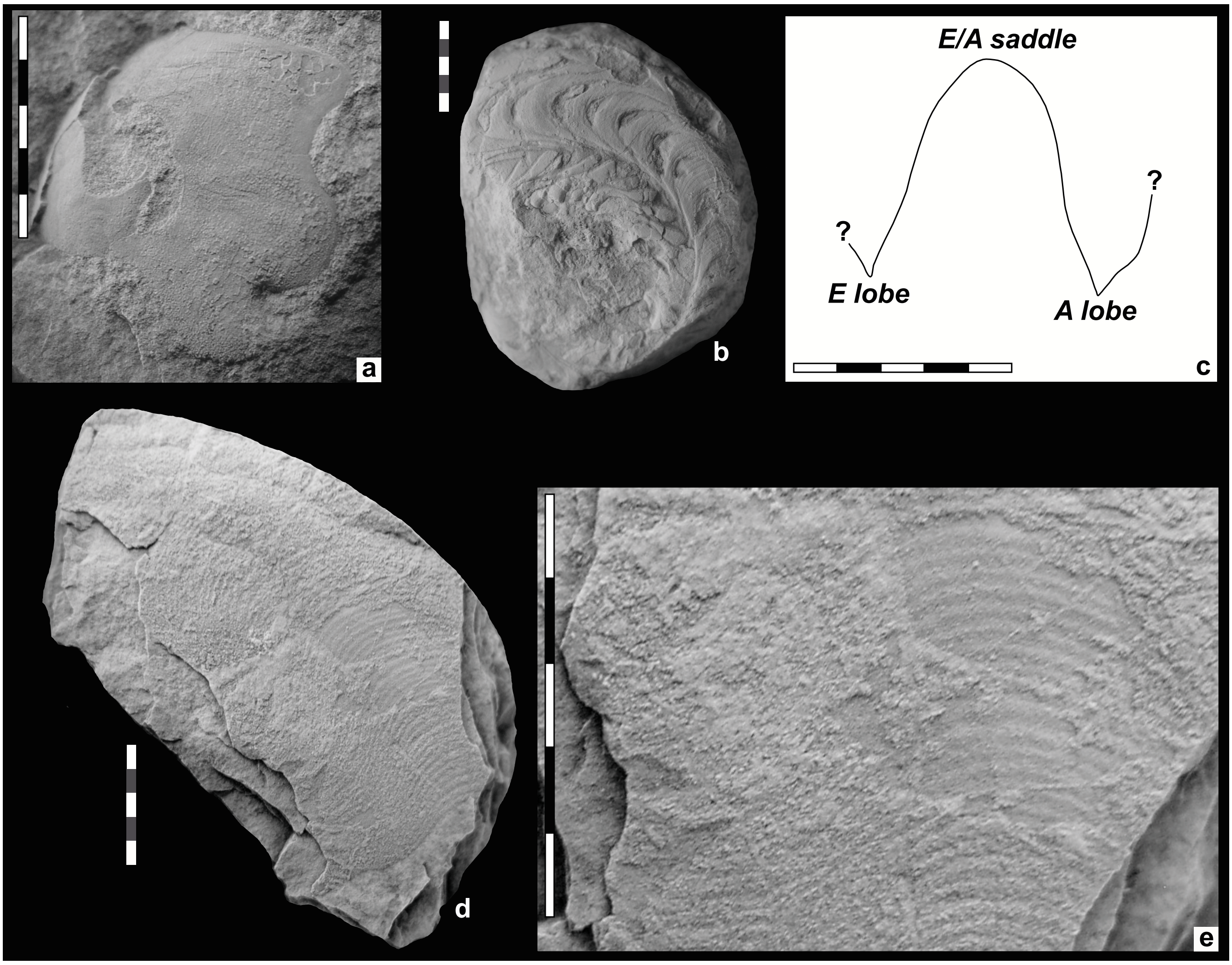
S p e c i e s i n c l u d e d . *C. miseri* McCaleb, 1964, Arkansas (USA); *C. otai* Nishida et Kyuma, 1982, Akiyoshi (Japan).

S t r a t i g r a p h i c r a n g e . Late Bashkirian.

***Cymoceras* sp.**
Text-fig. 7b, c

M a t e r i a l . One poorly preserved specimen from stratigraphic level 5b of the Mospyne Formation.

D e s c r i p t i o n . Specimen IGSU-4/573 is a fully limonitized specimen of 42.0 mm diameter (Text-fig. 7b). The conch is extremely discoidal (ww/dm = 0.29) with narrow and strongly convex venter; it merges imperceptibly into the broad flattened flanks. Ornamented with fine biconvex ribs that form a narrow sinus and projection on the ventrolateral area. On the ventrolateral area the ribs are spaced about 0.2 to 0.3 mm apart. The suture line has a narrow, sharply pointed lateral prong from the external lobe and high, narrow ventrolateral saddle; this saddle merges in the middle of the flank into a narrow, V-shaped pointed adventive lobe (Text-fig. 7c). The suture line is not preserved in the middle part of the venter and lower part of the flank.



Text-fig. 7. Ammonoids from the Mospyne Formation. a: *Anthracoceratites* sp., lateral view; specimen IGSU-4/3634. b, c: *Cymoceras* sp., lateral view (b), fragment of the suture line in a 42 mm diameter conch (c); specimen IGSU-4/573. d, e: Neodimorphoceratidae indet., lateral view (d), surface ornamentation on the flank (e); specimen IGSU-4/5350. Scale bars 10 mm.

R e m a r k s . *Cymoceras* sp. differs from *Cymoceras miseri* McCaleb, 1964 in a wider ventrolateral saddle.

O c c u r r e n c e . Late Bashkirian, Mospyne Formation; Donets Basin (Ukraine).

Superfamily Gastrioceratoidea Hyatt, 1884
Family Surenitidae Ruzhencev et Bogoslovskaya, 1975

Genus *Melvilloceras* Nassichuk, 1975

T y p e s p e c i e s . *Melvilloceras sabinensis* Nassichuk, 1975; by original designation.

D i a g n o s i s . Genus of the family Surenitidae with discoidal to pachyconic conch with moderately involute and rather narrow umbilicus. The venter is narrowly rounded and flanks are broadly rounded or flattened. Ornamentation is delicately reticulate and with umbilical nodes on the early growth stages; sinuous growth lines more conspicuous than longitudinal lirae; four to six constrictions per whorl. The external suture is characterized by ventral prongs that are attenuate and are separated from one another by a secondary ventral saddle that is greater than half the height of the broadly rounded first lateral saddle. The first lateral lobe is broad and pointed with straight or slightly curved sides (after Nassichuk 1975).

S p e c i e s i n c l u d e d . *M. sabinensis* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *M. rotaii* (Librovitch in Popov, 1979), Donets Basin (Ukraine).

S t r a t i g r a p h i c r a n g e . Late Bashkirian.

***Melvilloceras rotaii* (Librovitch in Popov, 1979)**
Text-fig. 8

1979 *Lutuginoceras rotaii*; Popov, p. 86, pl. XI, figs 1, 2, text-fig. 10I.
2021a *Melvilloceras rotaii*; Dernov, p. 13, text-fig. 1A–O.

H o l o t y p e . Specimen VSEGEI-73 in the Russian Geological Research Institute (St. Petersburg, Russia); figured by Popov (1979) in pl. XI, figs 1 and 2.

