

***BELOPTERA LONGA* NAEF, 1922 (CEPHALOPODA: COLEOIDEA) FROM THE LATE EOCENE (PALAEOGENE) OF UKRAINE**

Vitaly Dernov

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Abstract. *Beloptera longa* Naef, 1922 and *Beloptera* aff. *longa* Naef, 1922 have been described from the Priabonian Mandrykivka Beds of the Rybalsky Quarry Konzentrat-Lagerstätte in addition to previously known *Beloptera belemnoidea* de Blainville, 1825, *B. cf. longa* Naef, 1922, *Belosaepia blainvillei* (Deshayes, 1835) and *Vasseuria occidentalis* Munier-Chalmas, 1880. The geographical and stratigraphic distribution of the species *Beloptera longa*, which was previously recorded only in the Bartonian of England, has been expanded. Cephalopod assemblages from the Priabonian of Ukrainian consist of the genera *Beloptera*, *Vasseuria*, *Belosaepia*, *Aturia* and *Eutrephoceras*.

Keywords: spirulids, Priabonian, Mandrykivka Beds, Ukraine.

INTRODUCTION

In 2023, the author and Viktor Demianov published a paper on the study of the coleoid cephalopods *Beloptera belemnoidea* de Blainville, 1825, *B. cf. longa* Naef, 1922 and *Belosaepia blainvillei* (Deshayes, 1835) from the Mandrykivka Beds (Priabonian) exposed in the Rybalsky Quarry (city of Dnipro, Ukraine), which is the only available section of these deposits. Several other localities of the Mandrykivkian fauna, including the classical site in the Dnipro riverbed near the railway bridge in the city of Dnipro, have been lost. Later that year, during the study of the collection of fossil molluscs belonging to the renowned Ukrainian malacologist

Dr Dmytro Yelyseyovych Makarenko (Fig. 1a), the author discovered four additional specimens of *Beloptera* from the Mandrykivka Beds of the Rybalsky Quarry. One of the discovered specimens, defined here as *Beloptera longa* Naef, 1922, is well-preserved and exhibits slight morphological differences from *Beloptera cf. longa* described earlier from the Mandrykivka Beds by Dernov and Demianov (2023b). *Beloptera longa* is a rare species and is known from the Bartonian deposits of England (Edwards & Wood, 1877). As the Palaeogene coleoid cephalopods of Ukraine have only been found at one locality, namely the Rybalsky Quarry Konzentrat-Lagerstätte, this paper presents the results of studying additional material on *Beloptera* from this locality.

