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Selenichnites eotriassicus ichnosp.n., possible limulid traces from the Lower Triassic of the Volga River Basin, Russia

Selenichnites eotriassicus ichnosp.n., возможные следы мечехвоста из нижнего триаса бассейна р. Волги, Россия

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KEY WORDS: limulids, traces, paleoichnology, new ichnotaxa, Triassic, paleoecology.
КЛЮЧЕВЫЕ СЛОВА: лимулиды, следы, палеоихнология, новые ихнотаксоны, триас, палеоэкология.

ABSTRACT. The paper deals with a new ichnospecies *Selenichnites eotriassicus* ichnosp.n. found in the famous Tikhvinskoe locality, Yaroslavl region, European part of Russia. A formalized diagnosis of the new ichnospecies is given. According to the author viewpoint the traces *S. eotriassicus* were left by the limulid *Limulitella volgensis* Ponomarenko, 1985. General ideas on paleoenvironmental reconstruction of the Tikhvinskoe site are discussed.

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РЕЗЮМЕ: Статья посвящена описанию нового ихновида *Selenichnites eotriassicus* ichnosp.n., найденного в знаменитом местонахождении Тихвинское, Ярославская область, европейская часть России. Дан формализованный диагноз нового ихновида. По мнению автора, следы *S. eotriassicus* были оставлены мечехвостом *Limulitella volgensis* Ponomarenko, 1985. Обсуждаются общие представления о возможной палеоэкологической реконструкции местонахождения Тихвинское.

Introduction

It is difficult to imagine that somebody will argue against the idea that paleoichnological observations are extremely important components of paleoecological reconstructions, or even for reconstruction of whole paleoecosystems [Seilacher, 1954, 1964, 1967]. The paleoichnological records, which allow to link concrete morphological type of traces with concrete animal/trace-producer, are of especially high significance for paleoecology (for instance: Buhler, Grey [2016]; Naugolnykh, Bicknell [2021]). The present paper deals with a new discovery of the *Selenichnites*-type traces found by the present author in the Lower Triassic deposits outcropped in the famous Tikhvinskoe locality disposed in the Yaroslavl region, European part of Russia. A new ichnospecies *Selenichnites eotriassicus* Naugolnykh. ichnosp.n. is described on the basis of the collected material. The author believes that these traces belonged to/were left by *Limilitella volgensis* Ponomarenko, 1985, the only limulid species known from the Tikhvinskoe locality.

Material and methods

The material studied came from the Lower Triassic deposits of the Tikhvinskoe locality, Induan stage, Rybinskian Horizon. The Tikhvinskoe locality is disposed on the right bank of the Volga River, 15 km downstream of the City of Rybinsk, Yaroslavl region, European part of Russia (Fig. 1, A). The locality is a relatively small outcrop 7 m high (now only 2 m of the general thickness are visible) and about 50 m long, disposed near the Stenka Razin ravine, just downstream of its mouth. The deposits outcropped in the locality are represented by the fine intercalation of the blue-grey to green-grey clays and siltstones with bright brown-orange spots of iron hydroxides (Fig. 1, B), which include carbonate concretions of various shape and size, but mostly flattened ovoid. Most of the well-represented fossils are preserved inside the concretions (Fig. 2, A–C) or in dense siltstone layers (Fig. 2, D).

Sometimes the Tikhvinskoe locality is correlated with Lower Olenek Substage [Ivakhnenko *et al*., 1997], but the Induan stage for this locality is more appropriate concerning paleobotanical data [Dobruskina, 1982; Naugolnykh, 2013]. The deposits of Rybinskian Horizon in this locality are represented by intercalation of sands, sandstones, siltstones, and clays of continental or lagoon origin. There are two members of the Rybinskian Horizon at the Tikvinskoe locality [Kiselev *et al*., 2003, 2012]: the lower grey-colored member is

