

First Evidence of Burrows of the Polychaete *Lepidenteron lewesiensis* (Mantell, 1822) from the Upper Cretaceous of the Upper Don Region

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Abstract—Burrows of the predatory polychaetes *Lepidenteron lewesiensis* (Mantell, 1822) are first discovered in the marine Upper Cretaceous (Upper Coniacian–Lower Santonian) of the Upper Don (Voronezh) Region. Bone remains and scales of bony fish belonging to Clupeocephala indet. were found in the burrows. The discovery of *Lepidenteron lewesiensis* burrows in the Voronezh Region expands the paleogeographic distribution of this ichnogenus and ichnospecies in the second half of the Cretaceous and supplements our understanding of the Late Cretaceous marine paleoecosystems of this region.

Keywords: Burrows of *Lepidenteron lewesiensis*, polychaetes, teleost fishes, Late Cretaceous, Upper Don Region

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INTRODUCTION

In the marine Late Cretaceous and Paleogene deposits of Western and Central Europe, ichnofossils of *Lepidenteron lewesiensis* are widespread—unbranched, slightly curved or almost straight, rounded or oval in cross-section passages containing fish scales and bones (Suhr, 1988; Jurkowska and Uchman, 2013; Bieńkowska-Wasiluk et al., 2015; Niebuhr and Wilmsen, 2016; Schwarzahns et al., 2021; etc.). Similar burrows were also found in the Late Cretaceous marine deposits of Crimea (Alekseev, 1989; Baraboshkin et al., 2020; Komarov et al., 2022) and the Lower Volga region (Ivanov et al., 2025; Sennikov et al., 2025). This paper describes new finds of burrows of *Lepidenteron lewesiensis* in the Upper Cretaceous of the Upper Don area (Boguchar locality, Voronezh Region).

GEOLOGICAL BACKGROUND

The studied territory is composed of the crystalline basement and the Phanerozoic sediments: Devonian, Carboniferous, Cretaceous, Paleogene and Quaternary. The stratigraphy follows the Legend of the Donets Series of Sheets (*Gosudarstvennaya...*, 2013). The oldest beds, reaching the base level of the modern

erosional incision in the studied area, constitute the Mashkino Formation (Turonian, Coniacian and the lower part of the Santonian: *Geologicheskaya...*, 1957; Savko et al., 2004).

The Mashkino Formation is developed over almost the entire area under consideration, being absent in the area of Quaternary erosion along the Don River valley, and unconformably overlying Cenomanian or Carboniferous beds. Deposits of this age crop out on the surface along the right bank of the Don River and in the area of the mouth of the Bogucharka River. The formation is represented by chalk with marl interbeds. The chalk is white, whitish-gray to grayish-yellow, from dense to loose, pelitomorphous, patchily slightly ferruginous. Sometimes it contains rare elongated (less often isometric) ferruginous nodules up to 2–7 cm in size. At the base of the section, the chalk is unevenly sandy, the amount of sandy material increases towards the base of the bed. Inclusions of small (up to 1–2 cm) brown and greyish-brown sandy phosphorites and rare, small mica flakes are recorded. The thickness of the sandy chalk unit is variable, ranging from 0.3 to 1.5 m. The bivalve assemblage found in the lower part includes *Inoceramus lamarcki* Park. and *Ostrea* aff. *boucheroni* Coq. (*Geologicheskaya...*, 1957). To the north of the study area, foraminifers of the

