ISSN 0031-0301, Paleontological Journal, 2018, Vol. 52, No. 7, pp. 796–827.

Early Kazanian (Middle Permian) Gastropods

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Received July 7, 2017

Abstract—Taxonomy and stratigraphic distribution of the Early Kazanian gastropods of the Volga–Ural Region are studied. The material previously studied by Netchaev and collections from the northern areas of the paleobasin previously described by Licharew are reexamined. The Early Kazanian gastropod assemblages comprise 31 species, 20 genera, 16 families; of these four species and one genus are new; 67.7% species are in common with the Late Kazanian assemblages.

Keywords: mollusks, gastropods, morphology, systematics, taxonomy, Permian, Kazanian Stage, Volga–Ural Region

DOI: 10.1134/S0031030118070067

CONTENTS

INTRODUCTION

Gastropods are one of the most important components of the biota of the Kazanian paleobasin. From the Upper Kazanian, only 68 gastropod species have been reported (Mazaev, 2015). Apart from a relatively high diversity, many features of the evolution of this group reflect the unusual nature of the end-Paleozoic epicontinental basin in the East European Platform. While the fusulinids and platform conodonts (i.e., groups currently considered as stratigraphic standards) are absent, mollusks have a high potential to form a basis for a regional biostratigraphic scale of marine sections of the Kazanian Stage (Mazaev, 2016). At the same time, the entire biota of the Kazanian Stage is relatively poorly studied.

Until recently, only four gastropod species were known from the Lower Kazanian Substage; of these, two were incorrectly identified by Licharew (1913) as *Pleurotomaria* aff. *antriana* and *Pleurotomaria (Wortheniopsis) seguens*. Very recently, this small list was augmented by the descriptions of seven species from the Krasnyi Yar Beds on the Sok River (Mazaev, 2016, 2017a, 2017b).

This paper contains taxonomic descriptions of all known Early Kazanian gastropods of both the Volga–Ural Region and adjacent northerly regions.

Despite the relatively high diversity of the species described in this paper, it is still little known about gastropods the Lower Kazanian Substage. First, there is no data on gastropods from the northern sections of the Lower Kazanian paleobasin (outcrops in the Arkhangelsk Region on the Pinega, Kuloi, Soyana, Mezen, and other rivers). At the same time, the number of described gastropod species from the Vologda Region is considerably lower than that indicated by Licharew (1933a, 1933b) in the descriptions of sections. Second, there is no date on gastropods from the outcrops of the Samara Luka, or from the outcrops in the basins of the Ik and Dymka rivers, although Forsh (1955) recorded the presence of gastropods in the sections he studied.

The assemblage of the Lower Kazanian Substage is shown to include 16 families, 20 genera, and 31 gastropod species. Despite that, the diversity of Early Kazanian assemblages and also their species and generic composition differ essentially from the Late Kazanian gastropod assemblages, approximately two-thirds of the species are shared. The new data suggest that the evolution of gastropod assemblages in the Kazanian paleobasin was continuous, with sudden increases in diversity up to the Morkvashi time.

ABBREVIATIONS

The following abbreviations are used in this paper: (TsNIGRM) Chernyshev Central Research Geologi-

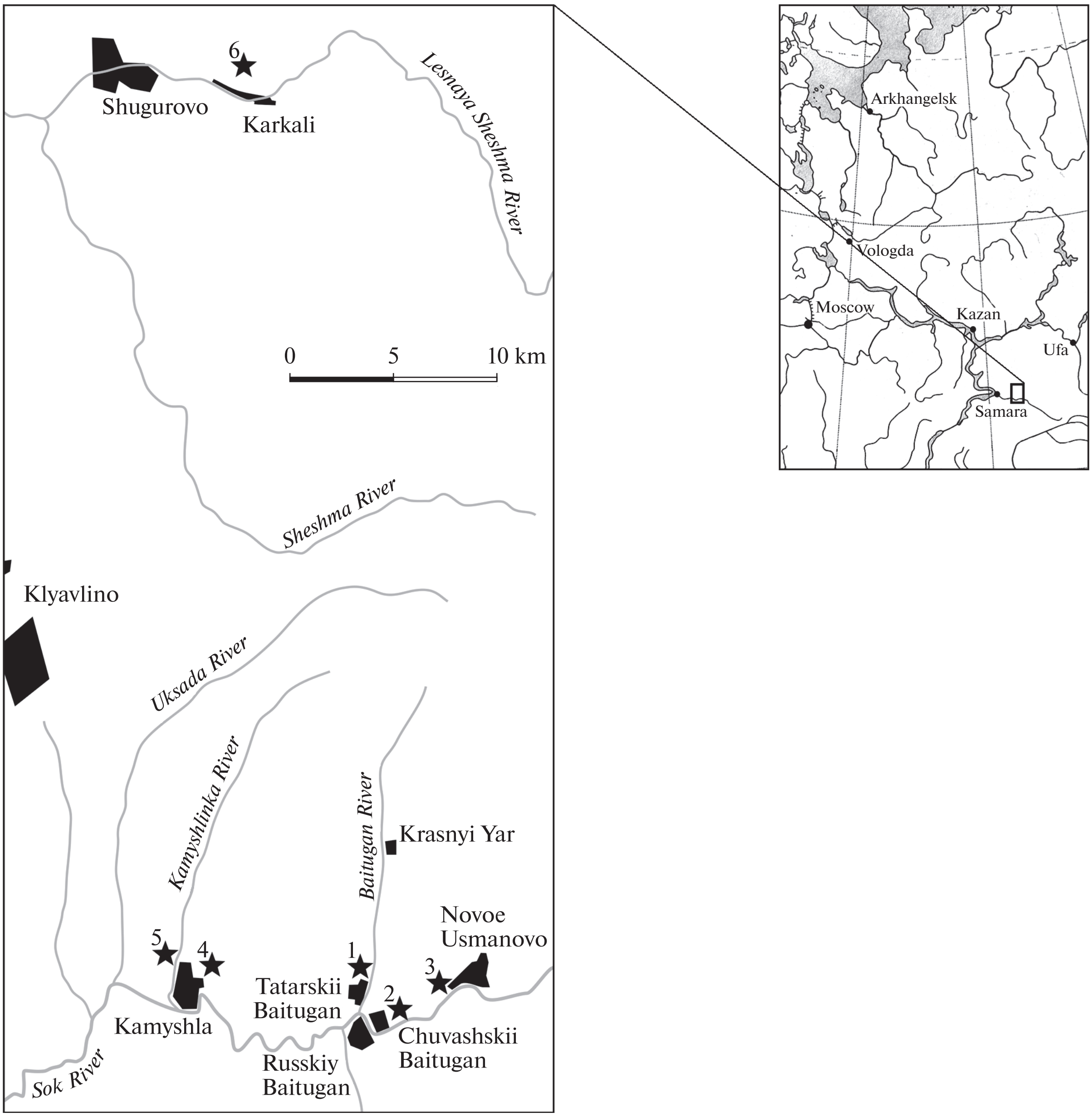


Fig. 1. Localities of Lower Kazanian gastropods at the Sok River and village of Shugurovo: (1) quarry near the village of Tatarskii Baitugan, locality no. 4919/29; (2) outcrop near the village of Chuvashskii Baitugan, locality no. 4919/23; (3) outcrop in the road cut in the village of Novoe Usmanovo; (4) outcrop in the village of Kamyshla, a road cut near the fire service station, locality no. 4919/20; (5) outcrops of solid limestone rocks on the right bank of the Kamyshlinka River; (6) Karkali quarry, locality no. 4919/32.

cal Prospecting Museum; (PIN) Borissiak Paleontological Institute, Russian Academy of Sciences; (KPFU) Kazan Federal University; (KGM) Stuckenberg Kazan Geological Museum; (ICZN) International Code of Zoological Nomenclature.

CHAPTER 1. GENERAL CHARACTERIZATION OF THE LOCALITIES

Gastropod occurrences in the Lower Kazanian deposits are inconsistent, which is reflected in the short list of localities. The most diverse assemblages for Lower Kazanian gastropods are selected from the so-called zone of "marine carbonate and siliciclastic deposits" (Forsh, 1955) of the Trans-Volga region near Samara from several outcrops in the Kamyshla–Baitugan–Usmanovo region (Fig. 1). This area, extending along the right bank of the Sok River, is a stratotype region of the Lower Kazanian Substage (*Resheniya …,* 1962).

The deposits of the Lower Kazanian stratotype region have repeatedly been studied (Forsh, 1951, 1955; Solodukho and Tikhvinskaya, 1977; Esaulova, 1996). Unfortunately, despite the existence of numer-

Fig. 2. Quarry section in the northern vicinity of the village of Tatarskii Baitugan: (1) tar sandstone, (2) basal member of the Baitugan Beds composed of clay, (3) sample locality in carbonate nodules.

ous isolated outcrops, their descriptions, with rare exceptions, are represented by compiled sections with averaged thicknesses of beds and members. Forsh (1951) shows a tripartite, cyclic structure of the Lower Kazanian deposits in the Sok River Basin. He designated two lower cycles as the Baitugan and Kamyshla beds and correlated the upper cycle with the Barbashi Beds, which had previously been recognized in the so-called "zone of carbonate deposits" in the vicinity of Samara (Forsh, 1940, 1955). It was later suggested to name the upper cycle of the Krasnyi Yar Horizon (after the village of Krasnyi Yar, on the Baitugan River), because of the suggestion that the Barbashi Beds corresponded to the Prikazan beds of the Upper Kazanian Substage (Solodukho and Tikhvinskaya, 1977). This is a very unfortunate choice of name because of the synonymy. However, this interval cannot be referred to the Barbashi Beds for a number of reasons, hence, in this paper, this interval corresponding to the terminal part of the Lower Kazanian Substage is referred to as the Krasnyi Yar Beds. All three cycles correspond to the marine stage of sedimentation and are locally underlain by thin-bedded terrigenous–carbonate lacustrine sediments. Ignatiev (1971) called the latter the Bugulma Beds and later proposed it as the basal horizon of the Lower Kazanian Substage (Ignatiev, 1977).

In the stratotype region, the time interval from the Baitugan to Krasnyi Yar time inclusive was characterized by a normal marine environment and/or rapid subsidence. In the Early Baitugan time, this area of the paleobasin was the deepest. However, as the basin evolved, the deposition depth decreased. In the Krasnyi Yar time, the sedimentation was mainly replaced by carbonate and occurred mainly in the shallow-water marine environment. The total thickness of the three cycles, according to the above authors, reached almost 90 m.

The earliest assemblage of Kazanian gastropods was collected from the Baitugan Beds near the village of Chuvashskii Baitugan and in a quarry near the village of Tatarskii Baitugan (localities nos. 4919/23, 4919/29, respectively)[1] (Figs. 1, 2). In each of the localities, the material was collected from the basal part of the Baitugan Beds in the interval 0–3 m from the border with the tar sandstone.