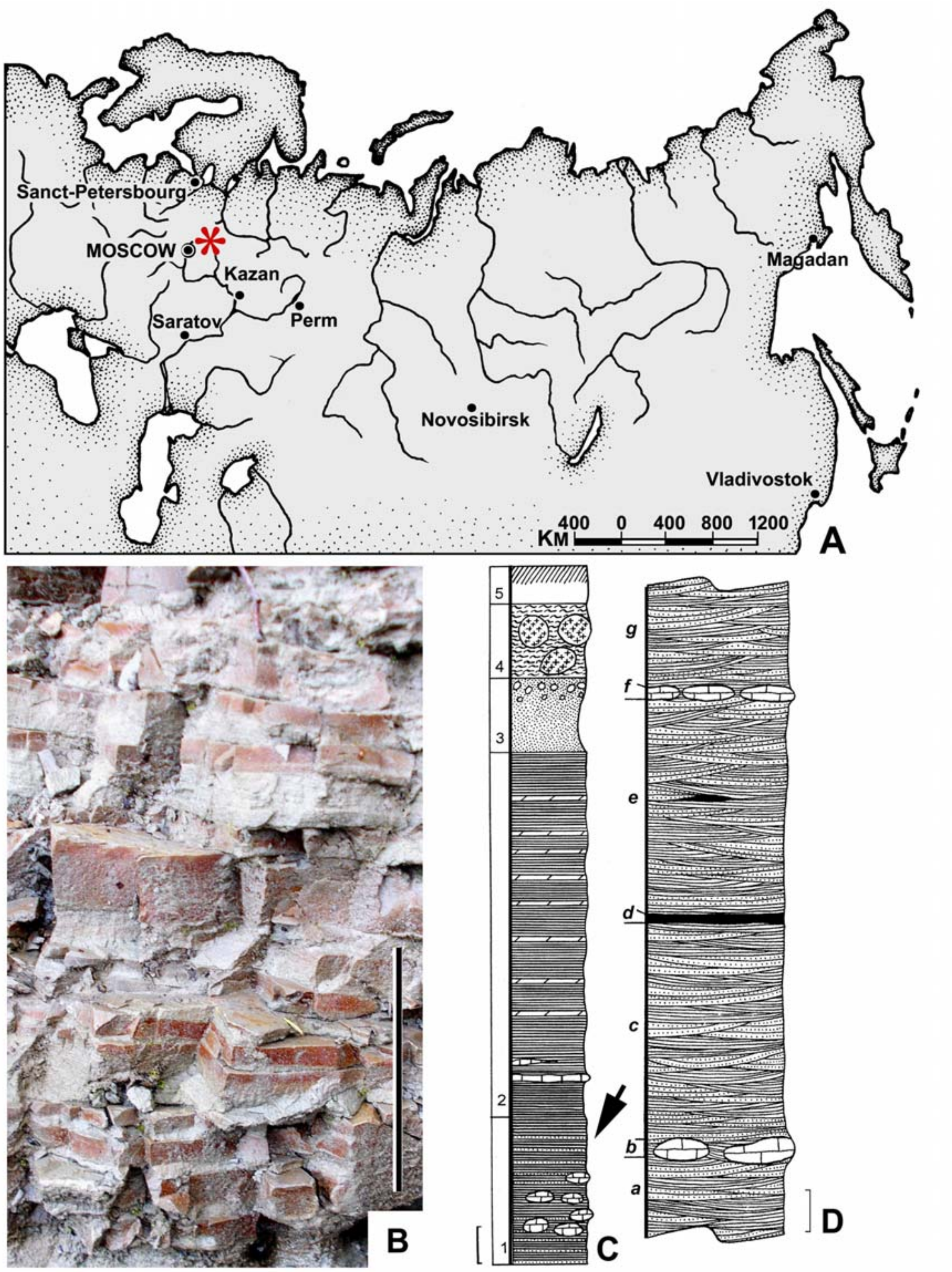

Fig. 1. Geographical and stratigraphical position of the locality Tikhvinskoe. A — geographical position of the locality studied marked by an asterisk; B — a part of the section; C — general stratigraphic log of the locality Tikhvinskoe; 1 — layer with marle concretions, Lower Triassic, 2 — intercalation of clay and siltstones, Lower Triassic, 3 — clays and sandstones, Upper Jurassic, 4 — fluvioglacial deposits, Pleistocene, 5 — present-day soil, Holocene; D — detailed column of the Tikhvinskoe locality corresponding to the layer 1 of the figure 1, B. Scale 1 m (C), 10 cm (B, D).

Рис. 1. Географическое и стратиграфическое положение местонахождение Тихвинское. А — географическое расположение изученного местонахождения отмечено астериском; В — часть геологического разреза; С — обобщенная стратиграфическая колонка местонахождения Тихвинское; 1 — слой с конкрециями мергеля, нижний триас; 2 — переслаивание глин и алевролитов, нижний триас; 3 — глины и песчаники, верхняя юра; 4 — флювиогляциальные отложения, плейстоцен; 6 — современная почва, голоцен; D — детальная колонка местонахождения Тихвинское, соответствующая слою 1 на фиг. 1, В. Масштаб 1 м (С), 10 см (В, D).