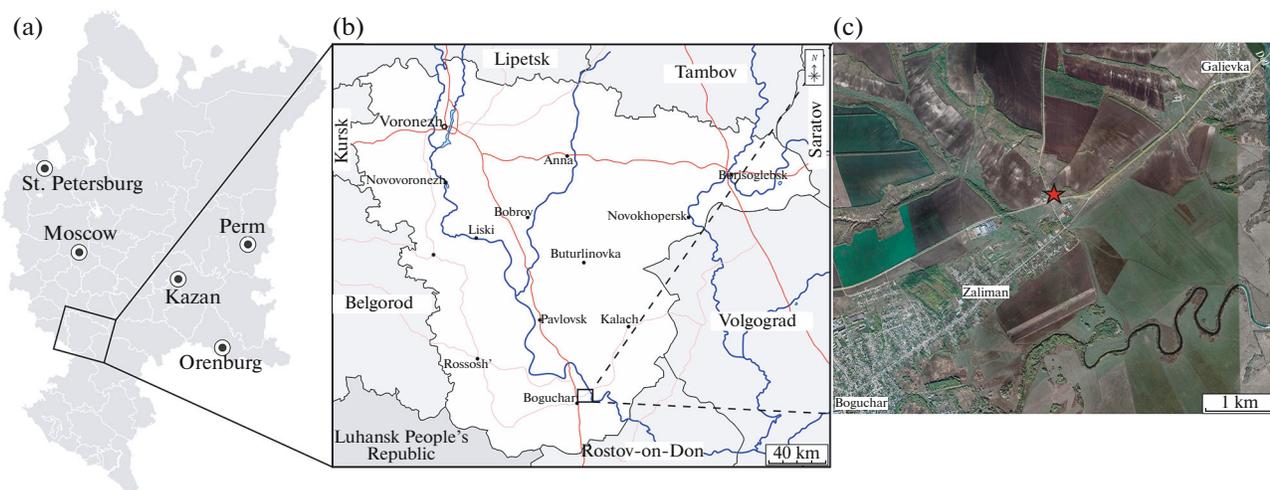


Fig. 1. Scheme of the location of the ichnofossils *Lepidenteron lewesiensis* Boguchar from the Upper Cretaceous of the Voronezh Region.

Gavelinella nana and *Gavelinella moniliformis* zones (*Gosudarstvennaya...*, 2013), characteristic of the Turonian Stage, were identified from similar deposits.

The middle part of the formation is composed of more clayey chalk and interbeds of chalk-like marls. The bivalves found here are represented by *Inoceramus involutus* Sow. (*Geologicheskaya...*, 1957), and in the northern areas of this part of the formation, foraminifers of the *Gavelinella kelleri* and *Gavelinella thalmani* zones were identified, characteristic of the lower and middle-upper Coniacian, respectively (*Gosudarstvennaya...*, 2013).

The upper part of the formation (Upper Coniacian–Lower Santonian), containing the Boguchar locality, is characterized by denser chalk with a well-defined conchoidal fracture. Thus, the host deposits of this locality, located in a small local quarry measuring 60 by 20 meters (Fig. 1), are represented by white chalk, less commonly light gray, dense, pelitomorphous, weakly silicified (Fig. 2). The chalk is characterized by large-piece jointing, a well-defined conchoidal and porcelain-like fracture. The chalk is unevenly weakly ferruginized in isolated spots. Rare thin-walled mollusk shells and their imprints are present, as well as rare elongated ferruginous nodules, less commonly isometric, up to 2–6 cm in size. The exposed thickness of the Mashkino Formation in the quarry is about 4.1 m. The total thickness of the formation reaches 50–66 m.

The upper part of the Santonian Stage and the lower part of the lower Campanian are represented by the Selivanovo Formation. It is developed almost throughout the studied area, is absent in the valleys of large rivers, and unconformably overlies the Mashkino Formation. In the lower part of the section, the Selivanovo Formation is represented by light-gray and white chalk and chalk-like marls; at the base, there is a layer

of silicified and ferruginized chalk with phosphatized sponges. In the upper part of the section, gray and greenish-gray strongly micaceous and clayey marls begin to predominate. Numerous ferruginous nodules of isometric and elongated forms up to 3–6, rarely 8–12 cm in size, are observed.

The Alekseevka Formation, which overlaps the Selivanovskaya Formation, corresponds to the upper part of the Lower Campanian. It is widespread, absent within the river valleys, and is represented by white chalk with interlayers of chalk-like marl. Sometimes, inclusions of phosphorite pebbles are noted at the base of the suite section. The thickness of the Alekseevka Formation is from 6 to 50 m.

SYSTEMATIC PALEONTOLOGY

Ichnogenus Lepidenteron Frič, 1878

Lepidenteron lewesiensis (Mantell, 1822)

Plate 2

Muraena? lewesiensis: Mantell, 1822, p. 232, pl. 34, figs. 10, 11.