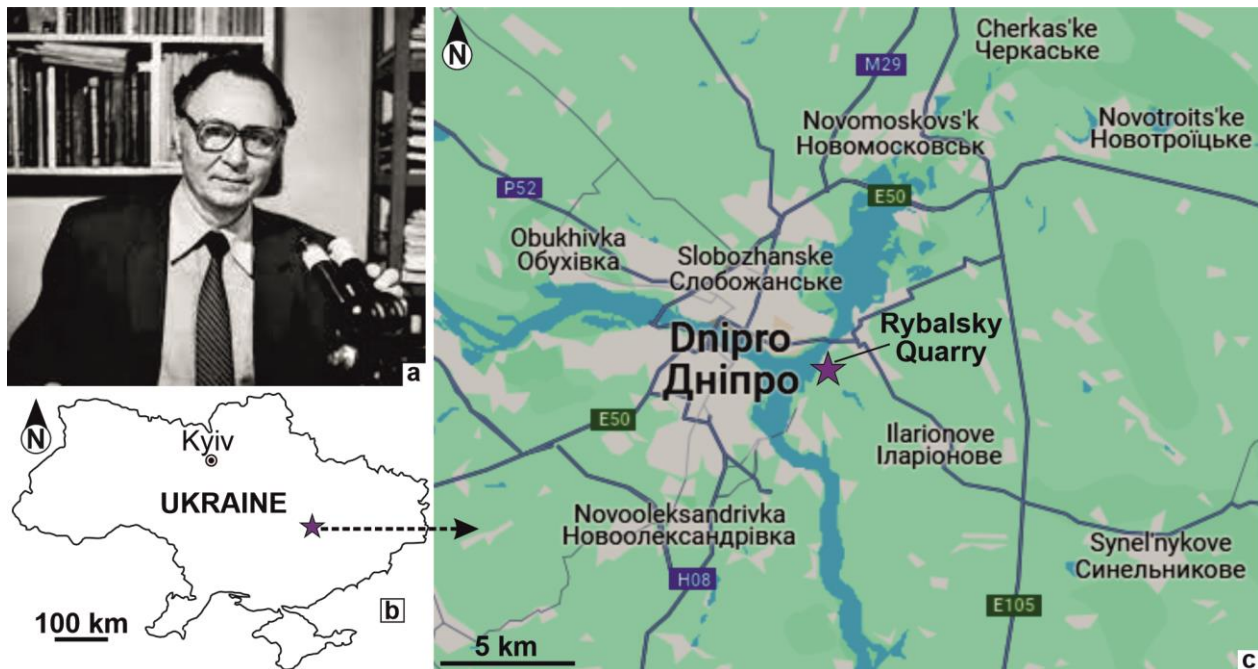


Fig. 1. Dr Dmytro Ye. Makarenko (a) and the schematic maps showing general (b) and detailed location (c) of the Rybalsky Quarry.

GEOLOGICAL SETTING

The Rybalsky Quarry (coordinates: 48°26'59.1"N 35°08'29.5"E; Fig. 1b, c), located on the left bank of the Dnipro River in the eastern part of the city of Dnipro (Manyuk, 2014; Stefanskyi, 2015a). The 3 to 6-m-thick Mandrykivka Beds (Bratishko, 2009; Stefanskyi, 2015a; Zosimovich & Shevchenko, 2015) are uncovered by the quarry wall and small ravines crossing the sides of the quarry (Manyuk, 2014; Stefanskyi, 2015a).

The Mandrykivka Beds are locally distributed in the southern and eastern parts of the city of Dnipro (Nesterenko, 1960; Veselov et al., 1974; Shirokov et al., 1986; Stefanskyi, 2014), filling a depression in the Precambrian crystalline basement, measuring 9 km by 3 km (Berezovsky, 2016). In most of the Rybalsky Quarry, the Mandrykivka Beds is overlain by Quaternary alluvial and fluvio-glacial sands and clays (Manyuk, 2014; Stefanskyi, 2014, 2015a) and underlay by Precambrian crystalline rocks or kaolin weathering crust (Stefanskyi, 2015a).

The detrital sands of the Mandrykivka Beds are an extremely shallow water age analogue of the Obukhiv Formation (Priabonian) developed elsewhere in eastern, central and northern Ukraine (Zosimovich & Shevchenko, 2015 and references therein) (see Fig. 2a). The rocks exposed in the Rybalsky Quarry belong to the calcareous nannoplankton zone NP19 and the base of zone NP20 (Martini & Ritzkowski, 1970); the dinoflagellate zones DP10 and DP11 were identified in the Mandrykivka Beds by Savytska (1996).

The Mandrykivka Beds (Priabonian, late Eocene: 37.71–33.90 Ma (International Chronostratigraphic Chart, 2023); Fig. 2a) are widely known because of the numerous and well-preserved fossils of marine and terrestrial biota, including spores and pollen, dinoflagellates, calcareous nannoplankton, infusorians, foraminifers, sponges, corals, worms, bryozoans, gastropods, bivalves, brachiopods, scaphopods, polyplacophorans, ostracods, barnacles, crabs, echinoids, fishes, tetrapods and problematics (Sokolov, 1894, 1905; Amitrov, 1993; Berezovsky, 2011, 2016; Berezovsky & Satanovskaya, 2019, 2020; Berezovsky et al., 2022, etc.). The lithological composition of the Mandrykivka Beds varies considerably laterally from calcareous fine-grained detrital (coral and shelly) sands to a weakly cemented coquina and sands with numerous calcareous microbialite nodules, but in general, these rocks are presented by yellowish to light grey, sometimes light brown detrital weakly clayey calcareous fine-grained sands (Stefanskyi, 2015a, b; see Fig. 2b, c).

MATERIAL AND METHODS

Four specimens of mostly moderately preserved apical parts of the sheath of *Beloptera* were investigated (specimens IGS-DYM01/05 to 08). The studied material was collected by Dr Dmytro Ye. Makarenko and are

housed in the Department of Palaeontology and Stratigraphy of the Cenozoic sediments, Institute of Geological Sciences of the National Academy of Sciences of Ukraine (Kyiv). The basic morphological terminology (after Naef (1922) and Dauphin (1985)) and the scheme of dimensions are shown in Fig. 3.