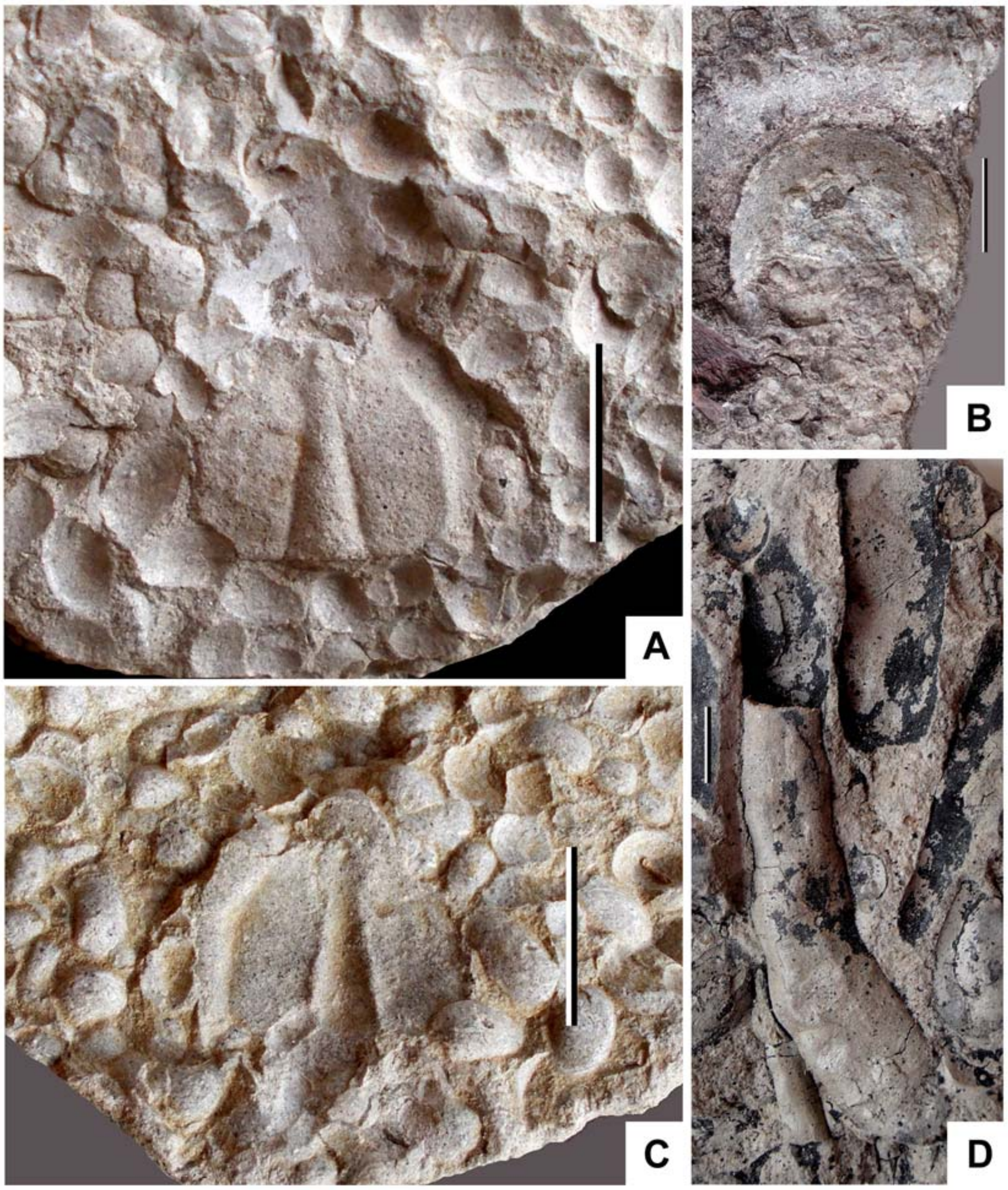

Fig. 2. Macrofossils from the Tikhvinskoe site. A–C — *Limulitella volgensis* Ponomarenko, 1985; D — mass-assemblage of the heterosporous lycopodiophyte *Pleuromeia rossica* Neuburg, 1960. Lower Triassic, Induan; the locality Tikhvinskoe. Scale 1 cm.

Рис. 2. Макро-окаменелости из местонахождения Тихвинское. A–C — *Limulitella volgensis* Ponomarenko, 1985; D — массовое захоронение побегов гетероспорового плауновидного *Pleuromeia rossica* Neuburg, 1960. Нижний триас, индский ярус, местонахождение Тихвинское. Масштаб 1 см.

Parshinskian layers (lowermost three meters of whole thickness of the section) and the upper reddish-colored member corresponds to the Cheremushkinskian layers (uppermost four meters of whole thickness of the section). The material studied originated from the middle part of the Parshinskian layers (Fig. 1, C, D), namely in pocket 1 (Fig. 1, C), layers ***b,c*** (Fig. 1, D).

The lower surface of the flatten concretions sometimes bears negative molds of numerous and morphologically various traces, both of invertebrates and vertebrates [Naugolnykh, 2009]. The traces initially were left on the soft clayey matrix on the lagoon bottom. After they were covered by the carbonate sediment, the traces were negatively fixed on the lower surface of the concretions when the carbonate material was cemented. Thus, all the traces initially expressed as depressions on the basin bottom, now are represented on the lower surface of concretions as positively protruding uplifting. The only rare exceptions are the traces, which were preserved inside the concretions divided into several layers corresponding to original layers of initial sediment.

For preparing the line-drawings of the studied specimens the present author used “Line-tracing” technique, which is very helpful for accurate showing the morphological pattern, which can be detected or distinguished on the specimen studied.

The holotype and syntype of a new ichnospecies *Selenichnites eotriassicus* ichnosp.n., are kept at the Monographic Department of the Darwin State Museum, Moscow.

Paleobiota

The paleobiota of the Tikhvinskoe locality includes numerous lycopodiophytes of *Pleuromeia rossica* Neuburg, 1960 [Neuburg, 1960; Dobruskina, 1974, 1982; Yaroshenko, 1975; Lugardon *et al.*, 1999, 2000; Naugolnykh, 2013], which are the most abundant macrofossils in the locality (Fig. 2, D). Invertebrates of the Tikhvinskoe locality include ostracods *Kostromella salubris* Mischina, 1965, *K. aspera* Mischina, 1965, *Marginella granumiformis* Mischina, 1965, *M. necessaria* Mischina, 1985, *Nerechtina plana* Mishina, 1965, *N. cordata* Mischina, 1965, *Darwinula activa* Srarozhilova, 1968, *D. regia* Mischina, 1965, *D. postparalella* Mischina, 1965, *D. temporalis* Mischina, 1965, phyllopods *Lioestheria jaroslavlensis* Novojilov, 1960, *Lioestheria quellaensis* Novojilov, 1959, *Pseudestheria rybinskensis* Novojilov, 1959, *P. kashirtzevi* Novojilov, 1959, *Cyclotongusites gutta* Lutkevich, 1937, *C. gazzimuri* Novojilov, *Notocrypta begitchevi* Novojilov, 1959, *Estheriina aequalis* Lutkevich, 1937 (Kiselev et al., 2003), insects, i.e. a representative of Orthoptera (namely, the Elcanidae family), grilloblattids *Tomia sennikovi* Aristov, 2003 [Aristov, 2003], Coleoptera, and Blattoidea [Kiselev *et al.*, 2003], xyphosurians *Limulitella volgensis* Ponomarenko, 1985 (Ponomarenko [1985]; for details see below). The Tikhvinskoe locality also includes numerous fish remains, i.e. isolated scales, disintegrated sceletons and even almost complete specimens. The fish assemblage includes dipnoi *Gnathorhiza triassica* Minikh, 1977, *G. lozovski* Minikh, 1977, *G. otschevi* Minikh, 1977, teeth and ichthyodorulites of *Hybodus spasskiensis* A.Minikh, 1985, shark teeth *Lissodus* sp., osteoderms of bradyodonts, ganoids *Saurichthys obrutchevi* A.Minikh, 1981, *S. proximus* A.Minikh, 1981, *S. tertius* A.Minikh, 1982, *S. eximius* A.Minikh, 1982, palaeoniscids *Pteronisculus* sp., *Boreosomus* (?) sp., *Birgeria* (?) sp. [Minikh, Minikh, 1998]. The tetrapods from the Tikhvinskoe locality are represented by amphibians (temnospondyl labyrinthodonts) *Benthosuchus korobkovi* Ivakhnenko, 1972, *Thoosuchus yakovlevi* (Riabinin, 1925), *Wetlugasaurus angustifrons* Riabinin, 1930 [Ivakhnenko, 1972; Ivakhnenko *et al.*, 1997] and terrestrial thecodont *Chasmatosuchus rossicus* Huene, 1940 [Sennikov, 1995]. Remains of *Wetlugasaurus* and *Chasmatosuchus* are very rare and scarce in that locality. *Benthosuchus* and *Thoosuchus* are found much more frequently, but the first genus normally is represented by larger specimens.

