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Lower and Middle Callovian Gastropod Assemblages from Central European Russia

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Abstract—Two gastropod assemblages from the Lower Callovian of the Kostroma Region and the Middle Callovian of the Yaroslavl' Region are studied and compared with synchronous assemblages of the Kostroma, Moscow, Bryansk, and Kursk regions. It is suggested that gastropods from the Yaroslavl' and Kostroma regions inhabited colder water basins than gastropods from more southern regions. A new genus and species *Znamenkiella ovalis* gen. et sp. nov. (family Pseudomelaniidae) are described from the Lower Callovian of the Kostroma Region.

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Key words: Gastropoda, Pseudomelaniidae, Callovian, gastropod paleobiogeography, gastropod assemblages.

INTRODUCTION

Results of the study of the Callovian gastropod assemblages from central European Russia were recently published by Guzhov (2004). However, some of the conclusions published were based on analysis of limited material from the Kostroma Region. On that occasion several tens of shells were collected from each locality. Almost the entire material came from Lower Callovian sandstone nodules (*koenigi–enodatum* zones), which were formed in places of subautochthonous accumulations of fossil fauna. Usually, the accumulation was centered around several large ammonites surrounded by smaller shells of other ammonites, gastropods, and bivalves. Because the gastropod samples from such localities are small, the composition of the assemblages is far from complete. The main conclusion on the gastropod assemblages from Lower Callovian sandy rocks of the Kostroma Region was their taxonomic similarity in several localities. However, based on this principle one can only observe the presence of the most characteristic species in assemblages rather than the number of species in assemblages.

In the course of additional study in 2004, bulk material of gastropods from the sandy rocks of the *calloviense* Zone in the vicinity of the village of Znamenka (Kostroma Region) and clays of the *jason* Zone near the town of Rybinsk (Yaroslavl' Region) was examined for the first time. The latter material was collected considerably later than the gastropod assemblages previously described from the Bryansk Region (village of Fokino, *jason* Zone) and Kursk Region (Mikhailovskii Quarry, *enodatum* Zone) (Guzhov, 2004). The map of localities is shown in Fig. 1. Over 1000 gastropod shells have been collected from each locality. The sandy rock was washed at the site using a sieve with 0.5 mm holes, whereas the remainder of the samples were studied in the lab. Because clays are difficult to wash without preliminary treatment, a sample of 35 kg was taken. Later, the dried clay was soaked several times in hot weakly alkaline solutions. After each session, the clay was washed and dried. Gastropod remains were collected from the remaining concentrate and sorted to species, after which the number of shells of each species was counted. When counting, the possibility of a shell breaking into fragments was taken into account. The data obtained were used in diagrams in Figs. 2 and 3.

The first gastropod assemblage comes from the medium-grained silty sands of the *calloviense* Zone, *calloviense* Biohorizon near the village of Znamenka (Kostroma Region). The benthos is subautochthonous, buried as accumulations of rounded shape. Shells are often partly dissolved. Because of this, in many gastropods only the last volutions are preserved. Some species of small gastropods are probably absent because of the dissolution of their shells. In its completeness and preservation, the material from Znamenka considerably exceeds material previously collected in other Lower Callovian sections in the Kostroma Region, gastropods were studied from a few imprints. The subautochthonous nature of the material is supported by the absence of evidence of transportation in those parts of the shells which were not dissolved. The undissolved shells of Mathildidae often have protoconchs. Accumulations are concentrated around a core of large ammonite shells of *Cadoceras* and *Sigaloceras* surrounded by smaller shells of *Pseudocadoceras* and some large bivalves. Small bivalves, gastropods, scaphopods, and *Pentacrinus* columnals are particularly numerous. Except in rare cases, the shell accumulations are cemented by pyrite; therefore, the periphery of the nodules, where