SYSTEMATIC PALAEOLOGY

Class Cephalopoda Cuvier, 1797

Subclass Coleoidea Bather, 1888

Order Spirulida Haeckel, 1866

Family Belopteriidae Fischer, 1887

Genus *Beloptera* de Blainville, 1825

Type species: *Beloptera belemnoides* de Blainville, 1825; by original designation.

Diagnosis: Chamber length-to-diameter ratio <0.2, except earliest (postembryonic–juvenile) chambers; post-alveolar sheath oriented towards venter, length of club variable, lateral extensions well developed, winglike, oriented towards venter, ventral ridge moderately developed (after Fuchs, 2023: p. 8–9).

Beloptera longa Naef, 1922

Fig. 4a–c

Synonymy

1877 *Beloptera belemnitoidea* de Blainville, 1825 – Edwards & Wood, p. 36, pl. 2, fig. 1, Bartonian of England.

1922 *Beloptera longa* sp. nov. – Naef, p. 57, text-figs 18a–g, 19, Bartonian of England.

Holotype: Not defined.

Diagnosis: *Beloptera* with an elongate guard-like sheath that is slightly curved ventrally and with semicircular in outline lateral expansions. The dorsal surface is roof-like, almost smooth with radial grooves on the rostrum; the ventral surface is concave and almost smooth (radial grooves are on the rostrum); the rostrum is nearly triangular in cross-section.

Material: One moderately preserved specimen (IGS-DYM01/05) from the Priabonian Mandrykivka Beds of the Rybalsky Quarry, Dnipro.

Description: The specimen IGS-DYM01/05 is a moderately preserved elongated ($L_2/W_2 = 2.44$, see Table 1), slightly curved ventrally 26.4-mm-long guard-like sheath with supposedly semicircular in outline lateral expansions inclined towards the venter and gives a convex form to the dorsal surface and a corresponding concavity to the venter. The lateral expansions are thick at the articulation area of the rostrum and sheath and become gradually thinner to the periphery. The dorsal surface is roof-like with a raised narrow medial zone and steep slopes gradually turning into lateral expansions. The rostrum is nearly triangular in cross-section and gradually widens; its apex is rounded in the ventral aspect