No gastropod remains are found in the Kamyshla Beds, although outcrops of this age are common in the stratotype region.

In the Krasnyi Yar Beds in the stratotype region, gastropods are found in outcrops in the village of Novoe Usmanovo (road cut) (Fig. 3), in the village of Kamyshla (a road cut near the fire service place), and in the horizon of pavement limestone on the right bank of the Kamyshlinka River. All horizons with gastropods contain unstratified, soft brownish yellow limestone with many voids left by leached out shells of mollusk, brachiopods, bryozoans, and crinoids, 0.2–0.5 m of thickness. The limestone contains large unrounded quartz grains and clay inclusions. Over 90% of bioclasts have an eroded surface. Few brachiopods and bivalves are buried in life position. The horizon is underlain by a thick member of barren, dark yellow, compact fiber grains, thin-grained dolomite limestone with broad jointing. It is overlain by a bed of light-colored thin-bedded barren packstone. In many respects this horizon is similar to the Podluzhnik Member of the Upper Kazanian Substage. It was deposited on a shallow marine carbonate platform.

[1] Here and below, see the Chapter LOCALITIES OF EARLY KAZANIAN GASTROPODS.

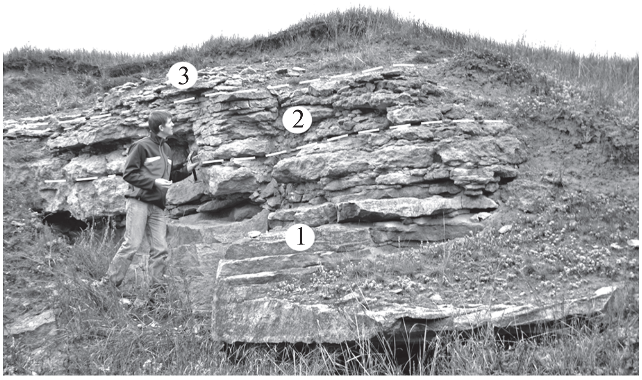


Fig. 3. Limestone of the Krasnyi Yar Beds in the road cut outcrop in the northwestern vicinity of the village of Usmanovo: (1) thick member of barren dark yellow dense fine-grained dolomitized limestone with large jointing, (2) soft, nodular, brownish yellow limestones with many voids of leached shells of mollusks, brachiopods, bryozoans, and crinoids, (3) light-colored barren packstones.

The previous interpretation of this horizon as "bioherm limestone" (Esaulova and Burov, 2003, p. 160, photograph 9) is incorrect.

Mass material from this horizon was collected in the village of Kamyshla (locality no. 4919/20). A part of this material was previously studied (Mazaev, 2016, 2017a, 2017b). This locality is distinguished by the maximum species diversity of Lower Kazanian mollusks.

Sections of the Lower Kazanian Substage in the vicinity of Shugurovo differ considerably from sections in the stratotype region, and their joint assignment to the same "Sok–Sheshma Region" (Forsh, 1955; Esaulova and Burov, 2003) is a source of some confusion. The depositional settings in the vicinity of Shugurovo were in general shallower. These sections feature thick members of blocky cross-bedded sandstones and limestone, the general thickness of which, according to Forsh, can be 20 m. Forsh (1951, 1955) correlated these members with the Kamyshla Beds. In the Karkali quarry, a sandstone member reaches six meters in thickness, and a limestone member can be 10 m thick. Their accumulation is associated with a zone of shoals and bars separating the lagoon and more marine parts of the paleobasin (Forsh, 1951, 1963). The upper members are composed of grainstones and packstones, with lenses of so-called "negative oolites" and large areas of shell pavements. The lower member is composed of monolith cross-bedded sandstone (Fig. 4). A specific feature of these members is sporadically occurring voids of tree trunks up to six meters long (Fig. 5). Trunk imprints are found at various levels, not oriented, and are subhorizontal. The cross-bedded members of sandstones and limestones were deposited in the environment of mobile sands of an oolitic shoal. The depositional settings were not stable, as the sections contain vertical voids left by roots (Fig. 6), ephemeral surfaces of nondeposition and levels corresponding to shallow subsidence, with thin intercalations of clay and marl. Occurrences of gastropods in the Karkali section are extremely rare and are not diverse. A few specimens were collected from a member of cross-bedded oolitic limestone (locality no. 4919/32). The gastropod shells are strongly rounded and scattered throughout the sec-

Fig. 4. Monolith cross-bedded sandstone in the Karkali quarry. Kamyshla Beds.

Fig. 5. Void of a calamite trunk in cross-bedded sandstone in the Karkali quarry.

Fig. 6. Horizons with vertical imprints of roots at the top of cross-bedded sandstones in the Karkali quarry.

tion. The Krasnyi Yar Beds contain large brachiopods and bivalves; no gastropods are found.

North of the village of Shugurovo, at the lower reaches of the Kama River Basin (Nizhnee Prikam'e), Lower Kazanian sections are composed of various facies, moatly of lagoon origin (Fig. 7). Evidently, the salinity of lagoons during the Early Kazanian repeatedly and suddenly changed as well as the depositional settings, which are reflected in a sharp replacement of siliciclastic and carbonate parts of the section. Members of thin-bedded lacustrine carbonates become relatively widespread. In the Bondyuga quarry (near Mendeleevsk), the entire section of which according to Golubev (2001) corresponds to the Baitugan Beds, contain completely different types of rocks. The gastropod fauna found in the carbonate members at the base of the section (Fig. 8) is represented by a few species. The member of gray and light brown sandy limestones with abundant bivalves (Bed 12–14 according to Golubev, 2001) has yielded only one species, *Stuckenbergispira kazanensis*. The member of massive light gray or light yellow limestone (Bed 15–16 after Golubev, 2001) encloses *Goniasma subangulata, Anomphalus barskovi,* and *Naticopsis permica*. The succession of the Bondyuga quarry generally coincides with the section in the quarry near the village of Kolosovka (Fig. 9). According to Forsh (1951), a thick member of oolitic limestone found near the town of Elabuga corresponds to the Baitugan Beds. The limestones are gray, monolithic, with many oolites or their voids, and a thick bed of shell pavement at the top (Fig. 10); the member is up to two meters thick; gastropods are extremely rare, being represented by only one species, *Glabrocingulum lebedewi*. Judging from the imprints, the shells were strongly rounded prior to burial (locality no. 4919/31).

In the Lower Kazanian sections situated northeast of the town of Mendeleevsk, marine carbonates are almost absent. In outcrops of Golyusherma (village of Blagodat'), the marine depositional settings are characteristic of only a small part of the section (Bed 20–22 according to Golubev, 2001), which includes the underlying and overlying siliciclastic members, is correlated with the Baitugan Beds (Golubev, 2001). A few specimens of *Goniasma subangulata* and *Naticopsis koljanuriensis* were collected from approximately the same level. Several specimens were collected from this locality (locality no. 4919/30).

Another gastropod locality was discovered by Bakaev (KPFU) in the Alnashskii District. The rock cut near the dam on the Toima River exposes gray marls, arenaceous and argillaceous limestones, which correlate either with the Baitugan Beds or the Kamyshla Beds (locality no. 4919/33).

CHAPTER 2. MATERIAL, PRESERVATION, AND METHODS OF PREPARATION

This study is based on the collection of N.I. Lebedev (TsNIGRM, coll. no. 26) from a locality near the village of Sandyreva (vicinity of the town of Kirillov, Vologda Region) and material that I collected in the past ten years in the Volga–Ural Region (Trans-Volga region near Samara and Kama Region, coll. no. 4919).

Lebedev's collection is housed in TsNIGRM in two parts: type and figured specimens from Licharew's (1913) work and duplicates. The latter include over 4000 specimens of various fossils. They mostly come from the outcrop near the village of Sandyreva. The collection of Early Kazanian gastropods collected by me in the Trans-Volga region near Samara and Kama Region includes more than 220 specimens; several specimens were received from G.V. Sonin and I. Yusupov (KFPU) and V.K. Golubev (PIN).

The poor preservation of gastropods in the deposits of the Lower Kazanian Substage is the main reason for the poor state of knowledge. The diagnostics of some species described in this paper is largely an interpretation based on the author's experience of studying the

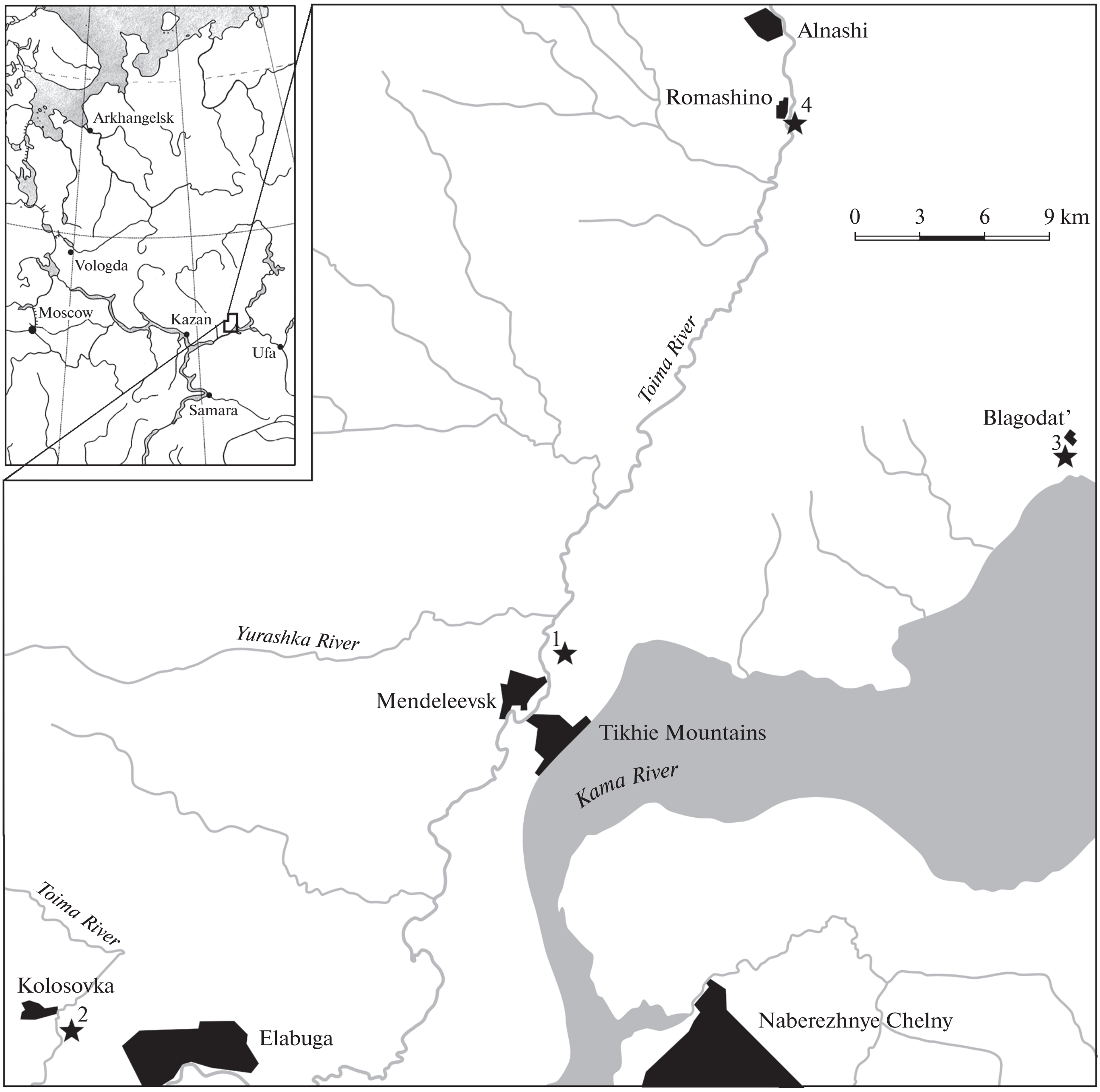


Fig. 7. Locality of Lower Kazanian gastropods in the Lower Kama Region: (1) Bondyuga quarry near the town of Mendeleevsk, locality no. 4919/34; (2) quarry near the village of Kolosovka, locality no. 4919/31; (3) outcrop near the village of Blagodat', locality no. 4919/30, (4) local quarry near the village of Romashkino, locality no. 4919/33.