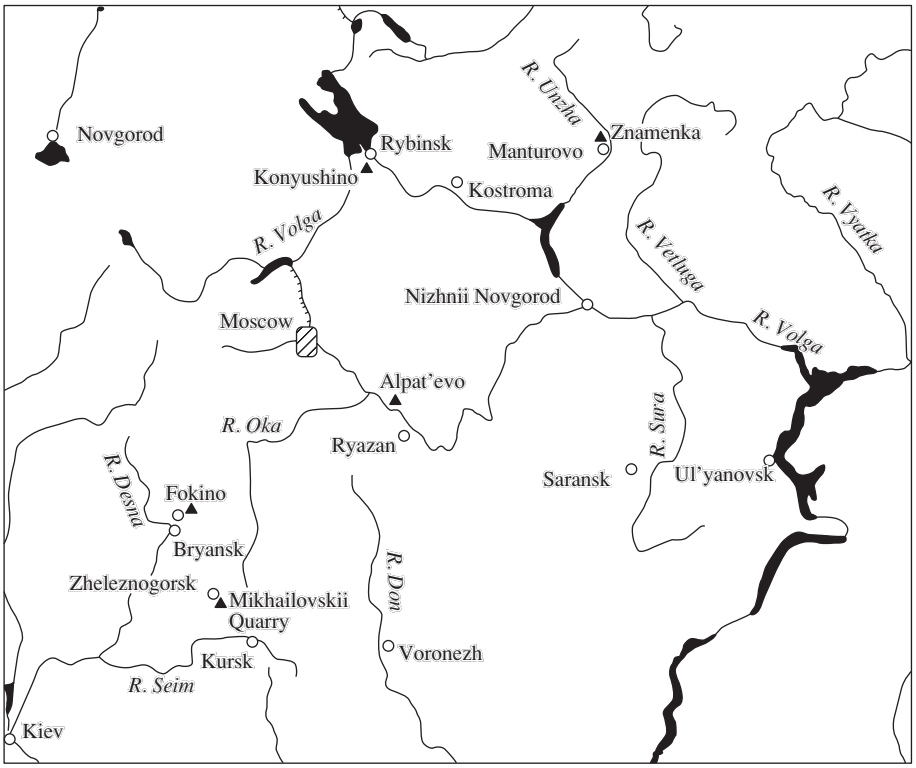


Fig. 1. Map of localities of the Lower and Middle Callovian gastropod assemblages studied.

pyritization was not developed, was chosen for washing. In broken nodules the same gastropod species that were found in the non-pyritized periphery were recorded. The gastropod assemblage studied has one prominent dominant species *Glosia* sp. 1 (81.7% of the total number of shells) (Fig. 2a). This species is close to *Glosia exigua* (Gerasimov, 1992), from which it differs in the larger and thicker-walled shells. Other characteristic species of this assemblage include *Sulcoactaeon* sp. 1 (5.1%), *Pseudomelania laubei* Cossmann (4.9%), *Znamenkiella ovalis* gen. et sp. nov. (1.9%) and *Parvulactaeon* sp. 1 (1.9%). In addition, 1% of the assemblage is composed of eroded shells of either *Sulcoactaeon* sp. nov. or *Parvulactaeon* sp. nov.; hence, the proportion of one of these species may be somewhat reduced.

The second assemblage was collected in the clay of the *jason* Zone exposed in the Eda River near the village of Konyushino (Yaroslavl' Region). The fauna is autochthonous and very well preserved. Clays are thin, gray, with pyrite, which forms pseudomorphs to isolated ammonite shells or fills the cavities of some gastropod and bivalve shells. The shells in the clays are numerous, although they do not form accumulations. Among gastropods, the species *Glosia exigua* (Geras.) is dominant (63.7% of all shells collected) (Fig. 2b). Other characteristic species in the assemblage are *Parvulactaeon* sp. 1 (17.7%), *Pseudomelania laubei* Cossmann (7.6%), and *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox) (6.9%).