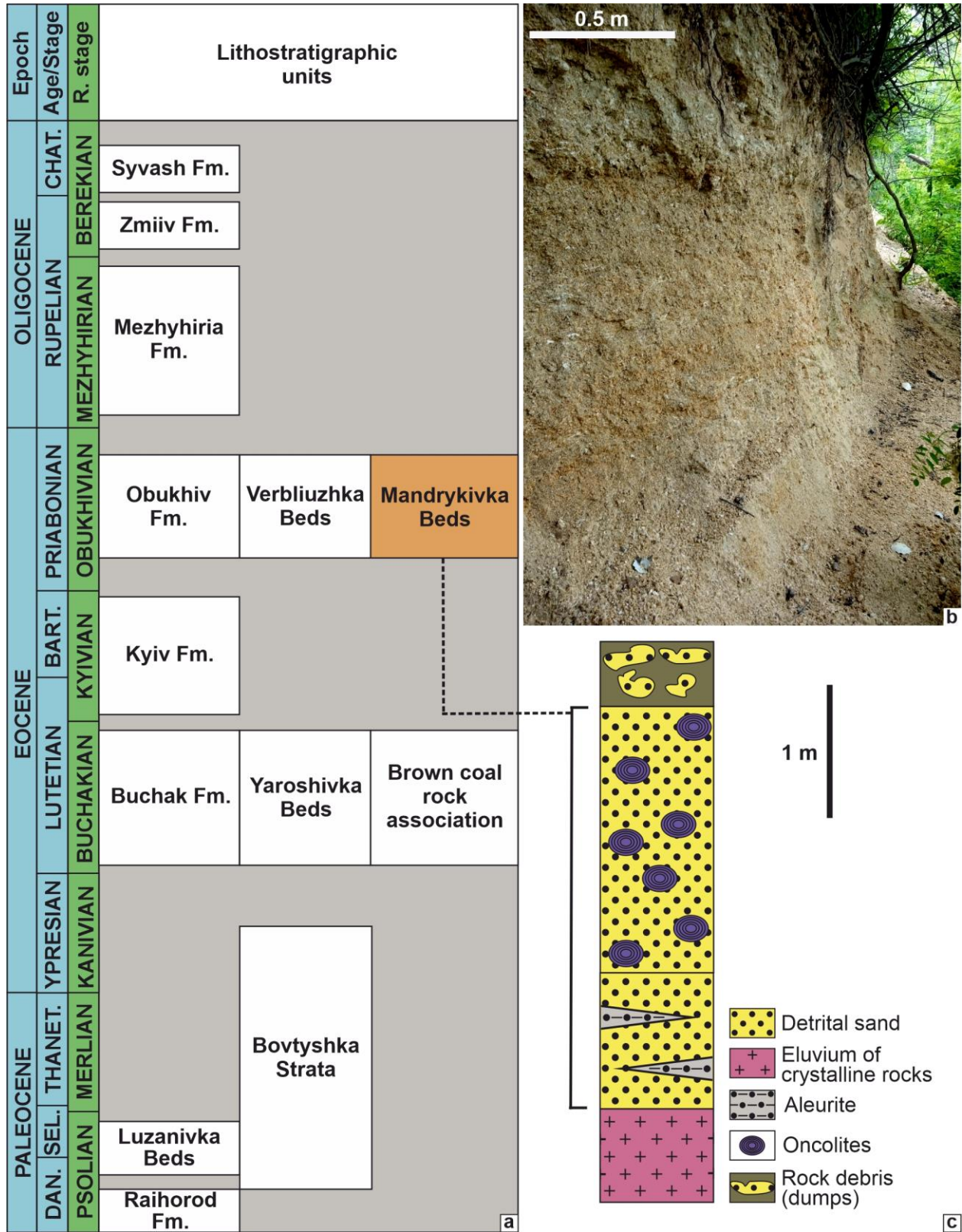


Fig. 2. Geological setting. **a.** Palaeogene stratigraphy of the central part of the Ukrainian Shield (after Zosimovich & Shevchenko, 2015: Tables 1, 2); **b.** Calcareous fine-grained detrital sands of the Mandrykivka Beds in the upper level of the Rybalsky Quarry; **c.** Lithological column of the Mandrykivka Beds in the SE part of the Rybalsky Quarry (after Stefanskyi, 2014: Fig. 2).

and slightly pointed in the lateral aspect; the rostrum is slightly curved ventrally and the guard-like sheath is somewhat arched longitudinally. The ventral surface is

almost smooth with very fine radial grooves on the rostrum. The dorsal surface is almost smooth with very fine radial grooves are on the rostrum.

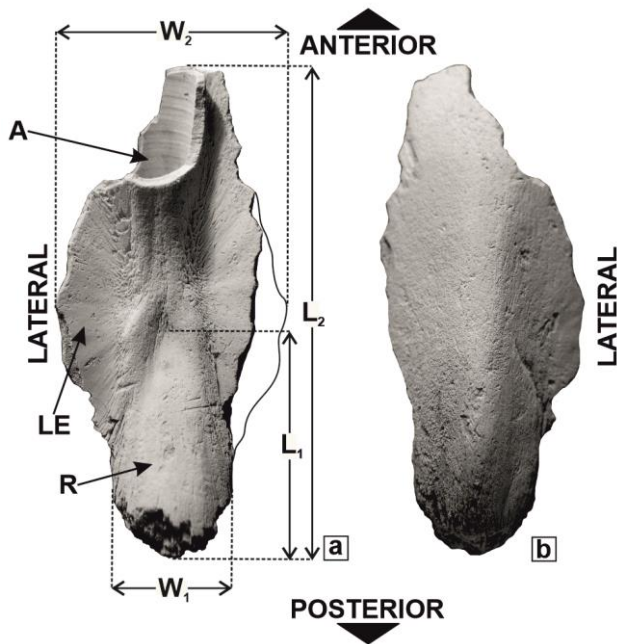


Fig. 3. The basic morphological terminology and scheme of dimensions of the sheath of *Beloptera* using the example of *B. belemnoidea* de Blainville, 1825 (**a** – ventral view, **b** – dorsal view). Abbreviations of morphological elements: A – alveolus, LE – lateral expansion, R – rostrum. Abbreviations of dimensions: L_1 – length of the rostrum, L_2 – length of the sheath, W_1 – width of the rostrum, W_2 – width of the sheath. Modified from Dernov & Demianov (2023b: Fig. 1).