Paleoichnological observations

There are two representative specimens in the author’s collection. Both specimens were attributed/assigned to one and the same ichnospecies. The holotype is a mold of the solitary body-trace. A trace of prosoma and opisthosoma connected together is visible (Figs 3, B; 4, B). The trace was formed when the animal was lying on the sediment, and its position was imprinted in the surface of the sediment. Most probably the animal had a rest or was in hunting position (for details see below). According to current paleoichnological classification treatment, all the traces described in the present paper can be attributed to the ichnogenus *Selenichnites* Romano et Whyte, 1990 [Romano, Whyte, 1990, 2019].

Selenichnites Romano et Whyte, 1990

Selenichnites eotrassicus Naugolnykh, **ichnosp.n.**
Figs. 3–5.

HOLOTYPE. Sel-1, the State Darwin Museum, Moscow; Lower Triassic, Induan, Rybinsk Horizon, Parshinskie Layers. Figured here on Figs 3, B; 4, B.

ETYMOLOGY. From “Eo-Triassic” (Latin), after Early Triassic age of the Tikhvinskoe locality, where the type material was collected.

DIAGNOSIS. Traces (hypichnia) with larger anterior part of convex crescent/semilunar shape, and with smaller posterior part of subtriangular shape. Liner trace of tail can be present.

DESCRIPTION. The holotype is a trace of practically complete body, with the imprint (so-called “lunate cast”) of the prosoma, subtrinagular opisthosoma, and a part of the telson (Figs 3, B; 4, B). The width of the holotype is 9 mm. This dimension corresponds to widest part of prosoma. General length of the holotype, i.e. the imprint of prosoma and posterior part of the animal body corresponding to opisthosoma and perhaps anterior part of the telson, altogether is 16 mm. General shape of the prosoma imprint is suboval crescent/semilunar. Surface of the holotype is covered by unclear prolonged ribs, probably left by the legs scratched the substrate. Highly likely, the holotype represents a trace of rest left by an animal which had lied on the lagoon bottom. In other words, regarding the behavioral activity of trace-producing animal, the holotype can be interpreted as a shallow-imprinted resting burrow.

The syntype is a print and counter-print of a limulid trace with incomplete anterior part left by prosoma, but with the well-preserved posterior part corresponding to opisthosoma. The long linear trace of telson (Figs 3, A, C; 4, A, C) is present as well. It is expressed in negative relief as a ridge projected behind the imprint of opisthosoma, The syntype in general is similar to the holotype, but is smaller. Maximal width of the syntype prosoma is about 10 mm. Maximal width of the opisthosoma is 7 mm, length of the opisthosoma is 8 mm. Length of the telson trace is 70 mm. Width of the lelson trace is 1.5 mm. The syntype as a whole, according to the author’s viewpoint, can represent some sort of feeding activity of the trace-producer moved on the semi-soft sediment surface.