The analysis of the new material is presented below. The gastropod assemblage from near Znamenka, despite being collected from coarser-grained rocks, is more similar in its structure to the previously studied assemblages from the Oxfordian and Callovian clays (Guzhov, 2004). This similarity is manifested in the clear dominance of one species (e.g., *Glosia* sp. 1). The proportion of this species is so high that in this feature the assemblage from Znamenka is comparable only to the gastropod assemblage from the *tenuiserratum* Zone near the town of Shchurovo, where the proportion of the dominant species *Exelissa* (*Exelissa*) *quinaria* (Trd.) is 80–85%. In contrast, other samples from the sandy rocks (Kuntsevo and others) and sandy-clayey rocks (Alpat'evo, "Severnyi Makariev") and silty clay (Kuntsvevo) contain several (three to five) dominant species, the proportion of which in the assemblage ranges from 15 to 40%. It is difficult to explain the "abnormality" of the Znamenka assemblage. It is possible that it is related to uniform and less favorable conditions, which led to the dominance of one species, the best adapted to these conditions. The presence of a brackish-water shallow basin is unlikely. Apart from members of the subgenus *Cryptaulax (Neocryptaulax)*, other gastropods have not been recorded from brackish-water basins. In addition, the role of *Neocryptaulax* in the assemblage is not large. Perhaps, the situation

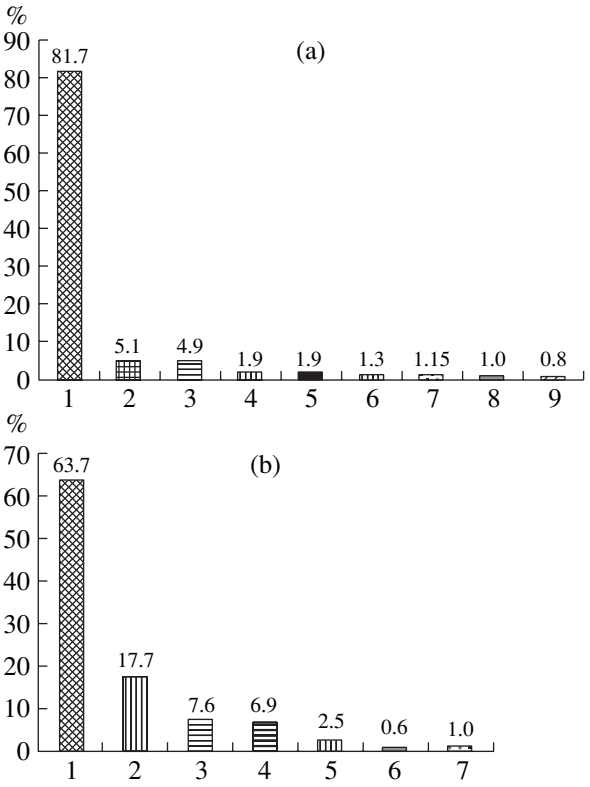


Fig. 2. Northern Lower and Middle Callovian gastropod assemblages of European Russia: (a) composition of the Lower Callovian assemblage (*calloviense* Zone, *calloviense* Subzone); village of Znamenka (explanations: (1) *Glosia* sp. 1; (2) *Sulcoactaeon* sp. 1; (3) *Pseudomelania laubei* Cossm.; (4) *Znamenkiella ovalis* sp. nov.; (5) *Parvulactaeon* sp. 1; (6) *Tricarilda plana* Gründel; (7) *Cryptaulax* (*Neocryptaulax*) spp.; (8) poorly preserved shells of *Sulcoactaeon* sp. 1 or *Parvulactaeon* sp. 1; (9) other genera and species (*Maturifusus kostromensis* (Geras.), *Tricarilda "angulata"* Gründel, *Eucyclus* sp. 1, *Bicorempterus pseudopellati* (Geras.), *Naricopsina, Endianaulax, "Ampullina"* and others; material 7772 specimens); (b) composition of the Middle Callovian assemblage (*jason* Zone), Eda River (explanations: (1) *Glosia exigua* (Geras.); (2) *Parvulactaeon* sp. nov.; (3) *Pseudomelania laubei* Cossm.; (4) *Cryptaulax (Cryptaulax) protortilis* (Cox); (5) *Tricarilda plana* Gründel; (6) *Cylindrobullina* sp. 1; (7) *Buvignieria calloviana* Gründel, *Khetella* sp. ind., *Maturifusus* (?) sp., *Tricarilda "angulata"* Gründel, *Tricarilda* sp. 1 and others; material 1720 specimens).