T y p e l o c a l i t y a n d s t r a t i g r a p h i c h o r i z o n . Rus'ko-Orlovka on Krynka River (Donetsk Region, Ukraine); Mospyne Formation, G_4 limestone layer (late Bashkirian).

D i a g n o s i s . *Melvilloceras* has a discoidal and subinvolute conch with narrow convex venter and weakly

Table 2. Dimensions (in mm) of *Melvilloceras rotaii* (Librovitch in Popov, 1979). The dimensions of the holotype (Popov 1979) are highlighted in grey.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-7/8040	32.1	~11.0	15.0	6.0	–	~0.34	~0.73	0.19	–	–
IGSU-7/496a	25.0	–	9.4	5.0	–	–	–	0.20	–	–
IGSU-7/468	23.4	11.2	12.3	4.1	7.4	0.48	0.91	0.18	2.14	0.40
IGSU-7/472	20.5	–	9.3	4.7	–	–	–	0.23	–	–
IGSU-7/540	19.7	9.3	10.7	4.8	–	0.47	0.87	0.24	–	–
VSEGEI–73	15.0	9.0	7.3	3.5	–	0.60	1.23	0.23	–	–
IGSU-7/496	14.0	6.7	8.4	3.0	–	0.48	0.80	0.21	–	–
IGSU-7/620	13.4	6.1	–	–	–	0.46	–	–	–	–
IGSU-7/8040a	13.3	7.0	–	–	–	0.53	–	–	–	–
IGSU-4/316	10.0	–	4.0	3.3	–	–	–	0.33	–	–
IGSU-7/6538	–	10.7	12.5	–	–	–	0.86	–	–	–

convex flanks covered with delicate concavo-convex growth lines; umbilical margin almost rectangular with small, sharp nodes.

Material. 13 specimens with conch diameter between 7 and 32 mm from stratigraphic levels No. 2–6 of the Mospyne Formation.

Description. The largest available specimen IGSU-7/8040 (Text-fig. 8a, b) with diameter 32.1 mm is subinvolute (uw/dm = 0.19), thinly discoidal (ww/dm ~ 0.34) with a weakly compressed whorl profile (ww/wh ~ 0.73). The venter is strongly convex and narrow; flanks weakly convex and slightly converging towards the ventrolateral shoulder. The umbilical margin is almost rectangular. The umbilical wall is vertical and flattened. The surface of the conch is covered with frequent and clearly visible lamellar lines and delicate growth lines, forming a narrow, deep external sinus, high ventrolateral projection and shallow, wide lateral sinus. On the midflank the growth lines are spaced about 0.4 to 0.5 mm apart. The umbilical margin has sharp elongated nodes.

Specimen IGSU-7/468 is an almost fully limonitized specimen with a diameter of 23.4 mm (Text-fig. 8g–i) and weakly compressed whorl profile (ww/wh = 0.91). The conch is thickly discoidal (ww/dm = 0.48) with narrow umbilicus (uw/dm = 0.18) and high aperture (WER = 2.14); the umbilical wall is flat and narrow; and the umbilical margin is almost rectangular. The venter is strongly convex; flanks are broad and very slightly convex. Ornamented with small, sharp hardly noticeable umbilical nodes.

Specimen IGSU-7/472 is a steinkern of 20.5 mm diameter (Text-fig. 8c, d). The conch has a narrow umbilicus (uw/dm = 0.23); a flattened, narrow umbilical wall and almost rectangular umbilical margin. The venter is strongly convex and narrow; the flanks are slightly convex (nearly flattened) and ornamented with small, sharp umbilical nodes (one node per 1 mm of the umbilical margin). Four narrow concavo-convex constrictions with high ventrolateral projection and deep ventral sinus are prominent on the whorl.

Remarks. *Melvilloceras rotaii* differs from *Melvilloceras sabinensis* in the coarser umbilical nodes, which don't disappear during ontogeny and absence of the longitudinal lirae. The conch form of the studied specimens differs from the single specimen of the type material, studied by Popov (holotype VSEGEI–73): ww/dm = 0.60 at conch diameter 15 mm in the holotype in comparison with ww/dm = 0.48 at conch diameter 14 mm (specimen IGSU-7/496). In addition, the specimens studied lack the longitudinal lirae noted by Popov (1979) in the original description. It is possible that longitudinal lirae are characteristic of young conchs; they may be absent on mature conchs (most of the specimens studied have a diameter of about 20 mm or more). The conch shape of the described specimens is more closely related to the species *Melvilloceras sabinensis* (ww/dm = 0.47 at 19.5 mm diameter in *M. sabinensis* and ww/dm = 0.47 at 19.7 mm diameter in *M. rotaii*).

Occurrence. Late Bashkirian, Mospyne Formation (shale 100 m below the G_1^2 limestone layer to the G_4 limestone layer; see Text-fig. 6); Donets Basin (Ukraine).

Family Gastrioceratidae Hyatt, 1884

Genus *Gastrioceras* Hyatt, 1884

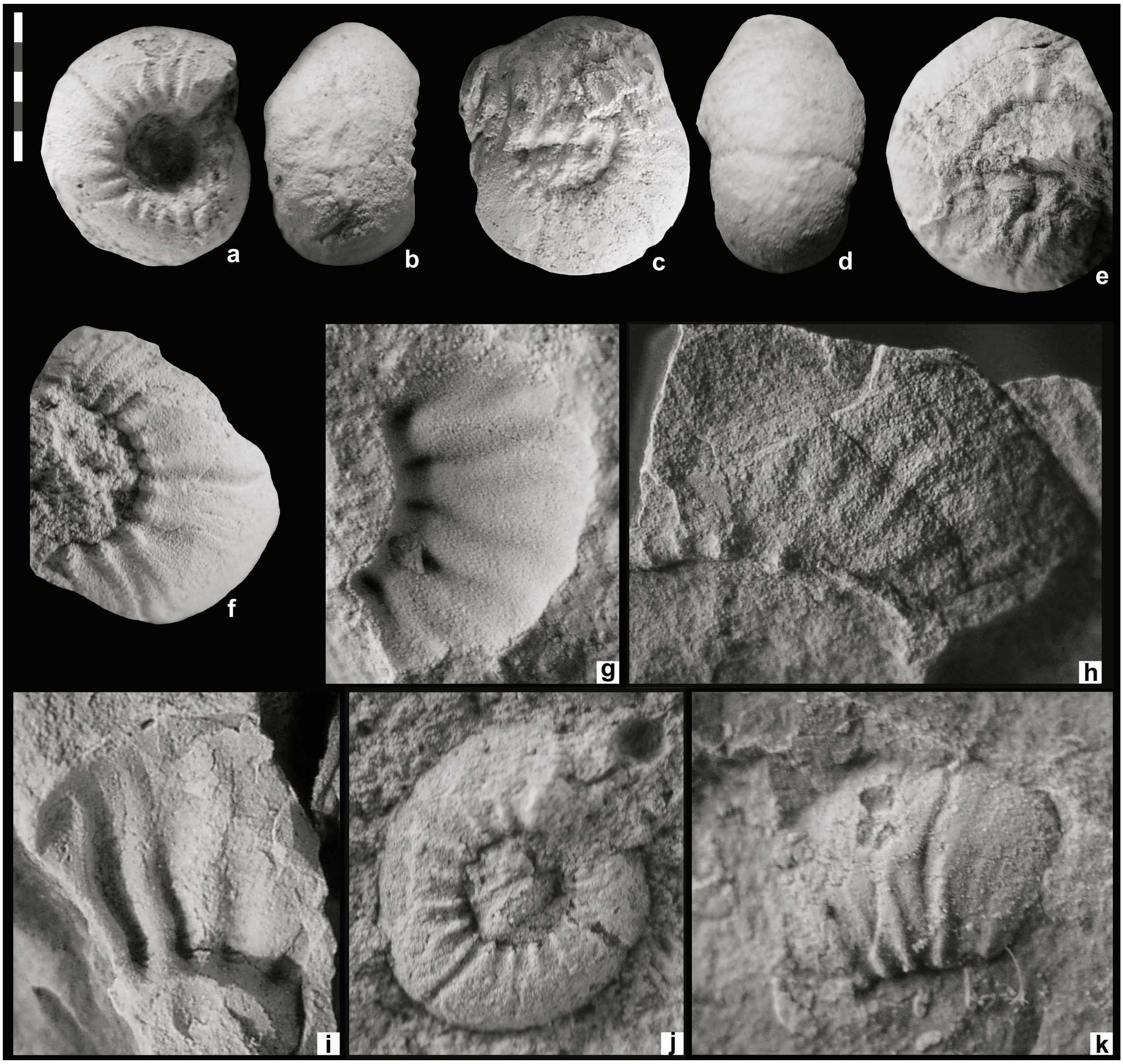
Type species. *Ammonites listeri* Sowerby, 1812; by subsequent designation (Foord and Crick 1897: 226; see also ICZN (1956): Opinion 420, p. 150).