Table 1. Dimensions (in mm) of *Beloptera longa* Naef, 1922

Specimen	L_1	L_2	W_1	W_2	L_2/W_2
IGS-DYM01/05	13.6	26.4	6.7	10.8	2.44

Remarks: The described specimen does not differ significantly from *Beloptera longa* figured by Edwards & Wood (1877: pl. 2, fig. 1) and Naef (1922: text-figs 18a–g, 19). *B. longa* differs from the most morphologically similar species *B. belemnoidea* de Blainville, 1825 in the following morphological features: (1) the very convex smooth dorsal surface; (2) the greatly curved ventrally guard-like sheath; (3) the nearly triangular in cross-section rostrum; (4) the slightly pointed in the lateral aspect rostrum.

B. longa differs from *B. curta* (Cossmann, 1896) in a much longer rostrum (relative to the total length of the guard-like sheath) and a more elongated guard-like sheath. In addition, the sheath of *B. curta* is rather strongly compressed in the dorsal-ventral direction. Vincent (1901) considered *B. curta* to be the "anomaly" of *B. belemnoidea*, probably referring to the manifestation of intraspecific, probably sexual,

dimorphism of *B. belemnoidea* specimens. However, *B. belemnoidea* significantly differs from *B. curta* in the longer and less massive rostrum, as well as an elliptical outline guard-like sheath.

It is rather difficult to compare *B. longa* with *B. konincki* Briart and Cornet, 1880, as I know this species is described from not well preserved material only in Briart & Cornet (1880); images of this species in this work are not of very high quality. Probably, in contrast to *B. longa*, *B. konincki* has a rather short guard-like sheath with a more pointed, relatively short rostrum and radial and concentric ornamentation of the ventral surface.

Occurrence: Bartonian of England, Priabonian of Ukraine.

***Beloptera* aff. *longa* Naef, 1922**

Fig. 4d–k

Material: Three moderately preserved specimens (IGS-DYM01/06 to IGS-DYM01/08) from the Priabonian Mandrykivka Beds of the Rybalsky Quarry, Dnipro.

Description: The specimen IGS-DYM01/06 (Fig. 4d–f) is a moderately preserved elongated ($L_2/W_2 = 2.51$; see Table 2) guard-like sheath, which is slightly curved ventrally; it is 34.6-mm-long with semicircular in outline lateral expansions inclined towards the venter, which gives a convex form to the dorsal surface and a corresponding concavity to the venter. The lateral expansions are thick at the contact area of the rostrum and sheath and become gradually thinner to the periphery. The dorsal surface is roof-like with a raised narrow medial zone and steep slopes gradually turning into lateral expansions. The rostrum is nearly triangular in cross-section and gradually widens; its apex is rounded; the rostrum is slightly curved ventrally and the guard-like sheath is somewhat arched longitudinally. The ventral surface is covered with very small elongate pits at the base of the lateral expansions and very fine radial grooves on the rostrum. The dorsal surface is almost smooth with very fine radial grooves on the rostrum and front zones of the lateral expansions.

Specimen IGS-DYM01/07 (Figs. 4g–i) is a moderately preserved elongated ($L_2/W_2 = 2.0$) guard-like sheath that is slightly curved ventrally; it measures 21.4 mm long with lateral expansions that are inclined towards the ventral surface, which causes a convex shape towards the dorsal surface and a corresponding concavity towards the ventral surface. The lateral expansions are thick in the area of contact between the rostrum and the sheath and gradually thinning towards periphery. The dorsal surface is roof-like with a raised narrow medial zone and steep slopes gradually turning into the lateral expansions. The rostrum is nearly triangular in cross-section and gradually widens; its apex is rounded in the ventral aspect and slightly pointed in the lateral aspect; the rostrum is slightly curved ventrally and the guard-like sheath is somewhat arched longitudinally. The ventral surface is covered with very small elongate pits at the base of the