resulted from a lower water temperature, which was more favorable for *Glosia*, which may have been more cryophilic. Accumulations of shells of rounded or oval shape were more likely formed in shallow water, in the zone with a more or less intense hydrodynamics, where, apparently, the waves produced a cellular appearance on the sandy bottom. Large ammonite shells were constrained in the deep cells of the bottom, and smaller shells of gastropods, bivalves, and ammonites accumulated around them. Apparently the depressions in the bottom trapped other organic remains apart from the shells. It is possible that these accumulations were trapped under a thick layer of sediment, which precluded the access of oxygen and resulted in strong pyritization of accumulations. Wave action is only possible in shallow water (10–20 m). At such depths, the water temperature strongly depends on the solar radiation and warm or cold surface currents.

Below, the gastropod assemblages near the village of Znamenka and from the Eda River (referred to below as northern assemblages) are compared to the assemblages from the clay near the village of Fokino and Mikhailovskii Quarry (referred to below as southern assemblages). The composition of gastropods from the *jason* Zone near the village of Fokino is shown in Fig. 2a. These assemblages are dominated by *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox), (over 70% shells). It is followed by *Pseudomelania laubei* Cossmann (22.8%), although its distribution in the section is very irregular. Other gastropod species do not play a large role. Of these, *Dicroloma* sp. 1 and *Tornatellaea* sp. 1 are found most frequently. A similar pattern is observed in the Lower Callovian *koenigi* and *enodatum* zones in the Mikhailovskii Quarry. The *koenigi* Zone contained only *C. (C.) protortilis,* whereas the *enodatum* Zone was dominated by *C. (C.) pseudoechinatus* (among large gastropods) and *Buvignieria* sp. (among small gastropods). Other species were *Pseudomelania laubei, P. extricata* Blake, *Dicroloma* sp., *Tricarilda* sp., *Sulcoactaeon* sp., and some others. The role of *P. laubei* in the assemblage is much smaller than in that from Fokino. The most striking feature observed by the comparison of the assemblages from the village of Fokino and Mikhailovskii Quarry, on the one hand, and from the Eda River and the village of Znamenka, on the other hand, is that the northern assemblages are dominated by *Glosia* species, whereas the southern assemblages are dominated by *Cryptaulax* s. s. A small number of gastropods were collected from the clay of the *elatmae* Zone near the village of Znamenka (solely *Glosia* sp. 1). *Glosia* is virtually absent from the northern assemblages, rarely occurring in Fokino only. *Parvulactaeon* sp. 1, which plays a significant role in northern assemblages (17.7% in the Eda River and 1.9% near the village of Znamenka), is unrecorded from the Kursk and Bryansk Regions. The role of *P. laubei* in the southern assemblages is relatively important. In the northern assemblages this species is always among the three most important species (5–7.5%). The rarity of *Buvignieria calloviana* Gründel in the northern assemblages (1 specimen) is striking because in the *enodatum* Zone of the Mikhailovskii Quarry, in some layers, this is the most widespread species of small gastropod. The three species of Mathildidae found in the northern assemblages are also known in the southern; however, their role in the latter is still insufficiently known.

Finally, comparison of the assemblages of Znamenka and Eda shows that there is more in common between them than, for instance, between the southern assemblages from different rocks: sandy-clayey (Alpat'evo) and clayey (Fokino, Mikhailovskii Quarry).

The northern assemblages are dominated by *Glosia* species. *Glosia* sp. 1 should be considered as the closest relative of *Glosia exigua*, which acquired adaptations for shallow-water habitats (a thicker shell and large size). Other shared species are *Parvulactaeon* sp. 1, *Pseudomelania laubei* Cossmann, *Tricarilda plana* Gründel and *T. "angulata"* Gründel, of which the first two species play an important role in both assemblages. The assemblages are different in that the assemblage from the Eda River contains *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox) (6.9%), which is not present in the assemblage from Znamenka, being replaced by species of *Cryptaulax (Neocryptaulax)*, which are "facial opposites" of *Cryptaulax* s. s. The proportion of the species of *Cryptaulax (Neocryptaulax)* is not large; they constitute only 1.15% of the assemblage and were found only in some shell accumulations. In contrast, the Znamenka assemblage contains numerous *Sulcoactaeon* sp. 1 and *Znamenkiella ovalis* sp. nov.