Diagnosis. Genus of the family Gastrioceratidae with thickly discoidal, pachyconic and globular conch with moderate and wide umbilicus; umbilical shoulder nodose. Ornamentation ranging from simple transverse lirae to reticulate pattern in some species. Suture line with a high median saddle between the attenuated prongs of the ventral lobe; lateral lobe generally nearly symmetrical and becoming attenuated on mature specimens (after Mapes et al. 1997).

Species included. *G. adaense* Miller et Owen, 1944, Oklahoma (USA); *G. angustum* Patteisky, 1964, Rhenish Mountains (Germany); *G. araium* McCaleb, 1968, Arkansas and Oklahoma (USA); *G. attenuatum* McCaleb, 1968, Arkansas and Oklahoma (USA); *G. carbonarium* (Buch, 1832), Rhenish Mountains (Germany); *G. circumnodosum* Foord, 1903, Leinster (Ireland); *G. coronatum* Foord et Crick, 1897, Lancashire

Text-fig. 8. Ammonoids *Melvilloceras rotaii* (Librovitch in Popov, 1979) from the Mospyne Formation. a, b: A slightly laterally compressed specimen IGSU-7/8040, lateral view (a), ventral view (b). c, d: A slightly laterally compressed specimen IGSU-7/472, lateral view (c), ventral view (d). e, f: Specimen IGSU-7/540, lateral view (e), ventral view (f). g–i: Specimen IGSU-7/468, dorsal view (g), lateral view (h), ventral view (i). j: Specimen IGSU-7/6538, dorsal view. k, l: Specimen IGSU-7/620, lateral view (k), ventral view (l). m–q: Lateral views of the conchs showing the different relief of the umbilical nodes; m – specimen IGSU-4/4148, n – specimen IGSU-7/522, o – specimen IGSU-7/468a, p – specimen IGSU-7/472a, q – specimen IGSU-7/316. Scale bars 10 mm.

(England); *G. crassum* Wedekind, 1914, Rhenish Mountains (Germany); *G. depressum* Delépine, 1937, Heerlen (the Netherlands); *G. fittsi* Miller et Owen, 1944, Oklahoma (USA); *G. formosum* McCaleb, 1963, Arkansas (USA); *G. glenisteri* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *G. kahrsi* Wedekind, 1914, Rhenish Mountains (Germany); *G. kenadsae* Delépine, 1941, Béchar Province (Algerian); *G. kutejnikovense* Popov, 1979, Donets Basin (Ukraine); *G. liratum* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *G. listeri* (Sowerby, 1812), Yorkshire (England); *G. lupinum* Popov, 1979, Donets Basin (Ukraine); *G. magoffinense* Work et al., 2012, Kentucky (USA); *G. matsumotoi* Nishida et Kyuma, 1982, Akiyoshi (Japan); *G. melvillensis* Nassichuk, 1975, Canadian Arctic



Text-fig. 9. Ammonoids from the Mospyne Formation. a–d: *Gastrioceras angustum* Patteisky, 1964, lateral view (a, c), ventral view (b, d); a, b – specimen IGSU-7/8100, c, d – specimen IGSU-7/669b. e–i: *Gastrioceras lupinum* Popov, 1979, lateral view; e – specimen IGSU-4/687, f – specimen IGSU-4/687a, g – specimen IGSU-4/687b, h – specimen IGSU-4/644, i – specimen IGSU-4/1516. j, k: *Gastrioceras kutejnikovense* Popov, 1979, lateral view; j – specimen IGSU-7/3254, k – specimen IGSU-7/3254a. Scale bar 5 mm.

Archipelago (Canada); *G. occidentale* Miller et Faber, 1892, Kentucky (USA); *G. stenolobum* Delépine, 1941, Atlas (Morocco); *G. stenumbilicatum* Ruan et Zhou, 1987, Ningxia (China); *G. weristerense* Demanet, 1943, Liège (Belgium); *G. wongi* Grabau, 1924, Ningxia and Gansu (China).

Stratigraphic range. Late Bashkirian to early Moscovian.

***Gastrioceras angustum* Patteisky, 1964**
Text-fig. 9a–d

1831 *Ammonites subcrenatus*; Münster, p. 371, pl. 8, fig. 1. [nomen nudum]
1897 *Gastrioceras carbonarium*; Foord and Crick, p. 229, fig. 110 (pars).
1914 *Gastrioceras carbonarium*; Pruvost, p. 16.
1929 *Gastrioceras subcrenatum*; Schmidt, pl. 19, figs 17, 18.
1931 *Gastrioceras subcrenatum*; Dorlodot and Delépine, p. 73, figs 10–13c.
1938 *Gastrioceras subcrenatum*; Demanet and van Straelen, p. 183, fig. 59.
1964 *Gastrioceras carbonarium angustum*; Patteisky, p. 650, pl. 1, figs 10–13, 15.
1965 *Gastrioceras carbonarium angustum*; Patteisky, p. 20, pl. 7, figs 12–15, pl. 8, figs 1–3.
1965 *Gastrioceras carbonarium carbonarium*; Patteisky, p. 19, pl. 7, fig. 4.
1997 *Gastrioceras angustum*; Korn, p. 89, pl. 15, fig. 7.
2007 *Gastrioceras angustum*; Korn, p. 29, figs 17, 18.

Holotype. Specimen BB.P223.WB in the Deutsches Bergbau-Museum (Bochum, Germany); figured by Korn (2007: fig. 17B).

T y p e l o c a l i t y a n d s t r a t i g r a p h i c h o r i z o n. Hammertal, Pleßbach pit (near Bochum-Stiepel, Rhenish Massif, Germany); marine horizon above Sarnsbank 2 coal seam, G2 Zone (base of Langsettian).

D i a g n o s i s. *Gastrioceras* with thickly discoidal, almost pachyconic conch with convex venter, weakly convex flanks and moderate umbilicus covered with nodes. Flanks bearing lamellae; four weak concavo-convex constrictions are prominent on each whorl.

M a t e r i a l. Six steinkerns of the very small conchs (dm = 5.5–8.5 mm) from stratigraphic levels 3 and 8 of the Mospyne Formation.