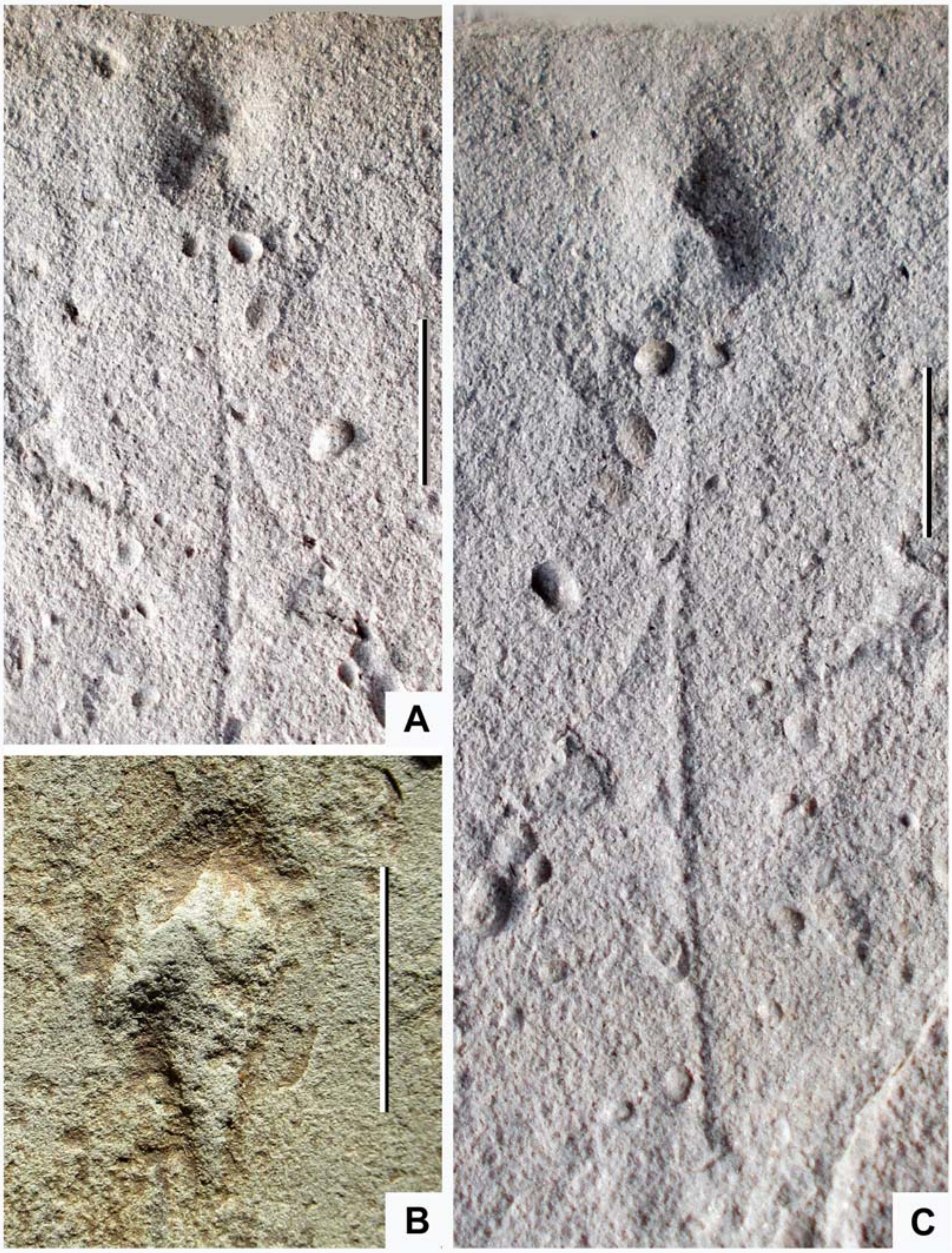

Fig. 3. *Selenichnites eotriassicus* ichnosp.n. A — Sel-3; B — holotype Sel-1; C — Sel-2. Lower Triassic, Induan; the locality Tikhvinskoe. Scale 1 cm.

Рис. 3. *Selenichnites eotriassicus* ichnosp.n. A — Sel-3; B — голотип Sel-1; C — Sel-2. Нижний триас, индский ярус, местонахождение Тихвинское. Масштаб 1 см.

REMARKS AND COMPARISON. General shape of *Selenichnites eotriassicus* ichnosp.n. is repeating the shape and morphology of limulid carapaces, and leaves no doubt that it was produced by a representative of xyphosurian arthropod. The only limulid species at the Tikhvinskoe locality is *Limulitella volgensis* Ponomarenko, 1985 (see here Figs 2, A–C; 5). Some of the *Limulitella volgensis* specimens were collected together with the trace fossils of *Selenichnites eotriassicus* described above. Therefore, it is a good reason to suggest that *Selenichnites eotriassicus* was left/produced by *Limulitella volgensis*.

The most important discriminative morphological feature of this new ichnospecies is a well-pronounced trace of the tail, very rarely detected on the traces of this paleoichnological type.