The study of gastropods from the locality near the village of Znamenka allow a different interpretation from that which previously existed for the material that had been collected from the sandy rocks of Kostroma Region, the results of which are discussed below. *Glosia* sp. 1 (*Glosia exigua* (Geras.) in Guzhov, 2004) was found in the *koenigi* Zone (village of Burdovo and village of Ileshevo), *calloviense* Zone (town of Manturovo), and *enodatum* Zone (village of Burdovo). However, on all occasions this species was represented in much smaller numbers than in the Znamenka assemblage. *Parvulactaeon* sp. 1 (*Parvulactaeon* spp. in Guzhov, 2004) was established in all previously known sections, but its proportion there was much higher. The same applies to *Cryptaulax* (*Neocryptaulax*) *mutabilis* (Geras.) and *Bicorempterus pseudopellati* (Geras.). In the material from Znamenka they constituted about 0.5 and 0.2% of the total number of taxa in the assemblage, respectively. However, the proportion of *P. laubei* (Cossm.) (*Pseudomelania* spp. in Guzhov, 2004) in all sections studied is approximately the same. The proportion of *Eucyclus* sp. 1 (*Eucyclus* sp. in Guzhov, 2004) in the *calloviense* Zone in the neighboring section in the town of Manturovo is more likely to be artificially increased because it is found sporadically near the village of Znamenka, and only in some accumulations does its proportion reach 0.1%.

Such a large difference between the proportions of the above species in the Znamenka assemblage and in the material from the previously studied sections may be explained in several different ways. Firstly, there is a possibility that gastropods collected from the previously studied sections inhabited environments different from those inhabited by the Znamenka gastropods. Secondly, the association of gastropods at Znamenka was more completely preserved. Thirdly, this is certainly connected to the fact that the material that was collected previously is limited and to the nature of nodules that were collected. The composition of gastropods from different nodules is somewhat different, and besides, not in all nodules the state of preservation allowed identification of most gastropods. These issues can strongly distort the actual composition of the gastropod assemblages. Therefore, the earlier material shows the presence of the most common representatives of the assemblages rather than their quantitative proportions. However, the Znamenka assemblage still cannot be considered typical of the sandy rocks of the Kostroma Region. To establish that, it would be necessary in addition to study several representative assemblages from