D e s c r i p t i o n. Specimen IGSU-4/669b (Text-fig. 9c, d) is an almost fully preserved steinkern of 8 mm diameter. The conch is thickly discoidal, almost pachyconic (ww/dm = 0.59) with moderate umbilicus (uw/dm = 0.36), moderately depressed (ww/wh = 1.80), semi-circular whorl profile and wide convex venter; ventrolateral shoulder is rounded; flanks are weakly convex; umbilical margin angular. Ornamentation with umbilical nodes and lateral lamellae, forming a narrow shallow sinus on the venter, a low projection on the ventrolateral shoulder and narrow shallow sinus on the flank. Four weak concavo-convex constrictions with high ventrolateral projection and very shallow ventral sinus are prominent on the whorl. The suture line is not preserved on the material studied.

Specimen IGSU-4/669b (Text-fig. 9a, b) is an almost fully preserved steinkern of 6.5 mm diameter. The conch is thickly discoidal (ww/dm = 0.51) with moderate umbilicus (uw/dm = 0.31), moderately depressed (ww/wh = 1.50), semi-circular whorl profile and wide convex venter; ventrolateral shoulder is rounded; flanks are weakly convex; umbilical margin angular; umbilical wall flattened and wide. Ornamentation with umbilical nodes and lateral lamellae, forming a narrow shallow sinus on the venter, a low projection on the ventrolateral shoulder and narrow shallow sinus on the flank. On the midflank the lamellae are spaced about 0.4 to 0.5 mm apart. Four weak concavo-convex constrictions with high ventrolateral projection and very shallow ventral sinus are prominent on the whorl. The suture line is not preserved on the material studied.

R e m a r k s. *Gastrioceras angustum* differs from *G. listeri* in the lack of spiral lines between the umbilical nodes, less coarse umbilical nodes, less depressed whorl profile, and from *G. circumnodosum* in the much lower number of umbilical nodes.

O c c u r r e n c e. Basal part of the Westphalian of Germany, Great Britain, and south Portugal.

Gastrioceras lupinum Popov, 1979

Text-fig. 9e–i

1979 *Gastrioceras lupinum*; Popov, p. 83, pl. X, figs 9–11.
2018 *Gastrioceras lupinum*; Dernov, p. 9, pl. 6, fig. 1.

H o l o t y p e. Specimen VSEGEI-3223 in the Russian Geological Research Institute (St. Petersburg, Russia); figured by Popov (1979: pl. X, fig. 9).

T y p e l o c a l i t y a n d s t r a t i g r a p h i c h o r i z o n. Sorocha Ravine, Donets Basin, Ukraine; Smolyanynivka or Belaya Kalitva Formation (H_5 or I_1 limestone layer; late Bashkirian).

D i a g n o s i s. *Gastrioceras* with involute pachyconic conch with moderately depressed whorl profile, strongly convex venter, slightly convex flanks and very narrow and moderate umbilicus covered with small sharp nodes. Flanks bearing thin concavo-convex ribs; three constrictions are prominent on each whorl.

M a t e r i a l. 11 fragments of steinkerns and conch impressions from stratigraphic level No. 8 in the upper part of the Mospyne Formation.

D e s c r i p t i o n. The most well-preserved specimen IGSU-4/687 (Text-fig. 9e) is pachyconic (ww/dm = 0.70 at conch diameter 9.4 mm) with moderate umbilicus (uw/dm = 0.34) and convex venter. The flanks are almost flat and weakly converge towards the ventrolateral shoulder. The umbilical margin is rectangular; the umbilical wall is vertical. The whorl profile is moderately depressed (ww/wh = 1.47 at conch diameter 9.4 mm and 1.60 at conch diameter 30.0 mm). The surface of the conch is covered with small sharp umbilical nodes and thin transverse ribs, forming a shallow external sinus, a low ventrolateral projection

Table 3. Dimensions (in mm) of *Gastrioceras angustum* Patteisky, 1964.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/669a	8.3	–	3.6	2.9	–	–	–	0.35	–	–
IGSU-4/669b	8.0	4.7	2.6	2.6	–	0.59	1.80	0.36	–	–
IGSU-4/8100	6.5	3.3	2.2	2.0	1.3	0.51	1.50	0.31	1.56	0.41
IGSU-4/365	6.5	3.8	2.2	1.9	–	0.58	1.73	0.29	–	–

Table 4. Dimensions (in mm) of *Gastrioceras lupinum* Popov, 1979. The dimensions of the holotype (Popov 1979) are highlighted in grey.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/687	9.4	6.6	4.5	3.2	–	0.70	1.47	0.34	–	–
VSEGEI-3223	30.0	16.0	10.0	13.0	–	0.53	1.60	0.43	–	–

and a very shallow, wide lateral sinus. Three prominent constrictions are present on each whorl.

Remarks. *Gastrioceras lupinum* differs from *Gastrioceras araium* and *G. magoffinense* in the coarser ornamentation. *Gastrioceras lupinum* is distinguished from *G. formosum* by the conch form (ww/dm = 0.53 at conch diameter 30 mm in the *Gastrioceras lupinum* holotype but 0.86 at conch diameter 30 mm in *G. formosum*), the narrower whorl profile (ww/wh = 1.60 at conch diameter 30 mm in *Gastrioceras lupinum* holotype but 2.22 in *G. formosum*) and the presence of lateral ribs in *Gastrioceras lupinum*.

Occurrence. Late Bashkirian, upper part of the Mospyne Formation to basal layer of the Belaya Kalitva Formation; Donets Basin (Ukraine).

***Gastrioceras kutejnikovense* Popov, 1979**
Text-fig. 9j, k

1979 *Gastrioceras kutejnikovense*; Popov, p. 84, pl. XI, fig. 3.

Holotype. Specimen VSEGEI-69 in the Russian Geological Research Institute (St. Petersburg, Russia); figured by Popov (1979: pl. XI, fig. 3).

Type locality and stratigraphic horizon. Zapovidka Ravine near Kuteynikove, Donetsk Region, Ukraine; the G_3 or G_4 limestone layer of the Mospyne Formation.

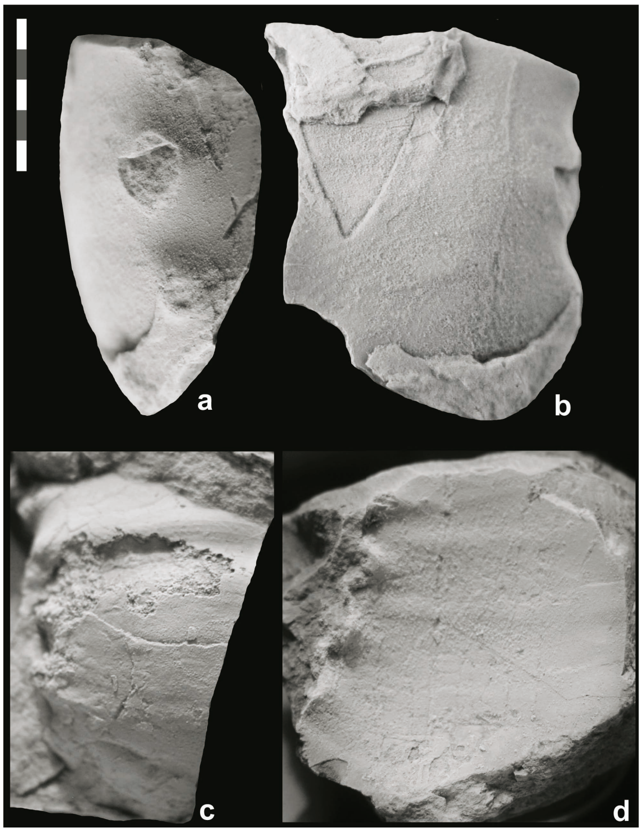
Diagnosis. *Gastrioceras* with pachyconic conch with weakly compressed whorl profile and moderate umbilicus; ornamentation consisting of concavo-convex growth lines and sharp elongate umbilical nodes.