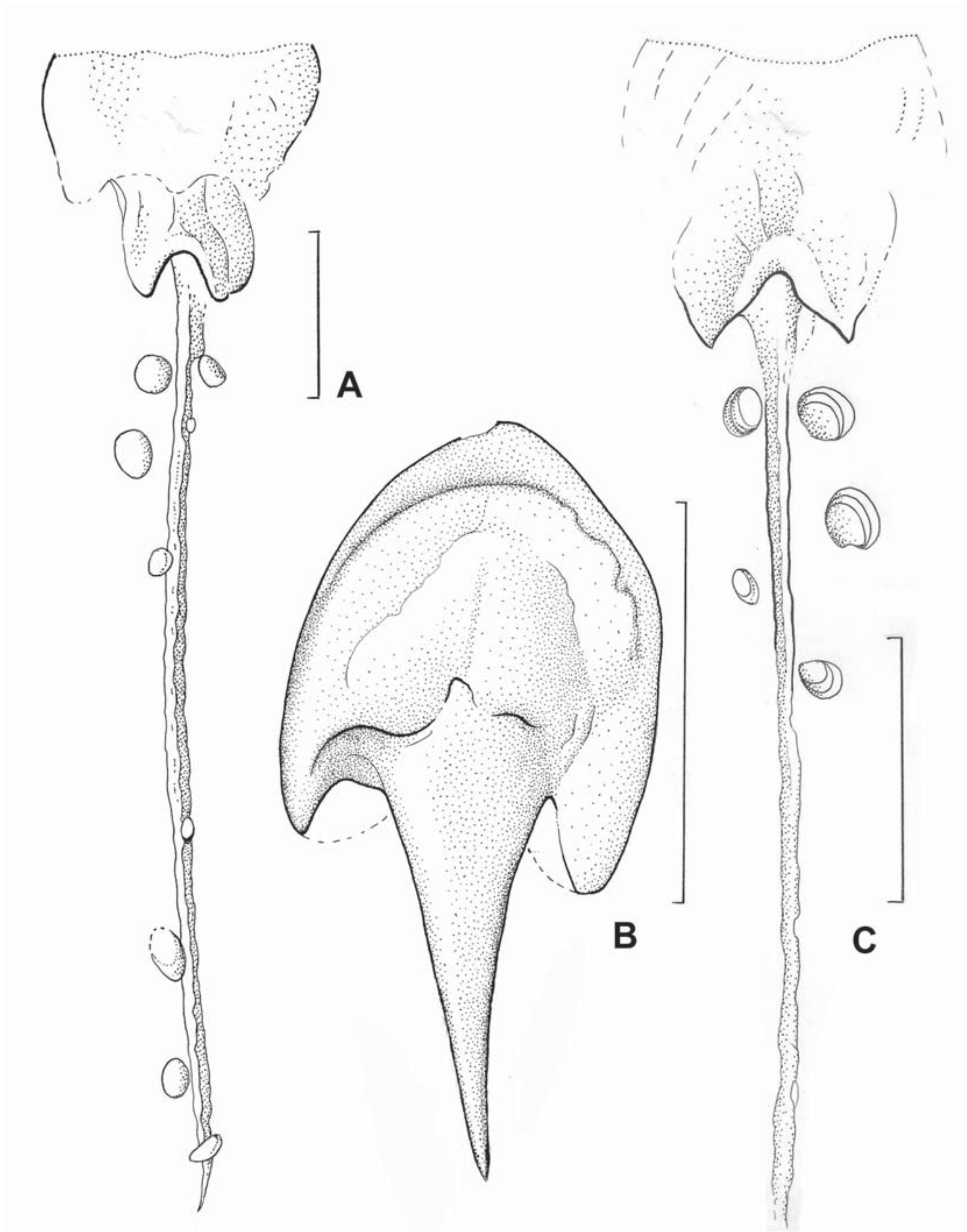

Fig. 4. *Selenichnites eotriassicus* ichnosp.n. A — Sel-2; B — holotype Sel-1; C — Sel-3. Lower Triassic, Induan; the locality Tikhvinskoe. Scale 1 cm.

Рис. 4. *Selenichnites eotriassicus* ichnosp.n. A — Sel-2; B — голотип Sel-1; C — Sel-3. Нижний триас, индский ярус, местонахождение Тихвинское. Масштаб 1 см.

Some similar traces of certain xyphosurid origin were reported from the Upper Carboniferous deposits of the Jogging Cliffs, Nova Scotia, Canada [Buhler, Grey, 2016, figs 3, A, B; 4, B, C]. As it was shown by the authors, these traces also assigned to *Selenichnites* (namely, *S. rossendalensis* Hardy, 1970) and most probably were left by the xyphosurian *Belinurus koenigianus* Woodward, 1872. Occasionally, *Selenichnites rossendalensis* demonstrates posterior traces, but they normally bear scratches of walking legs [King *et al*., 2019]. One more similar ichnospecies is *S. hundalensis* Romano et Whyte, 1987 from the Middle Jurassic deposits (Scalby Formation) of the United Kingdom. This species is different of *S. eotriassicus* in wider proportion and obtuse anterior margin of the prosoma area [Romano, Whyte, 2013]. Same type of *Selenichnites* traces were reported from Middle Jurassic of Morocco [Oukassou *et al*., 2016].

It should be noted that *Selenichnites eotriassucus* resembles the traces of *Selenichnites* sp. (in original descrip-