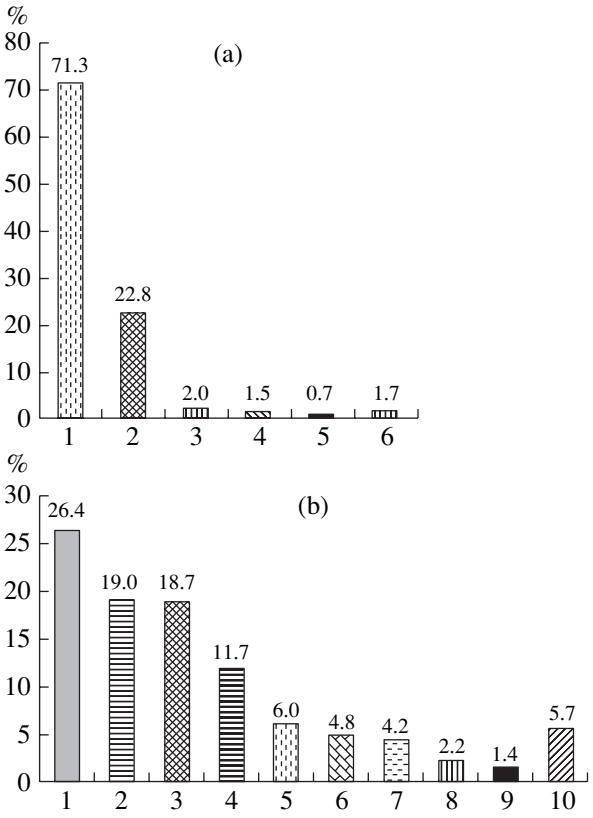


Fig. 3. Southern assemblages of the Lower and Middle Callovian gastropods of European Russia: (a) composition of the Middle Callovian assemblage (*jason* Zone), village of Fokino (explanations: (1) *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox); (2) *Pseudomelania laubei* Cossm.; (3) *Tornatellaea* sp. 1; (4) *Dicroloma* sp. 1; (5) *Companella struvii* (Lahusen); (6) *Glosia exigua* (Geras.), *Maturifusus kostromensis* (Geras.), *Bicorempterus* sp., *Tricarilda* spp., *Dicroloma* spp., *Bathrotomaria* sp. ind., and *Eucyclus* sp. ind.; material 1189 specimens); (b) composition of the Lower Callovian assemblage (*koenigi* Zone, *curtilobus* Subzone), village of Alpat'evo, (explanations: (1) *Tyrnoviella alpatyevensis* Guzhov; (2) *Shurovites multinodosus* (Gründel); (3) *Katosira okensis* Guzhov; (4) *Eucyclus gjeliensis* Gerasimov; (5) *Bathrotomaria* aff. *muensteri* (Roemer); (6) *"Proconulus"* sp. 1; (7) *Eucyclus verrucatus* Gerasimov; (8) *Metriomphalus* aff. *segregatus* (Hebert et Deslongchamps); (9) *Shurovites* (?) sp.; (10) *Pseudomelania ?laubei* Cossm., *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox), *C. (Neocryptaulax)* spp., *Maturifusus kostromensis* (Geras.), *Eucyclus* spp., *Bicorempterus* sp., *Dicroloma* sp., *Bathraspira* (?) sp., *Purpurina* spp. and others; material 882 specimens).

other sections. However, the new material shows that the taxonomic composition of gastropods from the Znamenka assemblage differs from that from the village of Alpat'evo, collected further south (Guzhov, 2004).

Near the village of Alpat'evo gastropods are found in a bed of ferruginous silty fine-medium-grained sandstone with scattered inclusions of harder argillaceous nodules. This bed is dated the Lower Callovian *koenigi* Zone, *curtilobus* Subzone. It is underlain by sand and gravel and overlain by alternation of sand and sandstone. The species *Tyrnoviella alpatyevensis* (26.4%), *Shurovites multinodosus* (19%), and *Katosira okensis* (18.7%) are the most abundant. *Eucyclus gjeliensis* Geras. (11.7%) and *Bathrotomaria* aff. *muensteri* (Roem.) (6%) are frequent. The structure of the assemblage is shown in Fig. 3b.

In fact there are only few taxa in common between the Alpat'evo and Znamenka (and other Kostroma) assemblages. The seven species most abundant in the Alpat'evo assemblage are not recorded from the Kostroma sections. There are a few species in common: *Cryptaulax (Neocryptaulax)* spp., *Bicorempterus* sp. ind. (?*B. pseudopellati*), and *Cryptaulax* (*Cryptaulax*) *protortilis* (Cox). The latter species is found in small numbers in the *curtilobus* Zone near the village of Burdovo. Thus, the difference between the Alpat'evo assemblage and the more northerly Kostroma assemblages is very apparent.

Most likely, the differences between the northern assemblages from the clayey and sandy rocks and the southern assemblages are related to the difference in temperature between the waters that were inhabited by both groups of gastropod assemblages. It is not certain whether this difference is related to the climatic factors (minimum average temperature of the water) or cold/warm currents. It is noteworthy that the effect of the suggested temperature factor on the composition of the gastropod assemblages from Znamenka and Konyushino exceeds, in my opinion, the effect of the hydrodynamics or substrate. On the other hand, there is virtually nothing in common between the assemblage from the sandy-clayey assemblage of Alpat'evo and assemblages from the clays (Fokino, Mikhailovskii Quarry). In other words, here, the differences in hydrodynamics and substrate play the most important role. In contrast, the assemblages from Znamenka and Eda are very similar in composition, despite the differences in hydrodynamics and substrate.