Material. Three steinkerns from stratigraphic levels 3 and 5a of the Mospyne Formation.

Description. Specimen IGSU-7/3254 is an almost fully preserved steinkern of 9.1 mm diameter with convex venter; it merges imperceptibly into almost flat flanks, which weakly converge onto the ventrolateral shoulder; the umbilical margin is rectangular and umbiblicus is moderate (uw/dm = 0.32). Ornamentation consisting of frequent clearly visible growth lines. These form a shallow external sinus and a low projection on the ventrolateral shoulder and very shallow, broad sinus on the flank. The surface of the umbilical margin is covered with sharp nodes, spaced approximately 0.35 to 0.40 mm apart at conch diameter 9.1 mm. Two weak concavo-convex constrictions with high ventrolateral projection and very shallow ventral sinus are prominent on whorl. The suture line is not preserved.

Remarks. The described species differs from other representatives of the genus in its more delicate ornamentation and the narrower umbilicus. *Gastrioceras kutejnikovense* is very similar to *Gastrioceras magoffinense* (early Atokan; Kentucky, USA). As the suture line of *Gastrioceras kutejnikovense* is not known, I cannot at present confidently compare these taxa; the conch morphology of these species is very similar.

Occurrence. Late Bashkirian, Mospyne Formation (sandstone and shale bellow the G_1^2 limestone layer to the G_4 limestone layer); Donets Basin (Ukraine).



Text-fig. 10. *Gastrioceras* sp., lateral view (a), ventral view (b–d); a, b – specimen IGSU-4/6390, c – specimen IGSU-4/6390a, d – specimen IGSU-4/6390b. Scale bar 10 mm.

***Gastrioceras* spp.**
Text-figs 4j, 10

Remarks. Several specimens of *Gastrioceras* sp. were found in shales above the G_1 limestone layer, in mudstones and siltstones below the G_1^2 limestone layer (Text-fig. 10), in the G_2 limestone layer and black shale above it (Text-fig. 4j), and in the H_1 limestone layer (Text-fig. 6).

Genus *Agastrioceras* Schmidt in Kukuk, 1938

Type species. *Glyphioceras carinatum* Frech, 1899; by original designation.

Diagnosis. Genus of the family Gastrioceratidae with discoidal and pachyconic conch and moderately wide umbilicus. Venter is narrowly rounded. Ornamentation of inner whorls consists of small umbilical nodes; some species with very fine spiral ornamentation. Suture line with moderately wide, Y-shaped ventral lobe and moderately high median saddle; prongs of ventral lobe symmetric (after Patteisky 1965, Korn 1997).

Species included. *A. adleri* Patteisky, 1965, Rhenish Mountains (Germany); *A. amaliae* Schmidt in Kukuk, 1938, Rhenish Mountains (Germany); *A. carinatum* (Frech, 1899), Rhenish Mountains (Germany); *A. clathratum* Korn, 1997, Praia das Quebradas (Portugal); *A. reifi* (Korn, 1997), Praia das Quebradas (Portugal); *A. subcrenatum* (Schlotheim, 1822), Rhenish Mountains (Germany); *A. supinum* Korn, 1997, Praia das Quebradas (Portugal); *A. vagum* Nikolaeva, 1989, Ugam Ridge (Kazakhstan).

Table 5. Dimensions (in mm) of ?*Agastrioceras* sp.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/389	27.8	11.6	13.2	6.9	9.1	0.42	0.88	0.25	2.22	0.31

Stratigraphic range. Yeadonian – Langsettian / late early and early late Bashkirian.

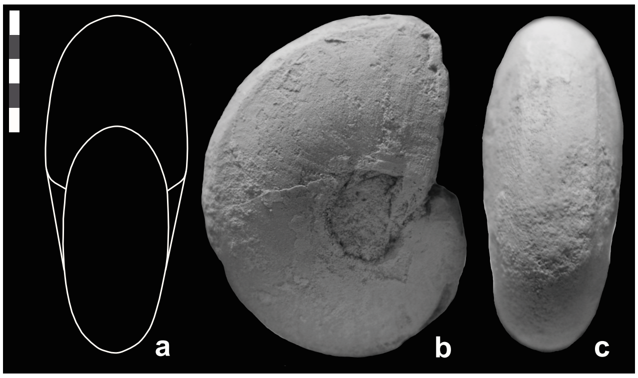
?*Agastrioceras* sp.
Text-fig. 11

Material. One poorly preserved specimen from stratigraphic level 5b of the Mospyne Formation.

Description. Specimen IGSU-4/389 is a sideritic specimen with a 27.8 mm conch diameter. The conch is thinly discoidal (ww/dm = 0.42) with narrow umbilicus (uw/dm = 0.25) and high coiling rate (WER = 2.22). It has a weakly compressed whorl profile (ww/wh = 0.88). The venter is narrow, strongly convex and roof-like because of the presence of three thin ridges, of which the median one is less clearly visible than the two lateral ones. The flanks are broad and almost flattened; they are slightly convergent. The umbilical margin is narrowly rounded and almost rectangular. The surface of the conch is covered with frequent lamellae that form a deep, broad sinus on the flanks and a low projection on the venter. Three thin ridges are present on the venter.

Remarks. ?*Agastrioceras* sp. differs from *Agastrioceras amaliae* in the lamellae having less relief l and the absence of umbilical nodes. The conch form of ?*Agastrioceras* sp. differs from the specimens of *Agastrioceras supinum.* Growth lines of *Agastrioceras clathratum* have a ventral sinus, but the growth lines of ?*Agastrioceras* sp. have a low projection on the venter. ?*Agastrioceras* sp. is differs from *A. clathratum* in the absence of umbilical nodes and from *A. reifi* by its thinly discoidal conch.

Occurrence. Late Bashkirian, Mospyne Formation; Donets Basin (Ukraine).



Text-fig. 11. ?*Agastrioceras* sp., dorsal view (a), lateral view (b), ventral view (c); specimen IGSU-7/389. Scale bar 10 mm.

Superfamily Thalassoceratoidea Hyatt in Zittel, 1900
Family Bisatoceratidae Miller et Furnish, 1957

Genus *Bisatoceras* Miller et Owen, 1937

Type species. *Bisatoceras primum* Miller et Owen, 1937; by original designation.

Diagnosis. Genus of the family Bisatoceratidae with subdiscoidal conch and very narrow or closed umbilicus. Ornamentation of transverse growth lamellae which form ventral and lateral sinuses and ventrolateral and dorsolateral salients. Constrictions present in early ontogenetic stages, but absent at maturity. Prongs of the ventral lobe are accuminate and inflatted and are broader than the first lateral saddle. The secondary ventral saddle is nearly as high as the rounded lateral saddle and is narrow and accuminate and the umbilical lobe is shallow and rounded (after Nassichuk 1975).