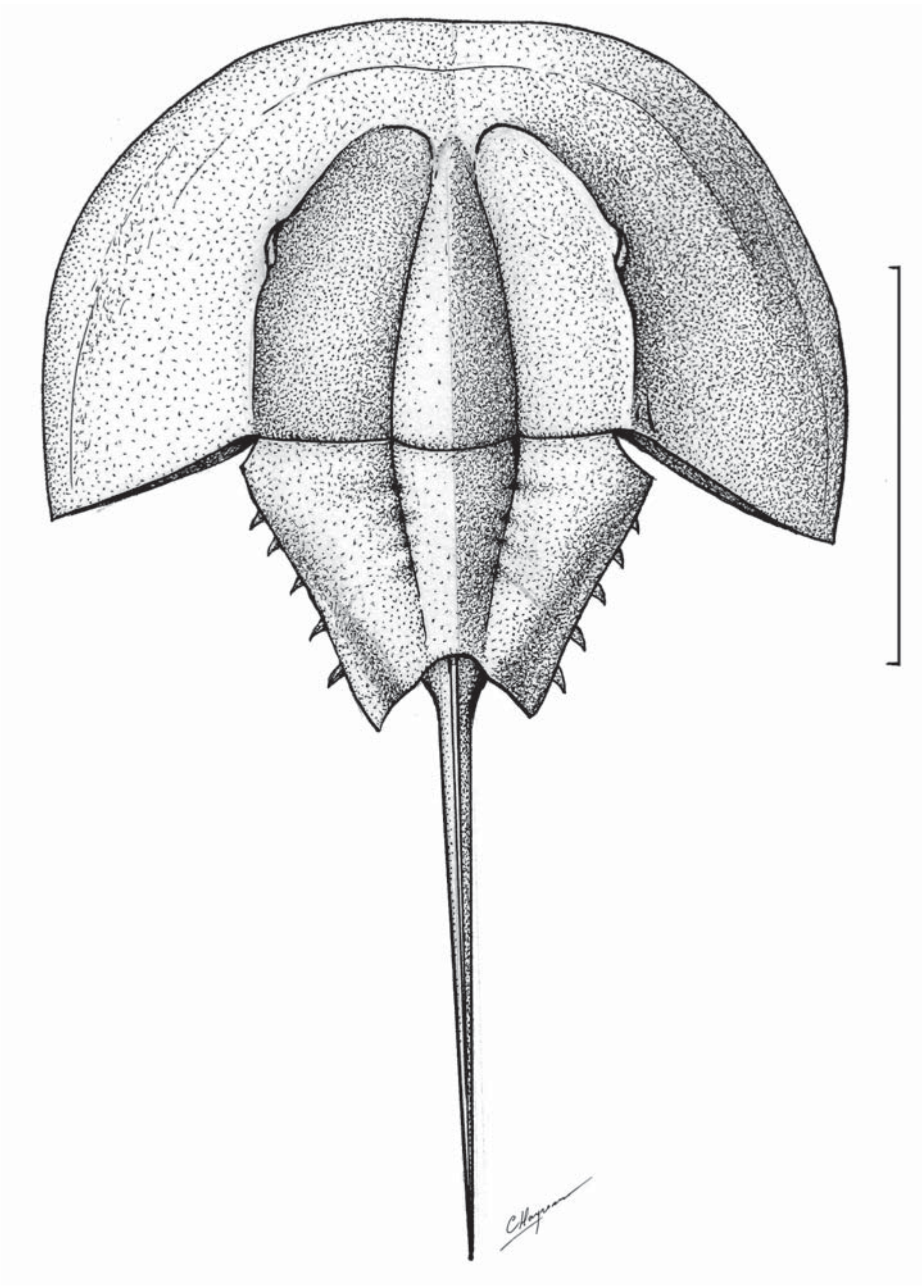

Fig. 5. *Limulitella volgensis* Ponomarenko, 1985. General habit of an adult animal. Lower Triassic, Induan; the locality Tikhvinskoe. Scale 1 cm.

Рис. 5. *Limulitella volgensis* Ponomarenko, 1985. Общий облик взрослого животного. Нижний триас, индский ярус, местонахождение Тихвинское. Масштаб 1 см.

tion this name is given under question mark) from the Upper Triassic deposits of southwest Britain [Wang, 1993] preserved in the shallow water lagoon deposits, which include teeth of the lungfishes *Ceratodus latissimus* Agassiz, 1837 [Wang, 1993]. As a matter of fact, the teeth of dipnoi can be found in the Lower Triassic deposits containing *Selenichnites eotriassicus* as well, what can point to the similar paleoenvironmental conditions of forming of both localities. What is also important, the traces *Selenichnites* sp. from the Upper Triassic of Britain are also corresponding to the limulid *Limulitella* Størmer, 1952 [Wang, 1993].

Discussion. Paleoenvironmental reconstruction

The Tikhvinskoe locality is under intensive studies already during several last decades [Ivakhnenko, 1972; Lozovsky, 1987; Arefiev, Shelekhova, 1991; Sennikov, 1995; Novikov, Sennikov, 1996; Kiselev *et al*., 2003, 2012], but any consensus about its origin is still not reached. The opinions on initial paleoenvironments of the Tikhvinskoe site vary from the very shallow sea basin [Kiselev *et al*., 2003] to the near-shore zone with periodically existed aerial conditions [Naugolnykh, 2004, 2012, 2013]. Lower part of the Tikhvinskoe section (Parshinskie layers) certainly represents aqual limnic deposits, judging from the numerous fish, ostracod and phyllopod fossils. But the uppermost part of the Tikhvinskoe section (Tcheremushkinskie layers) certainly represents subaerial to aerial conditions, judging from the presence of well-pronounced desiccation cracks. Therefore the general succession of the section can be interpreted as regressive.

As it was suggested by N.I. Strok *et al*. [1984] and later confirmed by M.G. Minikh & A.V. Minikh [1998], the epicontinental shallow-water basin of Tikhvinskoe was linked with the boreal sea basin through the Baltic region. But most probably this link was not permanent, and the gulf could be dried and blocked during Tcheremushka time.

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References

Arefiev M.P., Shelekhova M.N 1991. Palynological characteristics of age of the Parshinskie layers of Lower Triassic of the Moscow Syneclyse // Bulletin of Moscow Society of Naturalists, Geological Section Vol.66. No.3. P.73–77.

Aristov D.S. 2003. A revision of the family Tomiidae (Insecta: Grilloblattida) // Paleontological Journal. No.1. P.32–39.

Buhler P.B., Grey M. 2016. Xiphosurian digging traces at the Late Carboniferous Joggings Fossil Cliffs UNESCO World Heritage Site, Nova Scotia, Canada // Ichnos. Vol.24. No.3. P.1–12.

Dobruskina I.A. 1974. Triassic lepidophytes // Paleontological journal. No.3. P.111–124.

Dobruskina I.A. 1982. [Triassic floras of Eurasia] // Trudy Geologicheskogo Instituta AN SSSR. Vyp.365. Moscow: Nauka. 182 p. [In Russian]

Ivakhnenko M.F. 1972. A new benthosuchid from Lower Triassic of the Upper Volga region // Paleontological journal. No.4. P.93–99.

Ivakhnenko M.F., Golubev V.K., Gubin Ju.M., Kalandadze N.N., Novikov I.V., Sennilov A.G., Rautian A.S. 1997. [Permian and Triassic tetrapods of Eastern Europe] // Trudy Paleontologicheskogo Instituta RAN. Vol.268. Moscow: Geos. 216 p. [In Russian]

King O.A., Stimson M.R., Lucas S.G. 2019. The ichnogenus *Koupichnium* and related xiphosuran traces from the Steven C. Minkin Paleozoic footprint site (Union Chapel Mine), Alabama, USA: ichnotaxonomic and paleoenvironmental implications // Ichnos. Vol.26. No.4. P.266–302

Kiselev D.N., Baranov V.N., Muravin E.S., Novikov I.V., Sennikov A.G. 2003. Atlas of geological Monuments of nature of the Yaroslavl region]. Yaroslavl: State Pedagogical University. 121 p. [In Russian]

Kiselev D.N., Baranov V.N., Muravin E.S., Rogov M.A., Naugolnykh S.V., Dronov A.V. et al. 2012. [Geosites of the Yaroslavl area: stratigraphy, paleontology, paleogeography]. Moscow: Yustitsinform. 304 p. [In Russian]

Lozovsky V.R. 1987. [Triassic lakes of Moscow- and Poland-Litva syneclises] // Istoriya ozyor pozdnego paleozoya i rannego mezozoya. Leningrad: Nauka. P.199–213 [in Russian].