Upper Kazanian fossil material (Mazaev, 2015). Specimens in the collection are of various states of preservation: fossilized shells, molds, and imprints.

In sandstones, clay, and marl, gastropod shells are often replaced with calcite. In clayey parts of the section with a high pyrite content, such as, for example, in the stratotype region of the Baitugan Beds, shells are largely dissolved. Therefore, while lithified molds are abundantly found, well-preserved shells are only known from a few specimens. The shells were collected from clay manually on-site from the bedding surfaces and also by sieving clay in water.

The most abundant gastropod species in the Baitugan Beds—*Glabrocingulum lebedewi*—is represented mostly by molds (Pl. 14, fig. 10), dozens to hundreds of which cover the weathered surfaces of clayey rocks in the stratotype region. However, over all the time that the region has been studied, no more than ten well-preserved shells were found (Pl. 14, fig. 9; Pl. 16, figs. 10–12). Five specimens of *Eirlysia nodata* are

Fig. 8. Section of the Bondyuga quarry, Baitugan Beds: (1) member of massive light gray or light yellow limestone with gastropods, bivalves, etc. (Bed 15–16, after Golubev, 2001).

Fig. 9. Member of monolith oolitic limestone at the base of a quarry near the village of Kolosovka, Baitugan Beds. Above: member of alternating marl, clay, and sandstone, Kamyshla Beds.

very large, but represented only by molds (collected by G.V. Sonin and I. Yusupov (KPFU)). Rare specimens of *Peruvispira kirillowensis* are mainly represented by molds, and only two, by shells.

In the carbonate–marly nodules of the basal part of the Baitugan clay, the shells are preserved in their entirety, but only rarely it is possible to separate them from matrix with the ornamentation preserved. On the surfaces of nodules covered by fossilized remains of various organisms, gastropods are mainly represented by molds. One of the most abundant species is *Streptacis* sp. 2 (Pl. 20, figs. 14, 15). The residue of washed clay does not contain this species; apparently, this is explained by the dissolution of shells during or after lithification of the sediment.

Carbonate nodules were collected from the outcrops and cleaned with a brush under water. The shells found in siliciclastic sediments, marl and carbonate nodule were cleaned under a binocular microscope in a bowl of water using thin needles and brushes.

Relatively large stratigraphic intervals contained no gastropod remains. For instance, despite the presence of abundant remains of brachiopods, bryozoans, corals, and other taxa in the Kamyshla Beds in the stratotype region, gastropods are absent, which is possibly explained by the dissolution of aragonite shells at some stages of sediment lithification. *Goniasma subangulata*, the most common eurybiont species, is absent from these localities.

In the Lower Kazanian carbonates, gastropod shells are usually completely leached out. The leached voids, if they are not refilled by calcite or gypsum, are ideal objects for study. The best latex casts can be made from imprints in micritized limestone, known, for instance, from the localities of the Upper Kazanian reef bodies of the Vyatka Swell. However, in the Lower

Fig. 10. Thick bed of coquina pavement at the top of oolitic limestone in a quarry near the village of Kolosovka.

Kazanian localities, mollusk imprints are only found in coarse-grained and porous limestone.

In one of the richest Lower Kazanian localities (Kamyshla, locality no. 4919/20), all bioclasts are dissolved, including brachiopod shells and crinoid ossicles. The quality of imprints collected from one block of rocks varies considerably. Good-quality imprints comparable to the well-preserved specimens in micritized limestone are rare (Pl. 15, fig. 5; Pl. 19, fig. 7), whereas unidentifiable strongly distorted imprints are somewhat more common. Most imprints are of shells with their surfaces to some extent rounded, but because many of these have a thin apertural margin or some elements of ornamentation (Mazaev, 2016, 2017a, 2017b), the material preservation was previously generally cited as satisfactory. This type of preservation is well known from the material from the Late Kazanian localities in the Podluzhnik Member. However, the quality of imprints in this locality is considerably lower than in the Podluzhnik Member. As previously suggested, this kind of preservation is caused by karst. Subsequent study of the material showed that the extent of roundness of shells in different species varies and cannot be entirely attributed to physical causes. Evidently, shell fragments with acute edges (Pl. 15, fig. 6), which are sometimes found in this locality, result from fish bites. This is indirectly supported by the presence of many shells with one or more healed lifetime injuries (Pl. 15, fig. 5a, Pl. 18, fig. 2b)[2]. It is most likely that the altered shell surfaces in this locality as well as in the localities of the Podluzhnik Member are associated not only with a high-energy environment, but more importantly, with the partial dissolution of the shell material at a stage preceding sediment lithification. Thus, the shell surface in these specimens is eroded rather than rounded. Imprints of the truly rounded shells are found on facies of mobile oolitic shoals (localities nos. 4919/31, 4919/32), and sometimes in the Nemda reef facies.

Usually, in the rounded shells, ornamentation, apertural margin, and apical whorls are polished off, whereas on the eroded shells, the nature of changes in morphological characters is different.

The uneven dissolution of different shell layers and different thicknesses of these layers lead to an increase in the depth of the sutures and changes in the whorl surface profile. In some cases, the dissolution of the outer shell layer possessing ornamentation results in the etching of growth lines. Shell imprints lacking ornamentation, but possessing clear, sometimes very sharp growth lines are quite common. Depending on the length of the subfossil stage, the shell morphological characters are altered to varying extents. Therefore, the same oryctocoenosis may contain shells of the same species with a completely different set of characters, often not found in normally preserved shells. The determination of the degree of alteration of the shell surface is complicated by the presence in many of them of an entire, sometimes very thin apertural margin, and growth lines. The preservation of these elements can be mistaken for a satisfactory state of preservation of the material. The interpretation of changes in shell morphology due to their long stay in the sediment is often complicated by the subsequent change in the imprints caused by karst. Thus, locality no. 4919/20 due to the effect of the above factors contains the same species in different states of preservation.

The study of the states of preservation of *Goniasma subangulata, Glabrocingulum lebedewi, Eirlysia undata*, and some other species from the same locality suggests that the two species, *Goniasma golowkinskii* and *Sokella sokensis*, are in fact the states of preservation of *Goniasma subangulata* and *Baylea nemdaensis*, respectively.

Imprints of shells of *G. subangulata* in locality no. 4919/20 are found in four states of preservation[3]. This state of preservation is also found in the Podluzhnik Member, but previously this phenomenon was not sufficiently studied[4]. For example, one of the specimens (Mazaev, 2015; pl. 24, fig. 2) is almost devoid of spiral ornamentation elements, has a deep suture, and at the same time has a deep notch. The latter suggests that this imprint is well preserved. Such imprints were found relatively frequently in most localities of the Kazanian Stage. In fact, they belong to shells, in which the suture depth, the whorl profile, and ornamentation elements above and below the selenizone were altered during dissolution. Imprints in Verneuil's (1845, pl. 22, fig. 6) specimen lack ornamentation. Specimens of *Goniasma golowkinskii* lack spiral ornamentation above and below the selenizone, whereas the selenizone has several rows of pits (Yakovlev, 1899, p. 33, pl. 4, figs. 26, 27). Shells of this species, the surface of which was not affected by dissolution, have a different set of characters: the surface is covered by spiral ribs, the selenizone is delineated by well-developed ribs, and the suture is thin. The whorl surface also has differences, which is explained by the uneven thickness of the outer layer, which is present to a varying extent in shells with eroded surface.

The diagnostic characters of *Sokella sokensis* correspond to the state of preservation of *Baylea nemdaensis*. This species is represented in the Baitugan Beds by two states of preservation: molds and shells

[2] Shells with healed injuries are also found in Upper Kazanian localities of the Podluzhnik Member (Mazaev, 2015: pl. 11, fig. 7; pl. 13, figs. 11, 12; pl. 22, fig. 3; pl. 24, fig. 2; pl. 27, fig. 3; pl. 29, fig. 10; pl. 34, fig. 12; pl. 38, fig. 2; pl. 39, fig. 2; pl. 40, figs. 7, 8).

[3] See remarks in the species description.

[4] In siliciclastic rocks, *G. subangulata* is found either as lithified molds, or as shells replaced by calcite. The surface of the latter is usually rounded prior to the burial and/or dissolved during weathering. In such specimens, the sutures are very deep.