MATERIAL

The material is housed in the Geological-Mineralogical Museum of Moscow Regional State University (Moscow Region, town of Mytishchi), coll. no. 12.

SYSTEMATIC PALEONTOLOGY

Family Pseudomelaniidae Fischer, 1885

Genus *Znamenkiella* Guzhov, gen. nov.

Etymology. From the village of Znamenka.

Type species. *Znamenkiella ovalis* sp. nov.

Diagnosis. Shell small, anomphalous, turriculate, with few whorls, and rounded apex. Protoconch with approximately three smooth whorls. Teleoconch of 4.5–5 whorls. Whorls convex, separated by shallow, straight suture. Whorls of spire low. Ornamentation consisting of growth lines and very thin numerous spiral striae. Last whorl rounded, relatively high (half of shell height). Lateral side gradually fusing with high rounded base, which is covered by similar ornamentation. Aperture oval. Inner lip slightly turned onto the columella. Aperture at top acutely angular, and rounded at base. Growth lines on lateral side weakly opisthocyrt to become prosocyrt on base.

Composition. Type species.

Comparison. This genus differs from *Pseudomelania* Pictet et Campiche, 1862 in the lower, small shell with fewer volutions. It is distinguished from *Hudlestonella* Cossmann, 1909 by the absence of the collabral ornamentation at early stages of the teleoconch, it is distinguished from *Mesospira* Cossmann, 1892 by the high spire and the presence of the spiral ornamentation. From other pseudomelaniid genera it is distinguished by its small, turriculate shells with a few whorls and very weak spiral ornamentation.

Znamenkiella ovalis Guzhov, sp. nov.

Plate 6, figs. 1–7

Etymology. From the Latin *ovalis* (oval).

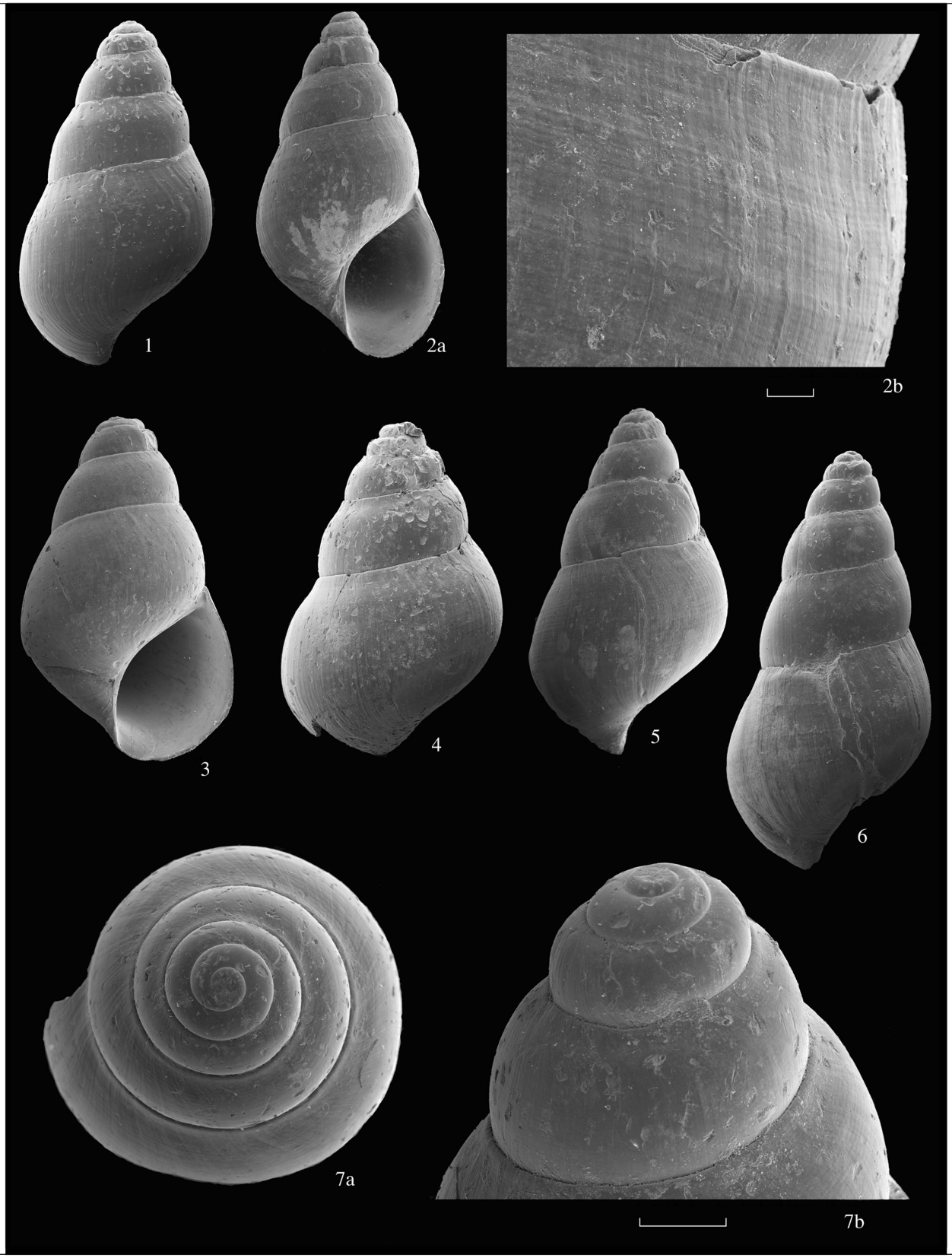
Holotype. GGM, MOGU, no. 12/137; Kostroma Region, Manturovo District, ravine near the village of Znamenka; Middle Jurassic, Lower Callovian, *calloviense* Zone, *calloviense* Biohorizon.