Lugardon B., Grauvogel-Stamm L., Dobruskina I. 1999. The microspores of *Pleuromeia rossica* Neuburg (Lycopsida; Triassic): comparative ultrastructure and phylogenetic implications // C.R. Acad. Sci. Paris. Sciences de la terre et des planets. Vol.329. P.435–442.

Lugardon B., Grauvogel-Stamm L., Dobruskina I. 2000. Comparative ultrustructure of the megaspores of the Triassic lycopsid *Pleuromeia rossica* Neuburg // C.R. Acad. Sci. Paris. Sciences de la terre et des planets. Vol.330. P.501–508.

Minich M.G., Minich A.V. 1998. [Pisces] // Granitsa permi i triasa v kontinental'nykh seriyakh Vostochnoi Evropy. Moscow: Geos. P.74–88 [in Russian].

Naugolnykh S.V. 2004. [Palaeophytogeography of Permian Period] // M.A. Semikhatov, N.M. Chumakov (eds.). Klimat v epokhi krupnykh biosfernykh perestroek. Trudy Geologicheskogo Instituta RAN. Vyp.550. Moscow: Nauka. P.194–240 [in Russian].

Naugolnykh S.V. 2009. [What's happen then?] // Permskiy period: organichekiy mir na zakate paleozoya. Perm: Art-Design. P.94–99 [in Russian].

Naugolnykh S.V. 2012. [Lycopodiophyta – *Pleuromeia rossica*] // Ob'yekty geologicheskogo naslediya Yaroslavskoi oblasti: stratigrafiya, paleontologiya i paleogeografiya. Moscow: Yustitsinform. P.92–95 [in Russian].

Naugolnykh S.V. 2013. The heterosporous lycopodiophyte *Pleuromeia rossica* Neuburg, 1960 from the Lower Triassic of the Volga River basin (Russia): organography and reconstruction according to the 'Whole-Plant' concept // Wulfenia. Mitteilungen des Kaerntner Botanikzentrums Klagenfurt. Bd.20. S.1–16.

Naugolnykh S.V., Bicknell R.D.C. Ecology, morphology and ontogeny of *Paleolimulus kunguricus* — a horseshoe crab from the Kungurian (Cisuralian) of the Cis-Urals, Russia. Lethaia. 2021. https://doi.org/10.1111/let.12451.

Neuburg M.F. 1960. [*Pleuromeia* Corda from the Lower Triassic deposits of Russian Platform] // Trudy Geologicheskogo Instituta AN SSSR. Vyp.43. Moscow: AN SSSR Publ. P.65–90 [in Russian].

Novikov I.V., Sennikov A.G. 1996. [Early Triassic locality Tikhvinskoe: geological structure, fauna and flora] // V Zolotarevskie Chteniya. Tezisy dokladov konferentsii (19–20 dek. 1995 g.). Rybinsk. P.8–10 [in Russian].

Oukassou M., Charrière A., Lagnaoui A., Gibbe S., Michard A., Saddiqi O. 2016. First occurrence of the Ichnogenus *Selenichnites* from the Middle Jurassic Strata of the Skoura Syncline (Middle Atlas, Morocco); Palaeoecological and palaeoenvironmental context // Comptes Rendus Palevol. Vol.15. P.461–471.

Ponomarenko A.G. 1985. New limulids and eurypterids from the Permian and Mesozoic of the USSR // Paleontological journal. No.3. P.115–118.

Romano M., Whyte M.. 1990. *Selenichnites*, a new name for the ichnogenus *Selenichnus* Romano & Whyte, 1987 // Proceedings of the Yorkshire Geological Society. Vol.48. No.2. P.221.

Romano M., Whyte M. 2013. A new record of the trace fossil *Selenichnites* from the Middle Jurassic Scalby Formation of the Cleveland Basin, Yorkshire // Proceedings of the Yorkshire Geological Society. Vol.59. P.103–210.

Romano M., Whyte M. 2019. Two previously unrecorded xiphosurid trace fossils, *Selenichnites rossendalensis* and *Crescentichnus tesiltus*, from the Middle Jurassic of Yorkshire, UK // Proceedings of the Yorkshire Geological Society. Vol.62. P.254–259.

Seilacher A. 1954. Die geologische Bedeuting fossiler Lebensspuren // Zeitschr. Deutsch. Geol. Ges. Bd.105. S.214–227.

Seilacher A. 1964. Sedimentological classification and nomenclature of trace fossils // Sedimentology. Vol.3. P.253–256.

Seilacher A. 1967. Fossil behavior // Scientific American. Vol.217. No.2. P.72–80.

Sennikov A.G. 1995. [Early thecodonts of the Eastern Europe] // Trudy Paleontologicheskogo Instituta RAN. Vol.263. Moscow: Nauka. 142 p. [In Russian]

Strok N.I., Gorbatkina T.E., Lozovsky V.R. 1984. [Upper Permian and Lower Triassic deposits of the Moscow Syneclyse]. Moscow: Nedra. 140 p. [In Rissian]

Wang G. 1993. Xiphosurid trace fossils from the Westbury Formation (Rhaetian) of southwest Britain // Palaeontology. Vol.36. No.1. P.111–122.

Yaroshenko O.P. 1975. Morphology of the spores of *Pleuromeia rossica* and *Densoisporites neuburgii* // Paleontological journal. No.3. P.101–106.

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