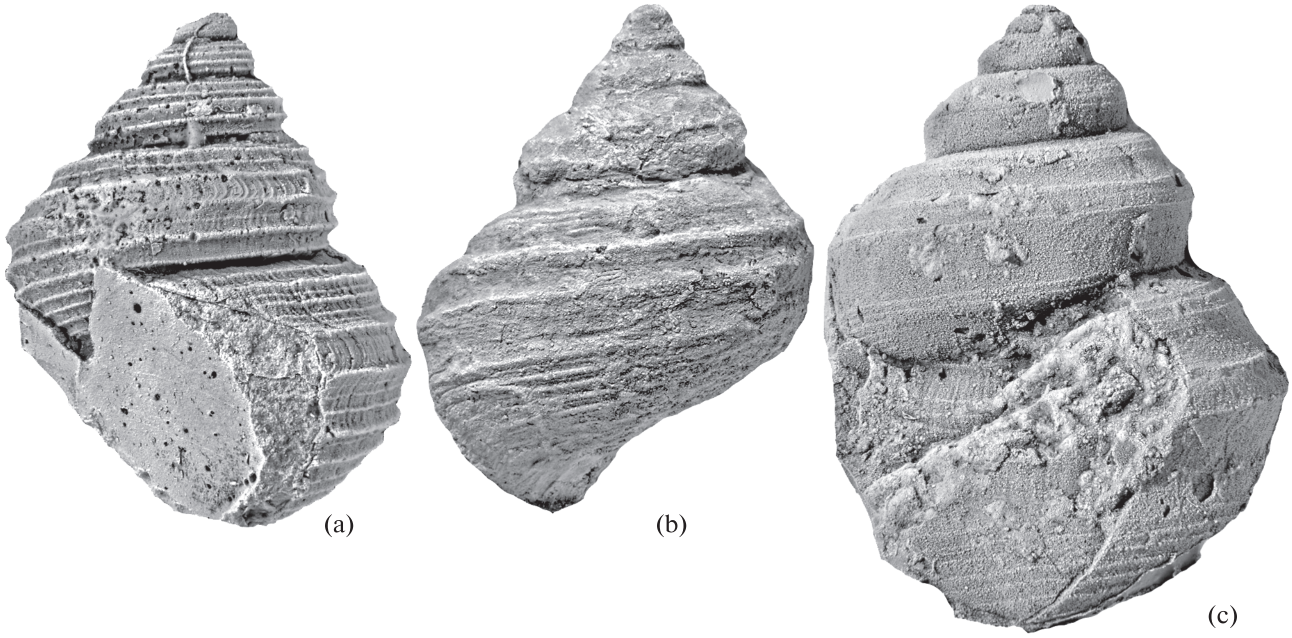


Fig. 11. Forms of preservation of *Baylea nemdaensis:* (a) holotype PIN, no. 4919/19-305, latex cast from an imprint in micritic limestone, ornamentation of satisfactory preservation; (b) specimen PIN, no. 4919/29-22, fossilized shell from a carbonate nodule of Baitugan clay, poorly preserved ornamentation; (c) specimen PIN, no. 4919/20-220, latex cast, only large spiral ribs are preserved, the rib thickness and cross sections are strongly altered.

with poorly preserved spiral ribs of the first and second order, while the elements of the selenizone are poorly preserved (Fig. 11b). Casts of shells from micritized limestone in the Chimbulat section show apparently the best kind of preservation found in this species (Fig. 11a). The comparison of these specimens certainly indicates the identity of many characters of definitive whorls: whorl profile, wide selenizone and its position, subsutural lira, ornamented at least by three ribs, well-developed ribs of two orders. However, the preservation of the shell surface of specimens from the Baitugan Beds could hardly be called satisfactory. On the other hand, the preservation type of Baitugan specimens allows their comparison with specimens from the Krasnyi Yar Beds of locality no. 4919/20, which were chosen as types of *Sokella sokensis* (Fig. 11c). The width and position of the selenizone, whorl profile, and ornamentation of the subsutural lira almost coincide. Therefore, the type series of *Sokella sokensis* represents nothing else than imprints of strongly altered shells of *Baylea nemdaensis*, almost completely devoid of spiral ornamentation. Unfortunately, specimens of *B. nemdaensis*, which were a connecting link in this interpretation, were not collected from the Baitugan Beds until summer 2016, and were only studied in 2017, after the work on the description of *Sokella* had been completed, and so too late to be included in Mazaev (2017b).

The forms of preservation of the shells of *Glabrocinglum lebedewi* are quite diverse. Several specimens from the Baitugan Beds preserved as fossilized shells (Pl. 16, figs. 10–12) and also imprints described by Licharew (1931, p. 3, pl. 1, figs. 4–8, 10) possess thin ornamentation. At the same time, locality no. 4919/20 contains shell imprints of this species or has a completely smooth surface, but with a selenizone bounded by two spiral ribs (Pl. 3, fig. 6), or almost devoid of spiral ornamentation, but with sharp growth lines and a pronounced umbilical callus (Pl. 16, figs. 7, 8). Imprints have growth lines and very often a complete aperture with a notch. Such a considerable change in the shell appearance and the presence of an intact aperture and growth lines can only be explained by dissolution of the external shell layer. This type of preservation is observed in locality no. 4919/31; however, the absence of ornamentation on imprints is not related to the dissolution of the shell surface, but caused by intense mechanical rounding before burial.

Some imprints of *Eirlysia undata* also belong to shells where the surface was strongly altered. The ornamentation is either partly lacking sculptural elements (Pl. 15, fig. 1), or spiral elements completely disappear, while the selenizone remains (Pl. 15, fig. 3).

The shell surface of *Peruvispira kirillowensis* had apparently also been eroded before the sediment lithified: the ornamentation above and below the selenizone is absent, but spiral ribs delineating the selenizone are thin and the lunules on the selenizone are readily discernible. Interestingly, thin elements of the selenizone exclude any doubt of the good preservation

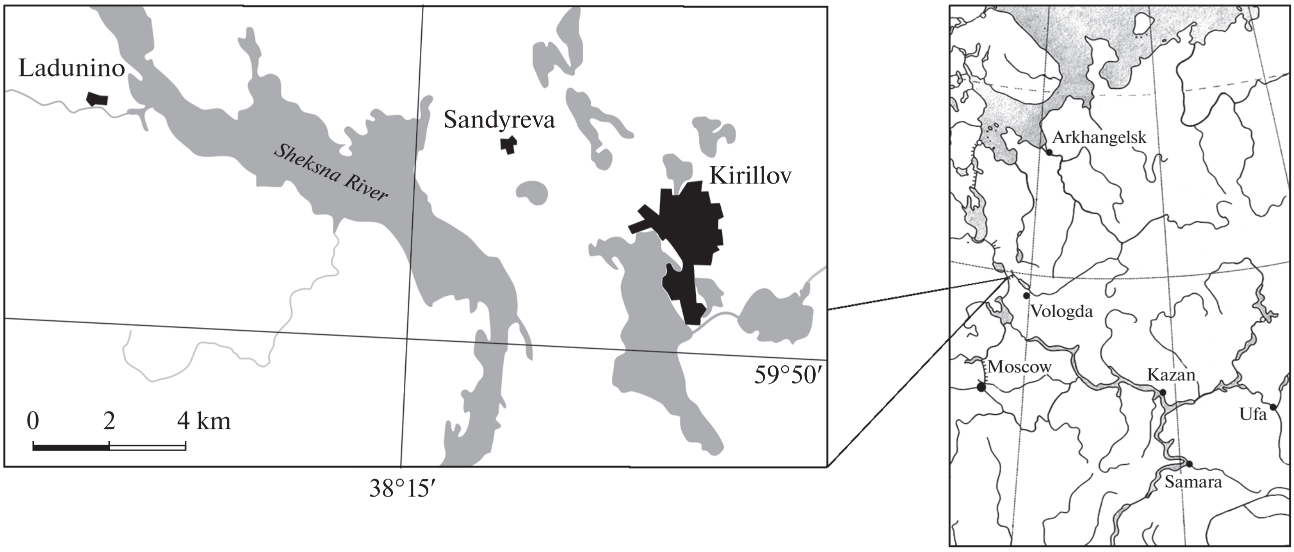


Fig. 12. Lebedev locality in the vicinity of the town of Kirillov; for explanation, see the text.

of this material. At the same time, in shells from Lebedev's collection, the surface above and below the selenizone is ornamented, whereas elements of the selenizone are more massive. If that is not a manifestation of variability, such alterations could only result from partial dissolution of the shell matrix.

Imprints of other species from this locality, with rare exceptions, are not well preserved, although still suitable for identification. It is important that the degree of shell erosion is associated with the taxonomic affinity of the species. For example, shells of *Baylea praeburtasorum* and *B. viatkensis* are relatively little eroded (see Mazaev, 2016); at the same time, more than 46 specimens[5] of *B. nemdaensis* (previously described as *Sokella sokensis*) do not include any specimens with preserved spiral ribs. The same degree of erosion is present in all specimens of *Biarmeaspira*. In specimens of *Baylea shilovskyi,* the degree of erosion is observed in various ways. The set of specimens of *Glabrocingulum lebedewi* includes a few specimens completely lacking ribs, except for the selenizone, whereas in other specimens, the ribs are very thin. Most shells of *Klavlia* and a few small specimens of *Anomphalus* have fine ornamentation. Evidently, the degree of dissolution of the shell depended not only on the duration of their subfossil stage but also on the nature of their surface.

All specimens were coated with ammonium chloride for photography. Specimens were photographed using a Nikon D7000 camera and processed using Helicon Ltd© software. Most measurements were taken from photographs.

[5] Even more specimens of this species were excluded from this study during the preparation stage due to poor preservation.

CHAPTER 3. REVISION OF COLLECTIONS OF A.V. NETCHAEV AND B.K. LICHAREW

Gastropods from the Lower Kazanian Substage were described for the first time by Netchaev (1894) as two species: *Euomphalus pawlowi* Netchaev, 1894 and *Pleurotomaria saranaeana* Stuckenberg, 1894. The specimen of the first species was a deformed mold of *Glabrocingulum lebedewi*, and all specimens identified by Netchaev as *Pleurotomaria saranaeana* were juvenile shells of *Peruvispira kirillowensis*.

Later, Licharew (1913) studied rich Lebedev's collection from the vicinity of the town of Kirillov (Vologda Region) (Fig. 12). Traditionally, all species described by Licharew were considered as having been from one Lower Kazanian assemblage. However, the study of the types (coll. TsNIGRM, no. 26) showed that material from the village of Ladunina is in fact Carboniferous. From this locality, Licharew described six gastropod species. Other six species come from the natural outcrop near the village of Sandyreva and are certainly Early Kazanian. A more precise stratigraphic positioning is not possible because of the absence of detailed stratigraphic schemes of the Lower Kazanian Substage of this region. No species in common with the first locality are found. The specimen described as *Patella (Lepetopsis)* sp. represents a polyplacophoran plate. Several large and deformed specimens identified by Licharew as *Pleurotomaria* aff. *antriana* Schlotheim belong either to *Eirlysia nodata*, or to *E. undata*, but a more precise identification is precluded by their poor state of preservation. The description of these specimens is not accompanied by illustrations; therefore, they were not included in the collection of type and figured specimens of Licharew and are housed in the duplicate collection (coll. TsNIGRM, no. 26). In addition, descriptions were completed before the specimens were numbered; they were numbered much later, after the paper was published. The only specimen from the village of Sandyreva identified as *Pleurotomaria (Wortheniopsis) seguens* Waagen represents a very well-preserved shell of *Baylea praeburtasorum*[6]. Licharew assigned two more species to *Pleurotomaria: Peruvispira kirillowensis* (Licharew, 1931) and *Glabrocingulum lebedewi* (Licharew, 1913). Another incomplete specimen of *G. lebedewi* from this locality was misidentified as *Murchisonia* sp. Thus, Licharew in fact described only four gastropod species from this locality.