Dercetis elongatus: Agassiz, 1833, p. 259, pl. 66, fig. 4; Mantell, 1844, p. 658; 1851, p. 438.

Lepidenteron longissimus: Frič, 1878, p. 19, text-fig. 45.

Terebella lewesiensis: Davies, 1879, p. 148; Bather, 1911, p. 482; Abel, 1935, p. 473, text-fig. 397.

Terebella lutensis: Bather, 1911, 484, pl. 24, fig. 6; Arnold, 1956, p. 58.

Lepidenteron lewesiensis: Suhr, 1988, p. 82, pl. 1, figs. 1–3; Schumacher, 2004, p. 239, text-fig. 1, pls. 1, 2; Jurkowska and Uchman, 2013, p. 616, text-fig. 3–5; Bieńkowska-Wasiluk et al., 2015, p. 798, text-figs. 4, 5; Niebuhr et al., 2016, p. 220, text-figs. 18a, 18b.; Sennikov et al., 2025, p. 301, fig. 3–7, pl. 10–11.

L e c t o t y p e. Natural History Museum, London, NHMUK, no. 4152; Southeast England, Cenomanian–Santonian (Bather, 1911; Suhr, 1988).

D i a g n o s i s. Ichnofossils (burrows) of *Lepidenteron*, bioclasts of which consisting of fish scales and bones in various proportions. Burrows 1 to 4 cm in



Fig. 2. View of the Boguchar locality of the ichnofossil *Lepidenteron lewesiensis*.

diameter, straight or slightly curved, of uniform thickness, less often with small expansions, sometimes tapering before the termination.

Description (Plate 2). The burrow fragments are oval or round in cross-section, 2.5 cm in diameter (along the long axis), of uniform thickness, less often with small thickenings and narrowings. Due to their fragmentary nature, it is not possible to judge their general shape. The longest burrow (specimen PIN, no. 5934/18) is 8 cm long (Pl. 2, fig. 1). Its terminations are broken off. The burrows are embedded in

chalk, and their matrix is indistinguishable from the surrounding sediment. The burrow has no distinct walls, but its external outlines are visible due to the lining of bioclasts. The bioclast is represented by fragments of ray-finned fish skeletons, mainly scattered and often broken scales, cranial bones and vertebrae.

Comparison. *L. lewesiensis* differs from all species of the ichnogenus *Lepidenteron* (except *L. mortenseni*) in the filling of its burrows, which consists of fragments of ray-finned fish skeletons. It differs from *L. mortenseni* in the curved shape of its burrows,

Explanation of Plate 2

Fragments of *Lepidenteron lewesiensis* burrows, from the Boguchar locality (Voronezh Region, Boguchar District; Upper Cretaceous, Upper Coniacian–Lower Santonian, upper part of the Mashkino Formation).

Fig. 1. Specimen PIN, no. 5934/18, general view.