Species included. *B. akiyoshiense* Nishida, 1971, Akiyoshi (Japan); *B. baraiense* Soboloev in Sobolev et al., 1998, Verkhoyansk Ridge (Siberia, Russia); *B. elegantulum* Ruan, 1981, Guangxi (China); *B. greenei* Miller et Owen, 1939, Missouri (USA); *B. hoeni* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *B. huashibanense* Yang, 1978, Guizhou (China); *B. kotti* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *B. micromphalus* McCaleb, 1968, Arkansas (USA); *B. nevadense* Gordon, 1969, Nevada (USA); *B. primum* Miller et Owen, 1937, Oklahoma (USA); *B. qixuense* Ruan, 1981, Guangxi (China); *B. renni* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *B. solominae* Popow, 1970, Kolyma Ridge (Siberia, Russia); *B. vidnayense* Popov et Kusina, 1993, Novaya Zemlya (Russia); *B. vulgare* Ruan, 1981, Guangxi (China).

Stratigraphic range. Late Serpukhovian to Gzhelian.

***Bisatoceras* sp.**
Text-fig. 12a–e

Material. Two poorly preserved specimens from stratigraphic level 5b of the Mospyne Formation.

Description. Specimen IGSU-4/500 is a sideritic specimen with 16.8 mm conch diameter (Text-fig. 12a–c). The conch is thickly dicoidal (ww/dm = 0.57) with very narrow umbilicus (uw/dm = 0.10) and moderate coiling rate (WER = 1.80) and weakly depressed whorls (ww/wh = 1.13). The venter is narrow and convex. The flanks are broad and almost flattened; they slightly converge onto the ventrolateral shoulder. The umbilical margin is narrowly rounded and almost rectangular. The conch ornamentation is not preserved.

The conch surface of specimen IGSU-7/500a is covered with frequent and clearly visible growth lines. These form a wide, shallow external sinus and a low projection on the midflank and a wide, shallow sinus on the umbilical part of the flank. On the midflank, the growth lines are spaced about 0.15 to 0.20 mm apart.

Text-fig. 12. Ammonoids from the Mospyne Formation. a–e: *Bisatoceras* sp., dorsal view (a), lateral view (b, d), ventral view (c), surface ornamentation on the flank of specimen IGSU-7/500a (e); a–c – specimen IGSU-7/500, d, e – specimen IGSU-7/500a. f: ?*Owenoceras* sp., lateral view; specimen IGSU-4/1367. Scale bars 2 mm (e) and 5 mm (a–d, f).

Table 6. Dimensions (in mm) of *Bisatoceras* sp.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/500	16.8	9.5	8.4	1.6	4.3	0.57	1.13	0.10	1.80	0.49

R e m a r k s . *Bisatoceras* sp. is very similar in the form of conch and surface ornamentation to the species *Bisatoceras kotti* Nassichuk, 1975, but the umbilicus in *B. kotti* is closed from 6.2–28.0 mm diameter and very narrow in *Bisatoceras* sp. (uw/dm = 0.10 at conch diameter 16.8 mm).

O c c u r r e n c e . Late Bashkirian, Mospyne Formation; Donets Basin (Ukraine).

Genus *Owenoceras* Miller et Owen, 1939

T y p e s p e c i e s . *Neoglyphioceras bellilineatum* Miller et Owen, 1939; by original designation.

D i a g n o s i s . Genus of the family Bisatoceratidae with pachyconic conch and moderately wide or rather narrow umbilicus. Ornamented with prominent longitudinal lirae and weak growth lines; umbilical nodes may be present. Suture line with an almost straight-sided bifid ventral lobe and on either side of it a rounded U-shaped asymmetrical first lateral saddle, a sharply pointed somewhat tongue-shaped first lateral lobe, a rather low broad asymmetrical rounded second lateral saddle, and a shallow broad pointed lobe on the umbilical wall (after Miller and Owen 1939, Miller and Furnish 1940).

S p e c i e s i n c l u d e d . *O. arcutum* Liang et Wang, 1991, Xinjiang (China); *O. bellilineatum* Miller et Owen, 1939, Missouri (USA); *O. orulganensis* Popow, 1960, Orulgan Ridge (Siberia, Russia).

S t r a t i g r a p h i c r a n g e . ?Late Bashkirian to Kasimovian or Gzhelian.

?*Owenoceras* sp.

Text-fig. 11f

2016 *Pseudobisatoceras* sp.; Dernov, text-fig. 4.

M a t e r i a l . One poorly preserved specimen from stratigraphic level 1 of the Mospyne Formation.

D e s c r i p t i o n . Specimen IGSU-4/1367 is a poorly preserved crushed fragment of a steinkern. The surface of the conch is covered with delicate lirae and very thin lamellae that intersect to form a reticulate and crenulate pattern. The transverse lamellae form a broad, shallow lateral sinus and a low projection on the ventrolateral shoulder. On the midflank, the lamellae are spaced about 0.5 mm apart. The constrictions broad, concavo-convex with a high ventrolateral projection and very shallow ventral sinus; they are clearly visible on the ventrolateral shoulder, but poorly visible on the flank. The suture line has a broad, V-shaped rectangular pointed adventive lobe and a broad, dome-like dorsolateral saddle. The suture line is not preserved on the venter, ventrolateral shoulder, umbilical wall and dorsum.

Remarks. ?*Owenoceras* sp. differs from *O. bellilineatum* Miller et Owen, 1940 in the less pointed adventive lobe; the conch surface ornamentation in ?*Owenoceras* sp. and *O. bellilineatum* is very similar. ?*Owenoceras* sp. is distinguished from *O. orulganensis* Popow, 1960 by its ornamentation of greater relief.

Occurrence. Late Bashkirian, Mospyne Formation, Donets Basin (Ukraine).

Superfamily Schistoceratoidea Schmidt, 1929
Family Schistoceratidae Schmidt, 1929

Genus *Branneroceras* Plummer et Scott, 1937

Type species. *Gastrioceras branneri* Smith, 1896; by original designation.

Diagnosis. Genus of the family Schistoceratidae with subdiscoidal, evolute conch with moderate to wide umbilicus. Ornamented with prominent ribs on or adjacent to the umbilical shoulder. In widely umbilicate forms the ribs are long and more strongly developed than in the narrowly umbilicate forms; these ribs decrease in size and robustness until they become more like nodes. Ventral region ornamented by prominent sinuous transverse lirae with wider interspaces, forming rounded prominent ventral and lateral sinuses and corresponding salients between, crossed by finer longitudinal lirae, giving a cancellate appearance and commonly beaded where two sets of lirae cross. Suture line with narrow, inflated and attenuate ventral prongs that are separated from each other by a relatively broad secondary ventral saddle; the ventral saddle is more than half the height of the first lateral saddle. The first lateral saddle is broad and evenly rounded and the first lateral lobe is comparatively narrow, asymmetric and attenuate (after Gordon 1965, McCaleb 1968, Nassichuk 1975).

Species included. *Br. branneri* (Smith, 1896), Texas (USA); *Br. hillsi* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *Br. nicholasi* Nassichuk, 1975, Canadian Arctic Archipelago (Canada); *Br. perornatum* (Yin, 1935), Guangxi (China); *Br. reticulatum* (Yin, 1935), Guangxi; *Br. termierorum* (Kullmann in Stevanovich et Kullmann, 1962), Kenadza Region (Algeria); *Br. triangularum* Sheng, 1987, Gansu (China); *Br. yohi* (Yin, 1935), Guangxi (China).