Later, after quite some time, the results of geological mapping in the basin of the Northern Dvina River in the Shenkursk–Vel'sk region, conducted by Licharew (1933a, 1933b) from 1917 to 1926, were published. Licharew recorded abundant fossils in the Ust'-Vaga series, including 12 gastropod species. Unfortunately, in the paper describing faunal remains of the Kazanian Stage of the northern territories, he described only one gastropod species (Licharew, 1931), which he had previously established (*Glabrocingulum lebedewi* was this time assigned to the genus *Gosseletina*). The gastropod types for this paper have been lost. Interestingly, at that time, Licharew (1919, 1933a) correlated the fossils from the Uts'-Vaga Formation with both the Kirillov fauna and "Conchifera Series" of the eastern part of the basin, i.e., with the Upper Kazanian Substage. Licharew based his conclusion on the low number of "*Spirifer*" and also on the absence of the taxa "characteristic of the *Spirifer* Substage—... *Pleurotomaria saranaeana* and *Euomphalus pawlowi*... indicated by Netchaev" (Licharew, 1933a, p. 49, abbreviations by the author). In other words, in the studied material, Licharew could not recognize species previously described by Netchaev. The poor preservation of Netchaev's material, stylized pencil drawings, which only approximately resemble the general shell outlines, could not provide a reliable basis for identification of morphological characters. This only became evident during the current study, after the types from these authors' collections were studied.

[6] Two imprints from the village of Ladunino, which Licharew also identified as *Pleurotomaria (Wortheniopsis) seguens*, belong to a Carboniferous species of *Baylea*.

CHAPTER 4. SYSTEMATIC PALEONTOLOGY

Family Eotomariidae Wenz, 1938

Genus *Peruvispira* Chronic, 1949

Peruvispira kirillowensis (Licharew, 1913)

Plate 14, figs. 1–8

Pleurotomaria saraneana: Netchaev, 1894, p. 332, pl. 12, figs. 10, 11 (non *Pleurotomaria saraneana* Stuckenberg, 1894).

Pleurotomaria (Ptychomphalus?) kirillowensis: Licharew, 1913, p. 12, pl. 5, figs. 3, 4.

L e c t o t y p e. TsNIGRM, collection no. 26, specimen no. 137; Vologda Region, vicinity of the town of Kirillov, village of Sandyreva; Lower Kazanian; collection of Lebedev.

D e s c r i p t i o n. The shell is small, conical, of five–seven rapidly expanding, sharply angular whorls.

The protoconch is of two smooth whorls and rounded in cross section, pea-shaped, raised over the teleoconch, around 0.35 mm in diameter.

The first teleoconch whorl is ornamented with cordlike spiral ribs, which delineate the selenizone; the whorl surface above and below the selenizone is sharply concave. A sharp bend is formed between the lateral and basal surfaces at the end of the whorl.

Adult teleoconch whorls. The selenizone is wide, located in the whorl periphery, strongly concave in profile, and almost flat in the last whorl, ornamented with sharp, cordlike lunules. The distance between the lunules exceeds their width. The suture is very thin, distinct, and impressed. The upper whorl surface is ornamented by weak, variously pronounced collabral lirae or wrinkles. Their shape coincides with the shape of the growth lines. The profile of the whorl upper surface in the first two–three whorls is distinctly concave; beginning with the fourth whorl, it is sharply convex below the suture and distinctly concave above the selenizone. The width of the upper whorl surface gradually increases as the shell grows; in the first whorl, it is the same as the selenizone width, while in the last whorls, it is more than 3.7 times as wide as the selenizone. The whorl lateral surface is located immediately below the selenizone, narrow, almost as wide as the selenizone, from straight to weakly concave in profile, ornamented with collabral lirae, which in most specimens are very weak and, in some specimens, are sharp and cordlike. The spaces between the lirae are always smaller than their width; the shape of the lirae follows the shape of the apertural margin. The lateral and

E x p l a n a t i o n o f P l a t e 14

Figs. 1–8. *Peruvispira kirillowensis* (Licharew, 1913). All specimens ×7, except fig. 8; (1–4) Vologda Region, vicinity of Kirillov, village of Sandyreva, Lower Kazanian, fossilized shell: (1) lectotype TsNIGRM, no. 137/26: (1a) apertural view, (1b) abapertural view; (2) specimen TsNIGRM, no. 103/26, (3) specimen TsNIGRM, no. 100/26, (4) specimen TsNIGRM, no. 101/26; (5–8) Samara Region, village of Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, latex casts: (5) specimen PIN, no. 4919/20-31, (6) specimen PIN, no. 4919/20-181, (7) specimen PIN, no. 4919/20-30, (8) specimen PIN, no. 4919/20-180, ×15: (8a) oblique top view, (8b) lateral view.

Figs. 9 and 10. *Glabrocingulum lebedewi* (Licharew, 1913). All ×3. Samara Region, Tatarskii Baitugan, locality no. 4919/29, Baitugan Beds: (9) specimen PIN, no. 4919/29-1, fossilized shell, coll. of G.V. Sonin; (10) specimen PIN, no. 4919/29-5, mold: (10a) lateral and (10b) apertural views.

Plate 14

basal surfaces are separated by a sharp shoulder sometimes forming a massive carina. The lateral surface is wide, almost straight in profile. A relatively narrow umbilical shoulder is present. The surface is smooth or with wide spiral cordlike lirae with narrow spaces between them. The umbilicus is absent. The aperture is almost rounded. The columellar lip is long, massive, arched, and forms an elongated ramp, which expands basally and gradually becomes a thin basal lip. The outer lip above and below the notch is very thin. The depth of the notch is unknown. The growth lines are thin, prosocyrtic below the suture, closer to the selenizone, almost straight, inclined prosoclinally at 45°; on the lower surface of the whorl below the selenizone weakly prosocyrtic, slightly prosoclinic, gradually continuing onto the basal surface, where they are almost straight or weakly prosocyrtic.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-181	7.3	9.9
4919/20-31	≈7.5	>9.7
4919/20-180	3.2	>3.6
4919/20-30	>4.1	>5.2

V a r i a b i l i t y. The transition of the lateral surface into the basal surface in most specimens is very sharp, almost angular; in a few specimens from Lebedev's collection, it is marked by a lira, sometimes very massive. The absence in specimens from locality no. 4919/20 of developed ornamentation is most likely not a manifestation of specific variability, but reflects the type of preservation.

C o m p a r i s o n. It is distinguished from *P. elegans* (Fletcher, 1958) by the less pronounced shoulder between the lateral and basal surface, which is never marked by a spiral lira. It differs from *P. fletcheri* Waterhouse, 1987 in the wider whorl upper surface.

R e m a r k s. Permian species of *Peruvispira* lacking prominent collabral ornamentation are relatively rare and known from eastern Australia (Fletcher, 1958; Waterhouse, 1987). Unfortunately, due to poor preservation, their identification cannot be precise or complete. *Peruvispira elegans* was originally described as a species of *Pleurocinctosa* (Fletcher, 1958), although *Pleurocinctosa* is apparently a junior synonym of *Peruvispira* (Knight et al., 1960; Dickins, 1961; Taboada et al., 2015).

Licharew's types of this species are lost. A lectotype is designated herein from the type series.

O c c u r r e n c e. East European Platform, Lower Kazanian.

M a t e r i a l. In total 12 specimens: ten from locality no. 4919/20 and two from locality no. 4919/23. More than 150 specimens in coll. TsNIGRM, no. 26 (duplicate material coll. of Lebedev).

Genus *Glabrocingulum* Thomas, 1940

Glabrocingulum lebedewi (Licharew, 1913)

Plate 14, figs. 9 and 10; Plate 16, figs. 6–12

Pleurotomaria penea: Barbot de Marnie, 1868, p. 208 (non *Pleurotomaria penea* Verneuil, 1845).

Euomphalus pawlowi: Netchaev, 1894, p. 353, pl. 1, fig. 1.

Pleurotomaria lebedewi: Licharew, 1913, p. 14, pl. 5, figs. 9 and 10.

Murchisonia sp.: Licharew, 1913, p. 10, pl. 5, fig. 7.

Pleurotomaria (Gosseletina) lebedewi: Licharew, 1931, p. 3, pl. 1, figs. 4–8, 10.

L e c t o t y p e. TsNIGRM, collection no. 26, specimen no. 14; Vologda Region, vicinity of the town of Kirillov, village of Sandyreva; Lower Kazanian; collection of Lebedev.

D e s c r i p t i o n. The shell is small, trochiform. The height is approximately three-fourths of the maximum diameter, composed of five–six whorls. The protoconch is very small, indiscernible in available material. The suture is distinct, shallow, or channeled. The subsutural ramp in the last whorl is wider than the lateral surface, inclined to the horizontal plane at 45°–50°, in profile moderately convex or moderately concave. In the first whorls, the profile of the subsutural ramp is always convex. The ornamentation of the subsutural ramp is formed of 10–15 cordlike spiral lirae of the same height, while thin auxiliary lirae are rarely observed. The collabral lirae, if present, occur near the suture as thin, sometimes closely spaced wrinkles; their intersection with the more massive spiral lirae form reticulate ornamentation near the suture. The selenizone is relatively wide, delineated by two massive cordlike lirae, the thickness of which exceeds the thickness of other spiral lirae. In most specimens, another massive spiral lira runs in the middle of the selenizone. The selenizone is flattened or weakly convex in profile. The lower selenizone lira marks the whorl periphery; the selenizone is generally inclined at 70°–80°. The lateral surface under the selenizone is concave in profile, basally convex, gradually and evenly continues as a convex basal surface; around 20 cordlike spiral lirae are between the selenizone and umbilicus, like on the subsutural ramp; spaces are either thin and channeled, or wider than the ribs themselves. The umbilicus is either slitlike, or almost completely covered by an exceptionally massive flattened turnout of the columellar lip. The lower part of the columellar lip forms a wrinkled or smooth massive circumumbilical callus. The aperture is complex in shape. The columellar lip is short, sharply arched, gradually curved, gradually becomes a relatively long, thin, and curved basal lip. The outer lip above and below the notch is very thin. The parietal region of the aperture is very wide. The notch is deep, up to one-fifth of the whorl length. The growth lines are very thin, prosocyrtic or almost straight on the subsutural ramp, prosoclinally inclined, and prosocyrtic immediately below the selenizone; further on, they are inclined prosoclinally, almost directly in the central region of the basal surface, although they are opisthocyrtic in the periphery near the circumumbilical callus.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-236	9.8	13.4
4919/20-243	8.3	9.6
4919/20-311	10.7	≈13.8
4919/20-312	10.2	>11.3
4919/29-2	15.0	17.4
4919/29-3	12.7	15.5
4919/29-4	11.2	>12.8

Comparison. *G. lebedewi* is similar to *G. stankovskyi* Mazaev, 2006, differing in the wider subsutural ramp, which in all whorls, except the last one, is convex in cross section and lacks a subsutural lira and in the smooth transition of the lateral surface to the basal one. It is distinguished from *G. ferganicum* Licharew, 1967 by the less developed collabral ornamentation, the absence of the umbilicus, and by the massive collabral lip and circumumbilical inducture. It is distinguished from *G. texanum* Batten, 1989 by the more strongly embracing whorls: the last whorl is more than three-fourth of the shell height.