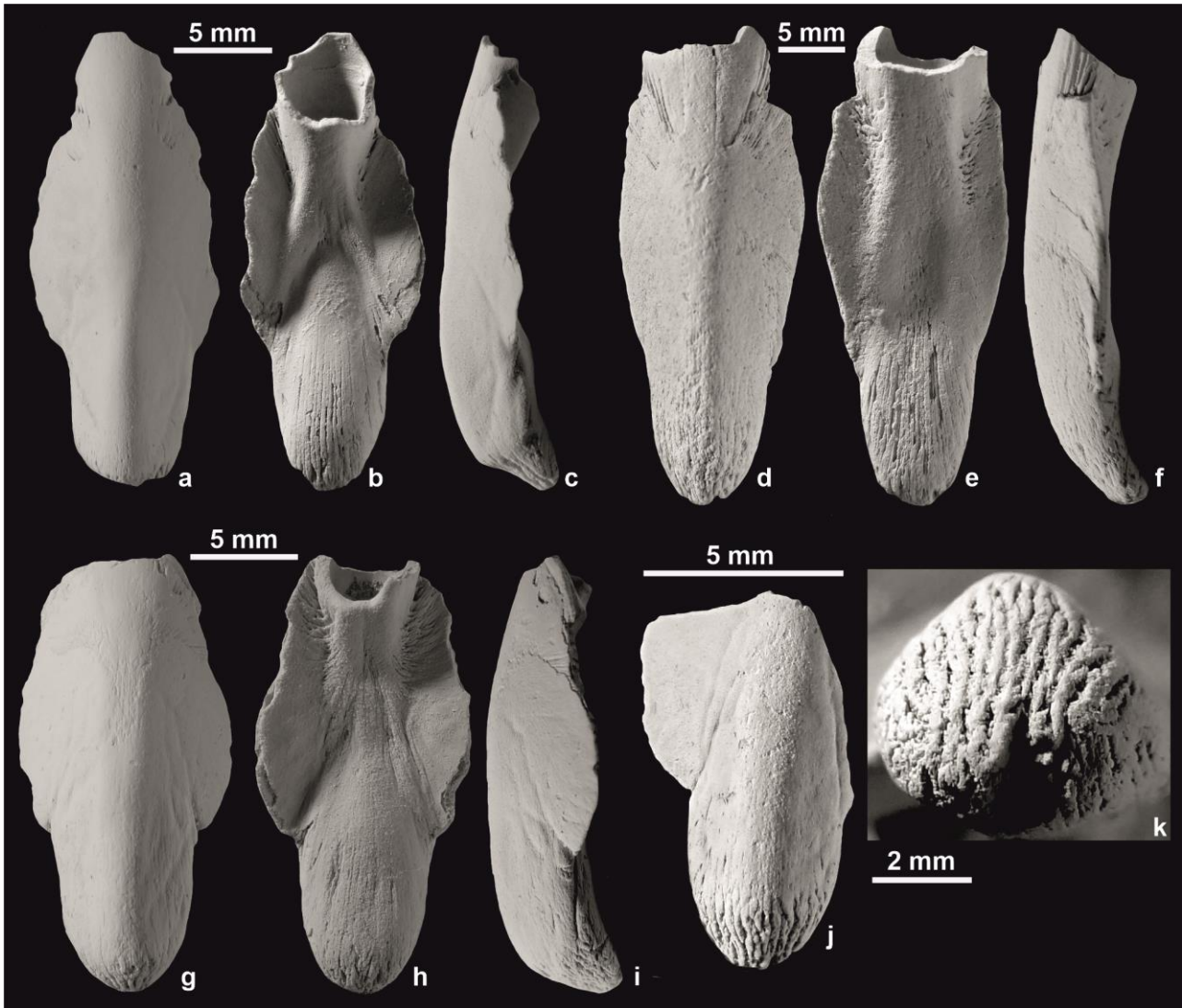


Fig. 4. Priabonian spirulids from the Rybalsky Quarry. **a–c.** *Beloptera longa* Naef, 1922 (IGS-DYM01/05, a – dorsal view, b – ventral view, c – lateral view); **d–k.** *Beloptera* aff. *longa* Naef, 1922 (d–f – IGS-DYM01/06, g–i – IGS-DYM01/07, j, k – IGS-DYM01/08; d, g, j – dorsal view; e, h – ventral view; f, i – lateral view, k – rostrum apex).

lateral expansions and very fine radial grooves on the rostrum. Most of the dorsal surface is smooth; only shallow marks of blood vessels occur on the preserved lateral expansion and very fine radial grooves are on the rostrum.