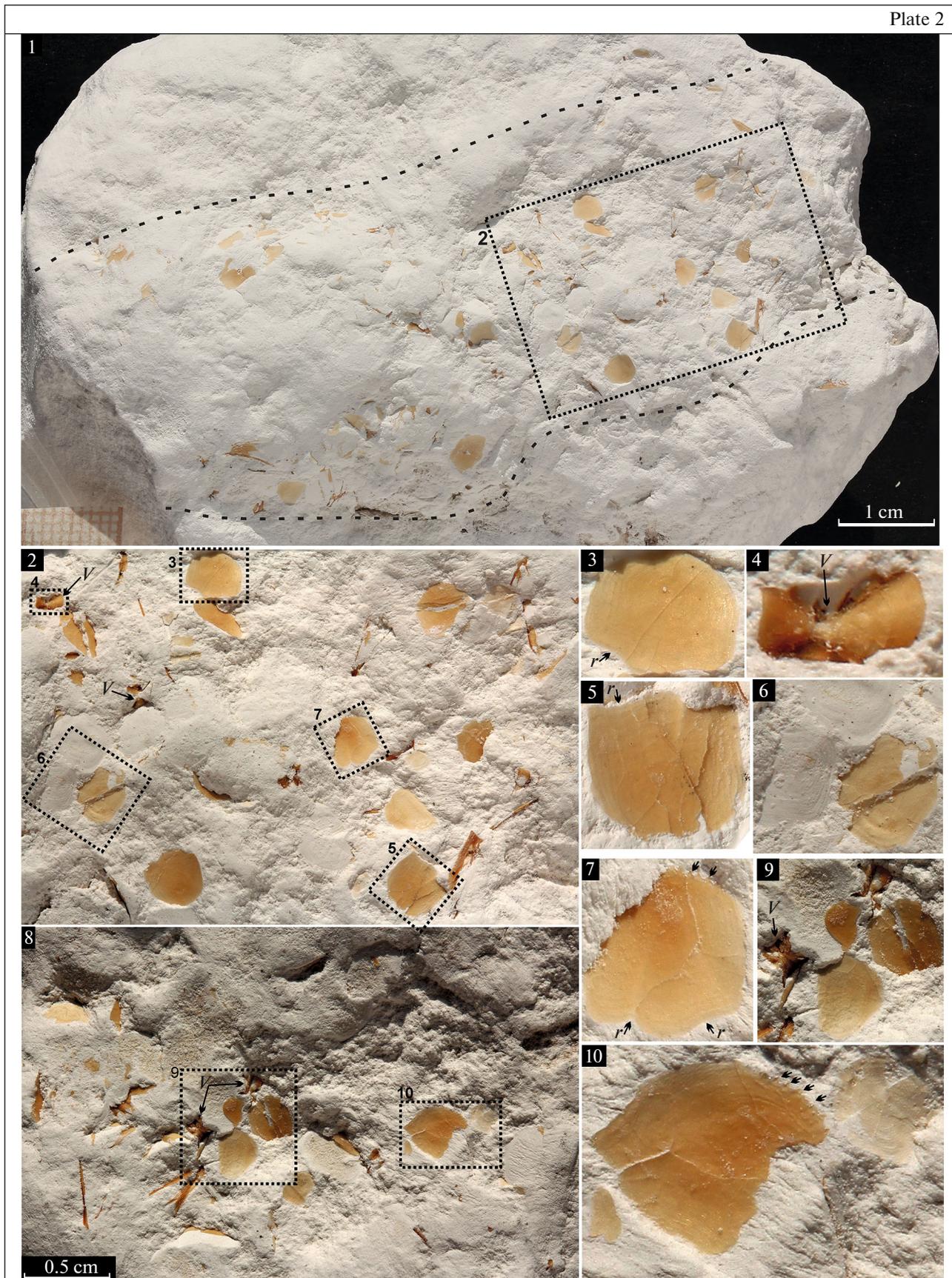
Figs. 2–7. The same, details of the structure at higher magnification.

Fig. 8. Specimen PIN, no. 5934/19, general view.

Figs. 9–10. The same, details of the structure at higher magnification.

Explanations: r—radial and concentric grooves; v—vertebrae; small arrows indicate spines. Approximate boundaries of the burrow are indicated by a dotted line.

Plate 2



which in some cases have a pointed end, their larger diameter, the presence of small expansions, and a less uniform distribution of fish bone remains.

O c c u r r e n c e. Europe; Middle Jurassic–Miocene (Suhr, 1988).

M a t e r i a l. Two fragments of burrows (specimen PIN, no. 5934/18 and 5934/19); Voronezh Region, Boguchar District; Upper Cretaceous, Upper Coniacian–Lower Santonian, upper part of the Mashkino Formation.