Description. The shell is up to 7.1 mm high. The protoconch contains about 3–3.3 smooth whorls. The first whorl of the protoconch is almost planispiral. As the protoconch and teleoconch grew the degree of

Explanation of Plate 6

Figs. 1–7. *Znamenkiella ovalis* sp. nov.; Kostroma Region, Manturovo District, right bank of the Unzha River, ravine near the village of Znamenka; Lower Callovian, *calloviense* Zone, *calloviense* Biohorizon: (1) GGM MOGU, holotype no. 12/137 (height of the shell is 5.2 mm); (2) GGM MOGU, specimen no. 12/138, (2a) general view (height of the shell is 6 mm), (2b) ornamentation (scale 0.1 mm); (3) GGM MOGU, specimen no. 12/139 (height of the shell is 4.2 mm); (4) GGM MOGU, specimen no. 12/140 (height of the shell is 4.6 mm); (5) GGM MOGU, specimen no. 12/141 (height of the shell is 5.4 mm); (6) GGM MOGU, specimen no. 12/142 (height of the shell is 7.1 mm); (7) GGM MOGU, specimen no. 12/143, (7a) apical upper view (shell diameter 2.25 mm), (7b) apical lateral view (scale 0.3 mm).

Plate 6



whorl overlap increased. The border between the protoconch and teleoconch is rarely preserved; it has the appearance of a prosocline rib. The angle of the teleoconch varies from 33° to 50°. The teleoconch consists of 4.5–5 convex whorls. The suture is straight and shallow. The whorls of the spire are low. The ornamentation consists of growth lines and very fine numerous spiral striae. In some shells several more prominent striae may be present in the large whorls. The last whorl is rounded; its height is 50–60% of the shell height. Its lateral side is gradually fused with the high rounded base, which is covered by similar ornamentation. The aperture is oval, with thin lips.

Occurrence. Lower Callovian; Russia, Kostroma Region.

Material. The Lower Callovian, *koenigi* Zone, Kologriv District, village of Burdovo (two specimens); *calloviense* Zone, *calloviense* Biohorizon, Manturovo District, ravine near the village of Znamenka (112 specimens).

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