Remarks. The lectotype is designated from Licharew's type series (1913, pl. 5, fig. 9). Later, Licharew (1931) essentially emended the diagnosis of the species, but the types for this paper are lost.

Evidently, *Glabrocingulum lebedewi* is a junior synonym of *Euomphalus pawlowi*. The latter was described by Netchaev based on a single specimen found in the vicinity of the village of Enbulatovo (Karla River) in "the limestone interbed among the strata of the Tatarian Stage" (Netchaev, 1894, p. 353). In fact, this specimen comes from an isolated block of Lower Kazanian limestone. According to Netchaev's illustration (Netchaev, 1894, p. 353, pl. 1, fig. 1), the specimen is represented by a deformed mold. Its size and shape coincides completely with the size and shape of numerous molds of *Glabrocingulum lebedewi* from the Baitugan and Krasnyi Yar beds in the stratotype region on the Sok River (Pl. 1, fig. 10, undeformed mold). Although the molds lack any diagnostic characters, in this case, they certainly belong to the same species, because other gastropod species with molds of such shape are absent in the Kazanian Stage. Thus, *Euomphalus pawlowi* should be considered as a *nomen oblitum*, although the use of the junior synonym, which is here proposed as a *nomen protectum* does not meet the conditions of Article 23.9.1.2 of the *International Code of Zoological Nomenclature.*

The states of preservation of the shells of *Glabrocingulum lebedewi* are diverse[7]. The shell is rarely preserved. As the shell is replaced by very soft calcite, the finest elements of ornamentation, primarily growth lines, are lost.

[7] The state of preservation is described in detail in the Chapter "Preservation of material."

Occurrence. East European Platform, Lower Kazanian.

Material. In total 67 specimens: 44 from locality no. 4919/20, six from locality no. 4919/23, 13 from locality no. 4919/29, and four from locality no. 4919/31. In addition, there are also about a hundred internal molds from localities nos. 4919/23 and 4919/29.

Family Gosseletinidae Wenz, 1938

Genus *Globodoma* Mazaev, 2006

Globodoma divesouralica (Golovkinsky, 1868).

Plate 16, figs. 1 and 2

Pleurotomaria portlockiana: Pictorsky, 1867, p. 503, pl. 10, fig. 5 (non *Pleurotomaria portlockiana* Koninck, 1844).

Pleurotomaria dives-ouralica: Golovkinsky, 1868, p. 108, pl. 5, fig. 6; Netchaev, 1894, p. 330, pl. 11, figs. 23–24.

Tretospira dives-ouralica: Yakovlev, 1899, p. 53, pl. 5, figs. 2, 11, and 12.

Globodoma divesouralica: Mazaev, 2006, p. 49, Mazaev, 2015, p. 891, pl. 5, figs. 2–5.

Description. See Mazaev, 2015, p. 891.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-201	2.9	2.3
4919/20-202	>2.5	>2.2

Remarks. The Lower Kazanian specimens are found only in locality no. 4919/20, where they are represented by imprints of juvenile shells.

Occurrence. Volga–Ural Region: Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage: reef limestones of the Nemda River region, Podluzhnik Member of the Verkhnii Uslon Beds.

Material. Two specimens from locality no. 4919/20 and 22 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Phymatopleuridae Batten, 1956

Genus *Eirlysia* Batten, 1956

***Eirlysia undata* Mazaev, 2015**

Plate 15, figs. 1–3

Eirlysia undata: Mazaev, 2015, p. 893, pl. 6, figs. 2 and 3.

Description. See Mazaev, 2015, p. 893.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-169	6.6	≈7.3
4919/20-175	7.1	5.9
4919/20-176	5.7	6.3

V a r i a b i l i t y. One specimen (Pl. 2, fig. 2) has distinct short collabral wrinkles on the subsutural margin.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian: Baitugan and Krasnyi Yar beds; Upper Kazanian Substage: reef limestones of the Nemda River region, Podluzhnik Member, Verkhnii Uslon Beds.

M a t e r i a l. Six specimens from locality no. 4919/20 and 14 from the Upper Kazanian Substage (see Mazaev, 2015).

***Eirlysia nodata* Mazaev, 2015**

Plate 15, figs. 4–8

Eirlysia nodata: Mazaev, 2015, p. 895, pl. 6, fig. 6, pl. 7, figs. 1 and 2.

D e s c r i p t i o n. See Mazaev, 2015, p. 895.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-59	>12.7	⩾12.5
4919/20-170	6.9	8.2
4919/20-171	≈9.2	≈10.5
4919/20-352	⩾11.0	⩾11.0
4919/29-17	>23.8	>22.2

V a r i a b i l i t y. Specimens studied, like in the Upper Kazanian samples of this species, include shells with a distinct reticulate ornamentation formed by massive cordlike collabral and spiral ribs. One specimen is distinct in having a massive collabrally elongated inflation of the subsutural lira (Pl. 15, fig. 4).

C o m p a r i s o n. This species is very similar to *E. verneuili* (Geinitz, 1848), from which it differs in the smaller shell height and well-developed subsutural lira.

R e m a r k s. The position and morphology of the selenizone, and the whorl profile of two species, *Pleurotomaria verneuili* Geinitz, 1848 (for a complete synonymy list, see: Hollingworth and Barker, 1991, p. 355) and *Pleurotomaria antrina* (Schlotheim, 1817) (for a complete synonymy list, see: Hollingworth and Barker, 1991, p. 351), correspond to the diagnostic characters of *Eirlysia* and apparently, should be placed in this genus. The ornamentation of the former species is typical of the genus. Shells of the latter species, like *E. seminuda* Mazaev, 2015, lack ornamentation, except the ornamentation of the selenizone.

Five large molds of *E. nodata* were found in the Baitugan Beds (locality no. 4919/29).

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Baitugan and Krasnyi Yar beds; Upper Kazanian Substage: reef limestones in the Nemda River area, Podluzhnik Member, Verkhnii Uslon Beds.

M a t e r i a l. Ten specimens from the Lower Kazanian Substage: five from locality no. 4919/20 and five from locality no. 4919/29, and also 23 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Genus *Baylea* Koninck, 1883

Yvania Fisher, 1885: Weller, 1929, p. 10;

Sokella: Mazaev, 2017b, p. 9;

Baylea: Knight et al., 1960, p. I203; Mazaev, 2015, p. 902.

R e m a r k s. Previously (Mazaev, 2016), four species were described from the Krasnyi Yar Beds, locality no. 4919/20: *B. subpenea* (Netchaev, 1894), *B. vjatkensis* Mazaev, 2015, *B. praeburtasorum* Mazaev, 2016, and *B. shilovskyi* Mazaev, 2016. In 2016, samples were collected from the Baitugan Beds, which contained early representatives of the genus in the Kazanian Stage: *B. vjatkensis* and *B. nemdaensis*.

As the type species of the genus *Sokella*, *S. sokensis,* turned out to be a a form of preservation of *B. nemdaensis*, the genus *Sokella* is a junior synonym of *Baylea*.

***Baylea vjatkensis* Mazaev, 2015**

Plate 16, fig. 3

Turbo thompsonianus: Netchaev, 1894, p. 348, pl. 11, fig. 16 (non *Turbo thompsonianus* King, 1850).

Baylea vjatkensis: Mazaev, 2015, p. 914, pl. 14, figs. 1–13; pl. 15, figs. 3–12; text-figs. 11b and 11c; Mazaev, 2016, p. 58, text-figs. 3k–3m, 7.

D e s c r i p t i o n. See Mazaev, 2015, p. 914.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/23-2	5.2	⩾3.35

E x p l a n a t i o n o f P l a t e 15

Figs. 1–3. *Eirlysia undata* Mazaev, 2015, latex casts, ×5; Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds: (1) specimen PIN, no. 4919/20-176: (1a) apertural , (1b) lateral, and (1c) oblique top views; (2) specimen PIN, no. 4919/20-169: (2a) apertural, (2b) lateral, and (2c) oblique top views; (3) specimen PIN, no. 4919/20-175.

Figs. 4–8. *Eirlysia nodata* Mazaev, 2015, latex casts (except for 7b and 8), all ×5, except fig. 8: (4–7) Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds: (4) specimen PIN, no. 4919/20-170: (4a) oblique top, (4b) apertural, and (4c) lateral views; (5) specimen PIN, no. 4919/20-171: (5a) lateral and (5b) oblique top views; (6) specimen PIN, no. 4919/20-352: (6a) lateral view, preceding whorl broken off before burial, (6b) oblique top view; (7) specimen PIN, no. 4919/2059: (7a) lateral view, (7b) the same specimen, mold; (8) Samara Region, Tatarskii Baitugan, locality no. 4919/29; Baitugan Beds, specimen PIN, no. 4919/29-17; coll. G.V. Sonin, mold, ×3.5.

Plate 15

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian: Baitugan, Krasnyi Yar Beds; Upper Kazanian Substage: reef limestones in the region of the Nemda River, Podluzhnik Member, Verkhnii Uslon Beds, "Modiolus horizon" of the Morkvashi Beds. North America, Guadalupe Mountains, Middle Permian, Capitanian Stage, Cherry Formation, Getaway Limestone.

M a t e r i a l. Twelve specimens from the Lower Kazanian Substage: one from locality no. 4919/23, 11 from locality no. 4919/20, and also 115 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Baylea nemdaensis Mazaev, 2015

Plate 16, figs. 13–15; Fig. 11

Baylea nemdaensis: Mazaev, 2015, p. 908, pl. 11, figs. 5–9.

Sokella sokensis: Mazaev, 2017b, p. 9, pl. 3, figs. 3–9.

D e s c r i p t i o n. See Mazaev, 2015, p. 908.

D i m e n s i o n s in mm:

Specimen no.	Shell height	Maximum diameter
4919/23-1	7.9	6.6
4919/29-21	>6.5	6.1
4919/29-22	8.3	6.6

R e m a r k s. Recently, based on the study of shell imprints from the Krasnyi Yar Beds in the vicinity of the village of Kamyshla (locality no. 4919/20), Mazaev (2016) described a new species, *Sokella sokensis*. As discussed above, it is one of the types of preservation of *B. nemdaensis*. Morphologically, the type series of the two taxa are considerably different. However, after studying specimens of *B. nemdaensis* from the Baitugan Beds, it has become apparent that the shells, imprints of which are present in the type series of *Sokella sokensis*, lacked spiral ornamentation prior to sediment lithification. Thus, *Sokella sokensis* should be regarded as a junior synonym of *B. nemdaensis*.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Baitugan and Krasnyi Yar beds; Upper Kazanian Substage: reef limestones from the Nemda River region, Podluzhnik Member of the Verkhnii Uslon Beds.