Remarks. *Branneroceras* differs from *Inzeroceras* Ruzhencev, 1974 by the more pronounced relief on the umbilical nodes, narrower ventral lobe and low median saddle; in addition, the umbilical lobe of *Inzeroceras* is displaced to the lateral face. *Branneroceras* is distinguished from *Retites* in long and narrow (longer than half the height of the first lateral saddle) ventral prongs. *Branneroceras* differs from *Diadoloceras* by the lack of triangular coiling of early whorls.

Stratigraphic range. Late Bashkirian (*Gastrioceras-Branneroceras* Genozone).

Branneroceras sp. A
Text-fig. 12a–u

2018 *Branneroceras branneri*; Dernov, p. 11, pl. 5, fig. 5, pl. 6, figs 2, 5.

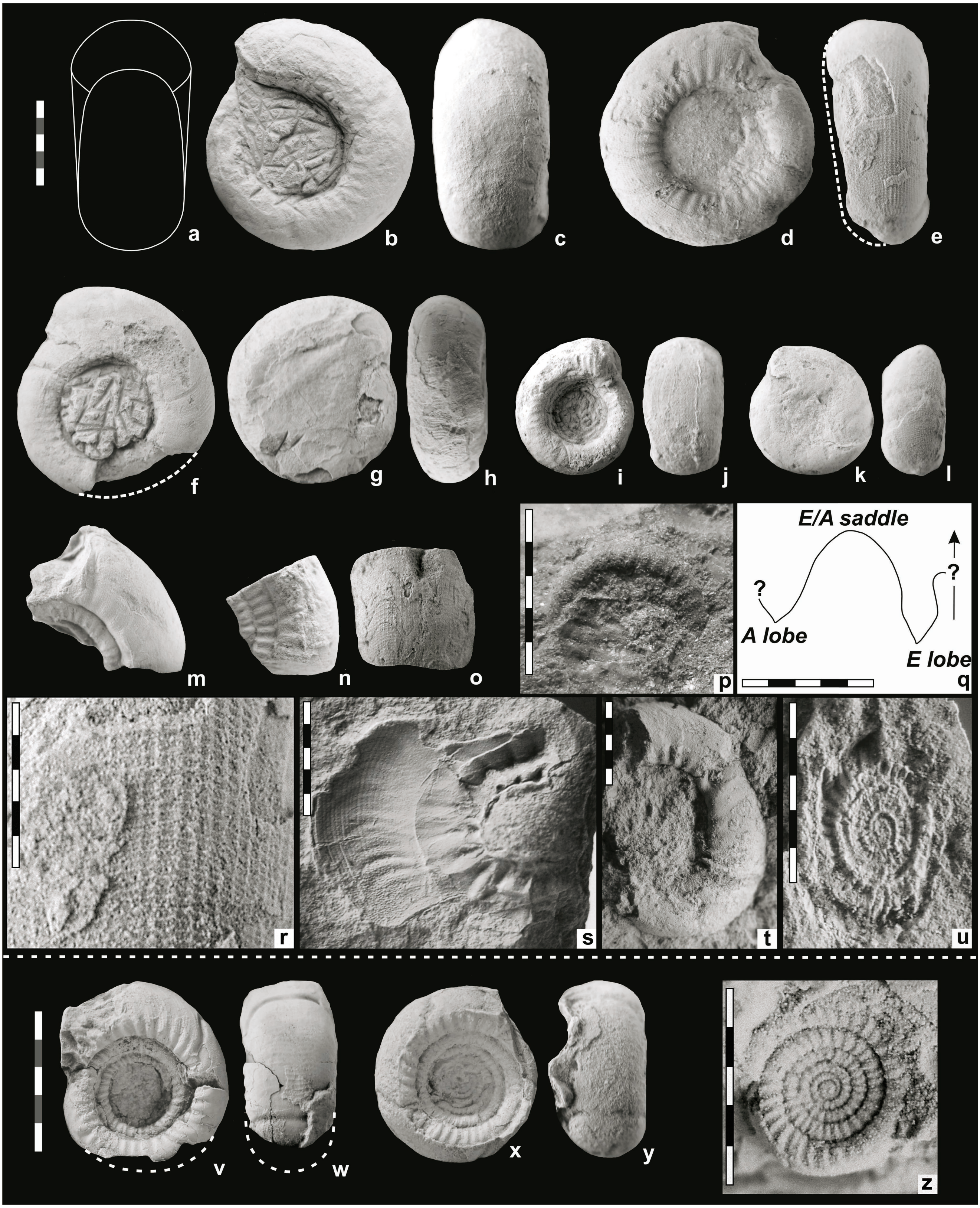
Material. 22 specimens between 13 and 40 mm conch diameter from stratigraphic levels No. 3, 5b and 6 of the Mospyne Formation.

Description. Specimen IGSU-4/315 is an almost fully limonitized specimen with 26.4 mm diameter (Text-fig. 13a–c). The conch is thickly discoidal (ww/dm = 0.52) with wide umbilicus (uw/dm = 0.44) and moderate coiling rate (WER = 1.96) and moderately depressed (ww/wh = 1.52) whorl profile; the venter is broad and weakly convex; ventrolateral shoulder is broadly rounded. The flanks are weakly convex, they slightly converge towards the ventrolateral shoulder. The umbilical margin is narrowly rounded and almost rectangular. The umbilical wall is flat and at an angle of 45º to the plane of symmetry of the conch.

The surface of the conch is covered with weak elongated umbilical nodes (~35 on the whorl), growth lines and well-developed lirae on the venter and ventrolateral shoulders.

Table 7. Dimensions (in mm) of *Branneroceras* sp. A.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/335	37.5	15.1	10.8	16.2	–	0.40	1.40	0.43	–	–
IGSU-4/656	30.0	–	8.0	14.0	–	–	–	0.47	–	–
IGSU-4/338	27.3	12.9	9.7	12.5	8.1	0.45	1.33	0.46	2.0	0.16
IGSU-4/315	26.4	13.7	9.0	11.7	7.5	0.52	1.52	0.44	1.96	0.17
IGSU-4/669	24.2	12.1	8.8	10.4	7.1	0.46	1.38	0.43	1.90	0.19
IGSU-4/710	18.0	–	5.0	10.0	–	–	–	0.55	–	–
IGSU-4/609	15.8	8.2	5.6	8.2	4.7	0.52	1.46	0.52	2.0	0.16
IGSU-4/350	15.5	7.6	5.5	6.7	–	0.49	1.38	0.43	–	–



Text-fig. 13. Ammonoids *Branneroceras* sp. A (a–u) and *Br*. sp. B (v–z) from the Mospyne Formation. a–c: Specimen IGSU-4/315, dorsal view (a), lateral view (b), ventral view (c). d, e: Specimen IGSU-4/338, lateral view (d), ventral view (e). f: Specimen IGSU-4/669, lateral view. g, h: Specimen IGSU-4/315a, lateral view (g), ventral view (h). i, j: Specimen IGSU-4/609, lateral view (i), ventral view (j). k, l: Specimen IGSU-4/350, lateral view (k), ventral view (l). m: Specimen IGSU-4/350a, lateral view. n, o: Specimen IGSU-4/725, lateral view (n), ventral view (o). p: Specimen IGSU-4/338a, lateral view of the juvenile conch. q: Fragment of the suture line of specimen IGSU-4/725 (at wh = 6 mm). r: Specimen IGSU-4/338, reticulate ornamentation of the ventrolateral shoulder of conch. s: Specimen IGSU-4/503, lateral view. t: Specimen IGSU-4/710a, lateral view. u: Specimen IGSU-4/5180, lateral view of early whorls. v, w: Specimen IGSU-4/626, lateral view (v), ventral view (w). x, y: Specimen IGSU-4/3984a, lateral view (x), ventral view (y). z: Specimen IGSU-4/626a, lateral view of early whorls. Scale bars 5 mm (p–r, u, z) and 10 mm (a–o, s, t, v–y).