The specimen IGS-DYM01/08 (Fig. 4j, k) is represented by a fragment of a rostrum that is nearly triangular in cross-section with a part of the lateral expansions. This poorly preserved fossil is indistinguishable from the specimen IGS-DYM01/06.

Table 2. Dimensions (in mm) of *Beloptera* aff. *longa* Naef, 1922

Specimen	L ₁	L ₂	W ₁	W ₂	L ₂ /W ₂
IGS-DYM01/06	15.2	34.6	8.3	13.8	2.51
IGS-DYM01/07	12.4	21.4	6.8	10.6	2.0

Remarks: The specimen IGS-DYM01/06 described above is better preserved than the single specimen of *Beloptera* cf. *longa* (IGS NASU-15/02) described in the work of Dernov & Demianov (2023: Fig. 6A–E). In particular, IGS-DYM01/06 shows that, unlike *B. belemnoides*, the lateral expansions of *B. aff. longa* have semicircular margins, while in *B. belemnoides* they are wavy (cf. Fig. 3a in this work). In contrast to *B. cf. longa* (IGS NASU-15/02), the specimen IGS-DYM01/06 is less ventrally curved and bears thin radial grooves on the anterior part of the dorsal surface of the lateral expansions.

The described specimens differ from the specimens of *B. longa*, figured by Edwards & Wood (1877: pl. 2, fig. 1), Naef (1922: figs 18a–g) and in Fig. 4a–c in this paper by a less massive rostrum. *B. aff. longa* differs from the most morphologically similar species *B. belemnoides* in a very convex smooth dorsal surface, a greatly curved ventrally guard-like sheath and the nearly triangular in

cross-section rostrum.

Occurrence: Bartonian of England, Priabonian of Ukraine.

DISCUSSION

A rather taxonomically diverse assemblage of coleoids, including *Beloptera belemnnoidea* de Blainville, 1825, *B. longa* Naef, 1922, *B. aff. longa* Naef, 1922, *B. cf. longa* Naef, 1922 and *Belosaepia blainvillei* (Deshayes, 1835), is currently known from the Mandrykivka Beds exposed in the Rybalsky Quarry (Dernov & Demianov, 2023b and this study). Furthermore, the species *Vasseurina occidentalis* Munier-Chalmas, 1880 is also known from this locality (Dernov & Demianov, 2023a), but I was unable to obtain this material for the description.

In the Obukhiv Formation, which is a more deep-water analogue of the Mandrykivka Beds, cephalopod remains, as well as other molluscs, are quite rare. Makarenko (1956) described the nautilids *Aturia* sp. and *Nautilus ucrainicus* Makarenko, 1956 from the so-called Kharkivian “Stage” (= Priabonian) of Zhytomyr Region in northern Ukraine. The latter species probably belongs to the genus *Eutrephoceras* Hyatt, 1894. Probably, nautilids identical to “*Nautilus*” *ucrainicus* were described by Slodkevich (1928) from the Kharkivian “Stage” of the Donets Basin (eastern Ukraine) under the name *Nautilus* sp. 1 together with *Aturia ziczac* Sowerby, 1812. Dernov & Udovychenko (2016) described *Eutrephoceras* sp. from the top of the Kyiv Formation (late Lutetian–Bartonian), which lies directly beneath the Obukhiv Formation. The material was found in the same area as that described by Slodkevich (1928) and is very similar to the aforementioned “*Nautilus*” *ucrainicus* and *Nautilus* sp. 1. Therefore, in addition to the above coleoids, the Priabonian cephalopod assemblages of Ukraine also include species of the genera *Aturia* and *Eutrephoceras*.

CONCLUSION

Beloptera longa Naef, 1922 and *Beloptera aff. longa* Naef, 1922 are described from the Priabonian Mandrykivka Beds of the Rybalsky Quarry Konzentrat-Lagerstätte.

The geographical and stratigraphic distribution of the species *Beloptera longa*, which was previously recorded only in the Bartonian of England, are longer than previously known and also extends to the Priabonian.

In general, cephalopod assemblages from the Ukrainian Priabonian consist of the genera *Beloptera*, *Vasseurina*, *Belosaepia*, *Aturia* and *Eutrephoceras*.

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