M a t e r i a l. Fifty-one specimens from the Lower Kazanian Substage: 46 from locality no. 4919/20, one from locality no. 4919/23, four from locality no. 4919/29, and also 17 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Genus _Biarmeaspira_ Mazaev, 2006

R e m a r k s. As previously shown (Mazaev, 2017a, 2017b), the genus *Biarmeaspira* is represented in the Lower Kazanian by two species only: *B. angulata* (Netchaev, 1894) and *B. jusupovi* Mazaev. All the indicated species come from the Krasnyi Yar Beds of locality no. 4919/20. The Lower Kazanian specimens of *B. angulata* differ from the Upper Kazanian specimens in the smaller size; therefore, they lack ribs of the second order (Mazaev, 2017b, pl. 3, figs. 1, 2). In addition, shells, judging from their imprints, were partly eroded prior to their burial, which is particularly noticeable by the strongly deformed selenizone lacking specific characters of this species (sharply angular in profile, with cordlike lunules). In this paper, the relatively rare occurrences of the Lower Kazanian specimens of *B. jusupovi* are described for the first time.

Biarmeaspira jusupovi Mazaev, 2015

Plate 16, figs. 4–5

Eirlysia nodata: Mazaev, 2015, p. 924, pl. 18, figs. 1–12; pl. 19, figs. 2–6.

D e s c r i p t i o n. See Mazaev, 2015, p. 924.

E x p l a n a t i o n o f P l a t e 16

Figs. 1 and 2. *Globodoma divesouralica* (Golovkinsky, 1868), latex casts, juvenile whorls, ×10; Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds: (1) specimen PIN, no. 4919/20-201, (2) specimen PIN, no. 4919/20-202.

Figs. 3. *Baylea vjatkensis* Mazaev, 2015; specimen PIN, no. 4919/23-2, fossilized shell, ×8; Samara Region, Chuvashskii Baitugan, locality no. 4919/23; Baitugan Beds.

Figs. 4 and 5. *Biarmeaspira jusupovi* Mazaev, 2015, latex casts, ×8, Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds: (4) specimen PIN, no. 4919/20-110, (5) specimen PIN, no. 4919/20-93: (5a) apertural and (5b) lateral views.

Figs. 6–12. *Glabrocingulum lebedewi* (Licharew, 1913). All ×3: (6–9): Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, latex casts: (6) specimen PIN, no. 4919/20-243, notch preserved; (7) specimen PIN, no. 4919/20-311: (7a) lateral view, notch preserved, (7b) apertural view; (8) specimen PIN, no. 4919/20-236; (9) specimen PIN, no. 4919/20-312, notch preserved; (10–12) Samara Region, Tatarskii Baitugan, locality no. 4919/29, Baitugan Beds, fossilized shell: (10) specimen PIN, no. 4919/29-4: (10a) apertural and (10b) oblique top views, (11) specimen PIN, no. 4919/29-3; coll. G.V. Sonin: (11a) apertural and (11b) oblique top views; (12) specimen PIN, no. 4919/29-2, coll. G.V. Sonin: (12a) apertural, (12b) lateral, (12c) and oblique top views.

Figs. 13–15. *Baylea nemdaensis* Mazaev, 2015. All ×8: (13) specimen PIN, no. 4919/29-22, fossilized shell; Samara Region, Tatarskii Baitugan, locality no. 4919/23; Baitugan Beds, (14) specimen PIN, no. 4919/29-21, fossilized shell, the same locality, (15) specimen PIN, no. 4919/23-1, mold, Samara Region, Chuvashskii Baitugan, locality no. 4919/23; Baitugan Beds, coll. I. Yusupov.

Plate 16

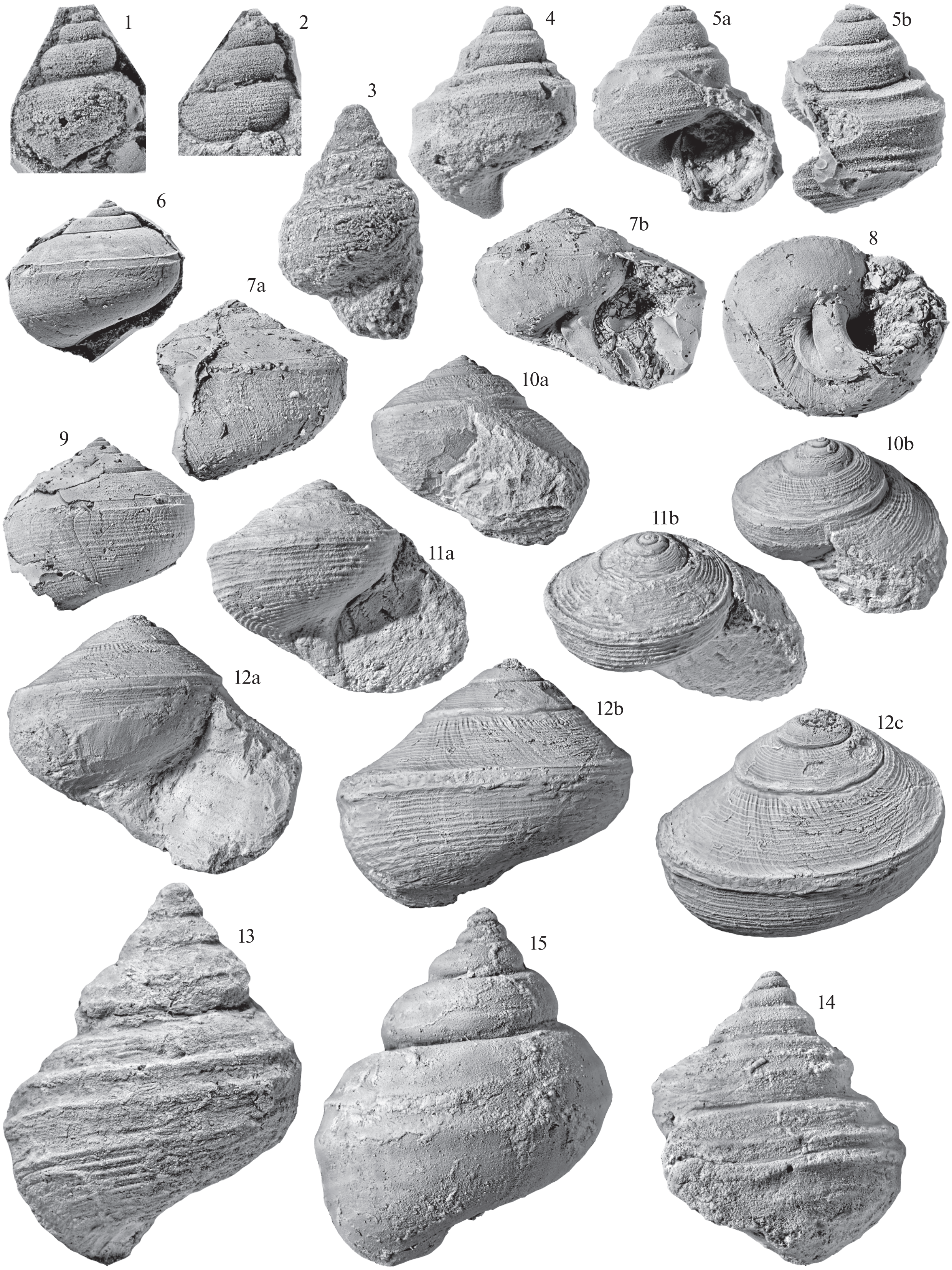
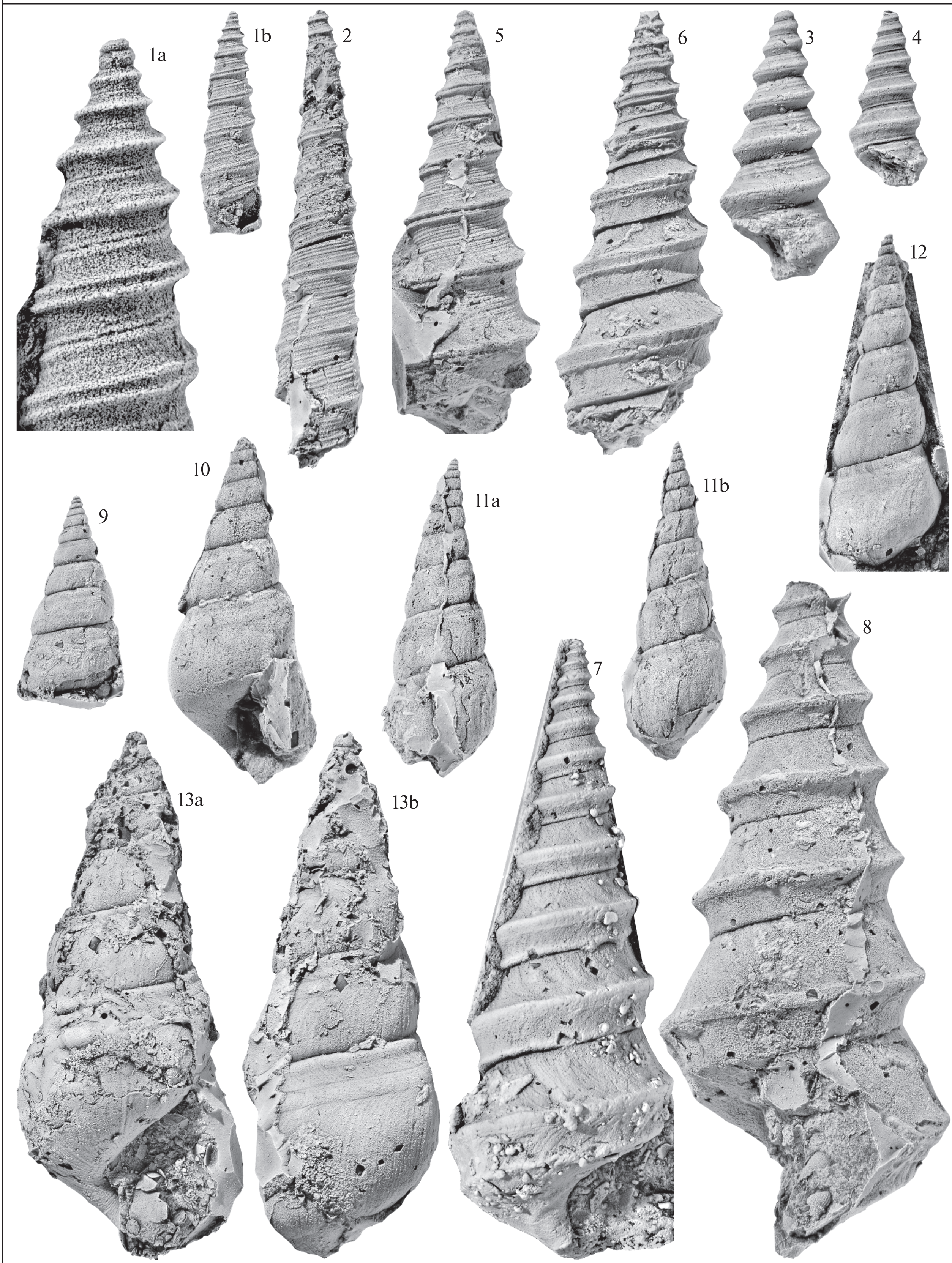


Plate 17



Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-93	4.6	4.0
4919/20-110	4.7	>3.7
4919/20-112	4.5	≈3.7

Remarks. All specimens are imprints of small shells composed of juvenile and one–two definitive whorls.