The growth lines form a shallow, broad sinus on the venter and a low projection on the ventrolateral shoulder; they are straight on the flanks. On the umbilical margin the transverse ribs are spaced about 0.60 to 0.75 mm apart. The number of lirae on the ventrolateral shoulder is two per 1 mm; on the midflank, the growth lines are spaced about 0.15 mm apart. Three weak concavo-convex constrictions with a low ventrolateral projection and a very shallow ventral sinus are prominent on the whorl.

Specimen IGSU-4/338 (Text-fig. 13d, e) is discoidal (ww/dm = 0.45) with a wide umbilicus (uw/dm = 0.46) and a weakly depressed whorl profile (ww/wh = 1.33) at 27.3 mm diameter. The venter is broad and weakly convex. The ventrolateral shoulder is broadly rounded. The flanks are weakly convex, they converge slightly towards the ventrolateral shoulder. The umbilical margin is narrowly rounded and almost rectangular. The umbilical wall is flat and at a 45º angle to the plane of symmetry of the conch. The surface of the conch is covered with weak elongated umbilical nodes and growth lines; the lirae on the venter and ventrolateral shoulders are not preserved. Two weak concavo-convex constrictions with a low ventrolateral projection and a very shallow ventral sinus are prominent on the whorl.

The suture line of specimen IGSU-4/725 (Text-fig. 12n, o, q) has a broad, sharply pointed lateral prong of the external lobe, a low, narrow ventrolateral saddle and V-shaped rectangular pointed adventive lobe. The suture line is not preserved on the umbilical wall and dorsum.

R e m a r k s . *Branneroceras* sp. A differs from *Branneroceras branneri* (Smith, 1896) in a wider ventrolateral saddle, a narrower umbilicus (uw/dm = 0.43 at 15.5 mm diamener in *Branneroceras* sp. A and uw/dm = 0.54 at 15.7 mm diamener in *Branneroceras branneri*) and in weak constrictions, which are absent in *Branneroceras branneri*. *Branneroceras* sp. A differs from *Branneroceras nicholasi* Nassichuk in a broader umbilicus (uw/dm = 0.55 at 18.0 mm diameter vs. uw/dm = 0.33 at 18.0 mm diameter, respectively) and a low whorl profile. The suture lines of *Branneroceras* sp. A and *Branneroceras nicholasi* Nassichuk are similar, but the adventive lobe of *Br.* sp. A is more pointed. The morphology of the conch and weak umbilical nodes make *Branneroceras* sp. A similar to *Inzeroceras bellum* Ruzhencev, 1974; the differences between *Branneroceras* sp. A and *Inzeroceras bellum* are in the narrower ventrolateral saddle and Y-like adventive lobe in *Inzeroceras bellum.*

O c c u r r e n c e . Late Bashkirian, Mospyne Formation; Donets Basin (Ukraine).

***Branneroceras* sp. B**

Text-fig. 13v–z

2018 *Branneroceras branneri*; Dernov, p. 11, pl. 5, fig. 4, pl. 6, fig. 4.

M a t e r i a l . Three specimens of small conch and several fragments of conch from stratigraphic level No. 5a of the Mospyne Formation.

D e s c r i p t i o n . Specimen IGSU-4/626 is an almost fully limonitized specimen with 13.7 mm diameter (Text-fig. 13v, w). The conch is discoidal (ww/dm = 0.46) with wide umbilicus (uw/dm = 0.50) and moderately depressed whorl profile (ww/wh = 1.85); the venter is broad and weakly convex; the ventrolateral shoulder is broadly rounded. The flanks are weakly convex and narrow, they slightly converge with the ventrolateral shoulder. The umbilical margin is narrowly rounded. The umbilical wall is weakly convex and at a 45º angle to the plane of symmetry of the conch. The surface of the conch is covered with weak elongated umbilical nodes and growth lines and well-developed lirae on the venter and ventrolateral shoulders. The growth lines form a shallow, broad sinus on the venter, a low projection on the ventrolateral shoulder and a broad shallow sinus on the flanks. On the umbilical margin, the growth lines are spaced about 0.15 to 0.20 mm apart. There are three or four lirae per mm on the ventrolateral shoulder. Three weak concavo-convex constrictions with a high ventrolateral projection and a very shallow ventral sinus are prominent on the whorl.

Specimen IGSU-4/3984a (Text-fig. 13x, y) is discoidal (ww/dm = 0.45) with a wide umbilicus (uw/dm = 0.53) and a moderately depressed whorl profile (ww/wh = 1.87) at 12.9 mm diameter. The venter is broad and weakly convex. The ventrolateral shoulder is broadly rounded. The flanks are narrow and weakly convex, they slightly converge onto the ventrolateral shoulder. The umbilical margin is narrowly rounded. The umbilical wall is weakly convex and at an angle of 45º to the plane of symmetry of the conch. The surface of the conch is covered with elongated umbilical nodes and growth lines; lirae on the venter and ventrolateral shoulders are not preserved. Three weak concavo-convex constrictions with a high ventrolateral projection and a very shallow ventral sinus are prominent on the whorl.

R e m a r k s . *Branneroceras* sp. B differs from *Branneroceras branneri* (Smith, 1896) in the weak constrictions, which are absent in *Branneroceras branneri*. *Branneroceras* sp. B is distinguished from *B. hillsi* Nassichuk by the less elongated umbilical nodes. *Branneroceras* sp. B differs from *Branneroceras nicholasi* Nassichuk in the more depressed whorl profile, less frequent constrictions and a wider umbilicus. *Branneroceras* sp. B differs from *Branneroceras* sp. A by the greater relief on the umbilical nodes and a more depressed whorl profile.

O c c u r r e n c e . Late Bashkirian, Mospyne Formation, Donets Basin (Ukraine).

Table 8. Dimensions (in mm) of *Branneroceras* sp. B.

Specimen	dm	ww	wh	uw	ah	ww/dm	ww/wh	uw/dm	WER	IZR
IGSU-4/626	13.7	6.3	3.4	6.8	–	0.46	1.85	0.50	–	–
IGSU-4/3984a	12.9	5.8	3.1	6.8	–	0.45	1.87	0.53	–	–

Conclusions

Ammonoids *Anthracoceratites* sp., *Cymoceras* sp., *Melvilloceras rotaii* (Librovitch in Popov, 1979), *Gastrioceras angustum* Patteisky, 1964, *G. lupinum* Popov, 1979, *G. kutejnikovense* Popov, 1979, *G.* spp., ?*Agastrioceras* sp., *Bisatoceras* sp., ?*Owenoceras* sp., *Branneroceras* sp. A, and *Br.* sp. B were found in the coal-bearing sediments of the Mospyne Formation at Makedonivka, central Donets Basin. Early Westphalian (ammonoid zone G2, Langsettian) ammonoids *Gastrioceras listeri* (Sowerby) (described by Popov (1979)), *G. angustum* Patteisky and *Branneroceras* spp. indicate that the Mospyne Formation belongs to the lower part of the *Gastrioceras-Branneroceras* Genozone.

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