FISH REMAINS FROM *LEPIDENTERON LEWESIENSIS* BURROWS FROM THE UPPER CRETACEOUS OF THE VORONEZH REGION

The assemblage of ray-finned fish remains contained in *L. lewesiensis* burrows from the Upper Cretaceous of the Voronezh Region includes scales, vertebrae, and cranial bones presumably associated with at least one fish taxon. The classification of spine-bearing scales is adopted according to Roberts (1993). The most numerous fish remains in these burrows are spinoid scales of *Clupeocephala* indet. (Taxon 2 according to Sennikov et al., 2025). The scales are round-triangular in shape, very thin, transparent, about 3 mm in diameter, with pronounced Lines of Arrested Growth, spines along the posterior edge and two wide radial grooves (Pl. 1). In some cases, such scales bear a lateral line canal. Similar spinoid scales are found in many higher and lower Teleostei. These scales show the greatest similarity to the spinoid scales of taxon 2 and type 2 (both identified as *Clupeocephala* indet.) found in *L. lewesiensis* burrows from the Upper Cretaceous of the Lower Volga region (Sennikov et al., 2025) and Poland (Turonian–Maastrichtian) (Bieńkowska-Wasiluk et al., 2015). Taking into account the identical morphology, the same age and relative geographic proximity, as well as the identical source of scales, we believe that these spinoid scales from the Voronezh Region, the Volga region and Poland belong to the same fish species. Also, vertebrae were found in the specimen PIN, no. 5934/18. All of them are damaged, only elongated, thin hourglass-shaped vertebral centra are preserved. The shape of the processes cannot be determined. In the burrows of *L. lewesiensis* from the Upper Cretaceous of the Volga region (Ivanov et al., 2024; Sennikov et al., 2025) and Poland, similar vertebrae are associated with the remains of Dercetidae gen. indet. (Bieńkowska-Wasiluk et al., 2015; Sennikov et al., 2025). Most likely, *Clupeocephala* indet. also had similar vertebrae. Several, apparently cranial bones are broken and partially embedded in the rock, which prevents their more precise identification.

DISCUSSION

The most likely interpretation of *Lepidenteron lewesiensis* is as burrows of predatory burrowing polychaetes which hunted and ate fish on the seabed, similar to the modern giant *Eunice aphroditois* (Jurkowska and Uchman, 2013; Schwarzhan et al., 2021; Sennikov et al., 2025). Remains of large predatory eunicid polychaetes are known from Devonian deposits (Eriksson et al., 2017). Apparently, such worms existed from the Devonian to the present, occupying the same ecological niche and having population explosions under favorable environment.

The Late Cretaceous was the era of flourishing and wide, mass distribution of predatory polychaetes, producers of *L. lewesiensis* burrows, from the territory of modern England to the territory of the Lower Volga region. Probably, it was a single vast habitat. *Lepidenteron lewesiensis* are found in various rocks—from sandstone to chalk, which indicates significant adaptive plasticity of the worms that produced them.

Sediments of the Mashkino Formation were deposited during the transgressive stage of basin evolution. At that time, there was a vast shallow epicontinental sea basin with a depth of no more than 100 meters with normal salinity and a predominantly low energy hydrodynamic setting (Savko et al., 2004).

The remains of ray-finned fish *Clupeocephala* indet., previously described from Late Cretaceous *L. lewesiensis* burrows in the Volga region and Poland (Jurkowska and Uchman, 2013; Bieńkowska-Wasiluk et al., 2015; Sennikov et al., 2025), are found for the first time in the Upper Cretaceous of the Voronezh Region, suggesting biogeographical connections between these regions. Paleogeographic reconstructions do not contradict this, since in the Late Cretaceous, the territory of the modern Voronezh Region was located directly between these regions (Scotese, 2014).

CONCLUSIONS

The findings of burrows of the predatory polychaete *Lepidenteron lewesiensis* from the Upper Cretaceous of the Voronezh Region significantly clarify and expand our understanding of the paleogeographic distribution of this ichnotaxon in the second half of the Cretaceous and supplement the data on marine Late Cretaceous paleoecosystems in this region, as the predatory polychaetes that produced these burrows were a link between the nektonic and benthic communities of the epicontinental sea of that time. They also indicate that this ichnotaxon is typical of marine Late Cretaceous deposits of Europe.

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ETHICS APPROVAL
AND CONSENT TO PARTICIPATE

This work does not contain any studies involving human and animal subjects.

CONFLICT OF INTEREST

The authors of this work declare that they have no conflicts of interest.

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