Previously, Mazaev (2015, p. 926) erroneously stated that the species is found in the Supai Formation of Texas.

Occurrence. Volga–Ural Region; Lower Kazanian, Krasnyi Yar Beds; Upper Kazanian Substage, Podluzhnik Member, Verkhnii Uslon Beds.

Material. In total four specimens from locality no. 4919/20 and also 67 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Goniasmatidae Nützel et Bandel, 2000

Genus *Goniasma* Tomlin, 1930

Goniasma subangulata (Verneuil, 1845)

Plate 17, figs. 3–8

Murchisonia subangulata: Verneuil, 1845, p. 340, pl. 22, fig. 6; Golovkinsky, 1868, p. 108, pl. 5, figs. 7 and 8; Netchaev, 1894, p. 333, pl. 12, figs. 1 and 2; Yakovlev, 1899, p. 31, pl. 4, fig. 25.

Goniasma subangulata: Mazaev, 2015, p. 936, pl. 24, figs. 2–7.

Murchisonia biarmica: Netchaev, 1894, p. 335, pl. 12, fig. 3; Yakovlev, 1899, p. 35, pl. 4, fig. 28 (non *Murchisonia biarmica* Kutorga, 1842).

Murchisonia golowkinskii: Yakovlev, 1899, p. 33, pl. 4, figs. 26 and 27.

Goniasma golowkinskii: Mazaev, 2015, p. 939, pl. 24, fig. 1; pl. 25, figs. 1–11; pl. 38, fig. 5.

Description. See description of *G. golowkinskii*: Mazaev, 2015, p. 939.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-34	>22.1	>8.0
4919/20-271	⩾24.2	>10.4
4919/20-272	⩾15.8	>6.0

Remarks. Two taxa: *G. subangulata* and *G. golowkinskii* are different forms of preservation of the same species. Yakovlev did not give any comparison between his species, *Goniasma golowkinskii*, and Verneuil's species *Goniasma subangulata*. The preservation of the type material in both cases is unsatisfactory. The species diagnostic method developed by the present author (Mazaev, 2015) is based on the whorl surface, suture depth, and selenizone morphology. However, the diagnostic characters of *G. subangulata* correspond to the morphological features of strongly rounded shells with a completely or partly lost upper layer, whereas the characters of *G. golowkinskii* correspond to the shells, the outer layer of which is preserved to a greater or lesser extent. Thus, *G. subangulata* is a senior synonym of *G. golowkinskii*.

Locality no. 4919/20 contains shell imprints of four types of preservation: (1) Almost unrounded shells. The spiral ornamentation is composed of thin cordlike ribs with narrow channeled interrib spaces. The suture is very thin; the selenizone is concave with distinct sharp wrinkled lunules separated by wide spaces. Growth lines, if present, are very thin (Pl. 17, fig. 5). (2) The shells have a partly eroded surface. The spiral ornamentation is absent or represented by indistinct simple ribs. The suture is deep, sharp, impressed; the selenizone is concave or almost straight in profile, smooth, delineated by massive spiral ribs; the growth lines are coarse (Pl. 17, fig. 6). (3) Eroded or rounded shells. The spiral ornamentation is absent. The suture is deep, distinct, impressed; the selenizone is convex in profile; the ribs delineating the selenizone are absent; the growth lines are coarse; the shell surface could possess spiral rows of small pits (Pl. 17, fig. 7). (4) Strongly eroded and/or strongly rounded shells, imprints of which changed by karst. Spiral ornamentation is absent. The suture is sharp, the selenizone is strongly convex in profile, and growth lines are absent (Pl. 17, fig. 8).

In siliciclastic deposits, specimens of *G. subangulata* are usually found as molds (Baitugan Beds stratotype region of the Sok River), less commonly, as shells replaced by calcite (Baitugan Beds in the vicinity of Golyusherma, locality no. 4919/30). In the latter case,

Explanation of Plate 17

Figs. 1 and 2. *Goniasma multilineata* (Netchaev, 1894), latex casts, Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds: (1) specimen PIN, no. 4919/20-152: (1a) protoconch and juvenile whorls, ×20, (1b) teleoconch, ×5; (2) specimen PIN, no. 4919/20-267.

Figs. 3–8. *Goniasma subangulata* (Verneuil, 1845). All ×5: (3, 4) Udmurtia, Alnashskii District, village of Blagodat, locality no. 4919/30, Baitugan Beds, coll. V.K. Golubev, fossilized shell: (3) specimen PIN, no. 4919/30-1, (4) specimen PIN, no. 4919/30-2; (5–8) Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, latex casts: (5) specimen PIN, no. 4919/20-347; (6) specimen PIN, no. 4919/20-272, the same locality, (7) specimen PIN, no. 4919/20-34; the same locality, (8) specimen PIN, no. 4919/20-271, the same locality.

Figs. 9. *Arribazona lata* (Netchaev, 1894), specimen PIN, no. 4919/20-2, latex cast, ×5. Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds.

Figs. 10–13. *Arribazona kasanensis* (Netchaev, 1894); the same locality, latex casts, ×5: (10) specimen PIN, no. 4919/20-332, (11) specimen PIN, no. 4919/20-329: (11a, 11b) view, with the shell axis turned for 90°, (12) specimen PIN, no. 4919/20-335, (13) specimen PIN, no. 4919/20-328: (11a) apertural and (11b) lateral views.

the external layer of the shells are dissolved, the spiral ornamentation is only partly preserved. The suture is sharp and deep (Pl. 17, figs. 3, 4).

Some shells collected from the reef facies of the Upper Kazanian Substage can be recognized as a separate morphotype, because it is considerably different in its more strongly elongated shape, more strongly pronounced spiral and collabral ornamentation. The lunules on the selenizone are massive (Mazaev, 2015, pl. 25, figs. 1, 4). Locality no. 4919/19 contains both morphotypes.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian, Baitugan and Krasnyi Yar beds; Upper Kazanian Substage, reef limestones of the Nemda River region, Pechishchi Beds, Podluzhnik Member, Verkhnii Uslon Beds, "*Modiolus* Horizon" of the Morkvashi Beds.

M a t e r i a l. Twenty-one specimens from the Lower Kazanian Substage: 19 from locality no. 4919/20, three from locality no. 4919/30, and also several dozen from localities no. 4919/23 and no. 4919/29. One hundred thirty five specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Goniasma multilineata **(Netchaev, 1894)**

Plate 17, figs. 1 and 2

Murchisonia multilineata: Netchaev, 1894, p. 339, pl. 12, figs. 4 and 5.

Murchisonia multilineata: Yakovlev, 1899, p. 37, pl. 4, fig. 30 (non *Murchisonia multilineata* Netchaev, 1894).

Goniasma multilineata: Mazaev, 2015, p. 940, pl. 23, fig. 8; pl. 24, figs. 8 and 9; pl. 25, figs. 12–15.

D e s c r i p t i o n. See: Mazaev, 2015, p. 940.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-152	>8.0	2.2
4919/20-267	>16.3	≈3.3

R e m a r k s. An imprint of one specimen from locality no. 4919/20 shows protoconch morphology (Pl. 17, fig. 1a). This is the first occurrence of a protoconch of *G. multilineata*. The protoconch lacks the first whorl, whereas the sinusogera, if was present, was poorly preserved. The protoconch has at least three evenly rounded turriform whorls. The surface morphology is unknown. The suture is deep. The protoconch is 0.32 mm in diameter. The first teleoconch whorl has a sharp carina, which divides the lateral whorl surface into two equal parts. The selenizone is discernible on the fourth teleoconch whorl; the lower rib of the selenizone is marked by the carina, whereas the upper rib of the selenizone is weak and lies above the carina. In the sixth teleoconch whorl, the selenizone is subvertical.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage: reef limestones of the Nemda River region, Pechishchi Beds, Podluzhnik Member of the Verkhnii Uslon Beds, "*Modiolus* Horizon" of the Morkvashi Beds.

M a t e r i a l. Nine specimens from the Lower Kazanian Substage, locality no. 4919/20, and 39 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Orthonematidae Nützel et Bandel, 2000

Genus *Arribazona* Kues, 1990

Arribazona kasanensis **(Netchaev, 1894)**

Plate 17, figs. 10–13; Plate 18, fig. 5

Loxonema kasanensis: Netchaev, 1894, p. 361, pl. 12, figs. 36, 37.

Arribazona kasanensis: Mazaev, 2015, p. 943, pl. 26, figs. 1–8, pl. 40, fig. 4.

D e s c r i p t i o n. See Mazaev, 2015, p. 943.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-168	>18.6	6.2
4919/20-328	18.8	8.2
4919/20-329	11.4	4.1
4919/20-335	>12.4	5.3

R e m a r k s. In the Lower Kazanian Substage, the species is found only in locality no. 4919/20, where it, like in the Upper Kazanian Substage, is represented by two morphotypes. The morphotypes are distinguished by the shape of the spire outline. For instance, in one of the morphotypes, the first whorls expand very rapidly, later, the expansion slows down; the outline of the spire contour is arched (Pl. 17, fig. 13). In the second morphotype, all whorls expand slowly and evenly,

E x p l a n a t i o n o f P l a t e 1 8

Figs. 1 and 2. *Stuckenbergispira kazanensis* Mazaev, 2015; Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, ×8: (1) specimen PIN, no. 4919/20-57: (1a) mold, oblique top view, (1b) latex cast, top view; (2) specimen PIN, no. 4919/20-325: (2a) mold, oblique top view, (2b) latex cast, top view.

Figs. 3 and 4. *Anomphalus barskovi* Mazaev, 2015; the same locality, latex casts, ×10: (3) specimen PIN, no. 4919/20-353: (3a) oblique top and (3b) lateral views; (4) specimen PIN, no. 4919/20-192.

Figs. 5. *Arribazona kasanensis* (Netchaev, 1894); specimen PIN, no. 4919/20-168, the same locality, latex cast, ×5.

Figs. 6–10. *Klavlia klavlia* gen. et sp. nov; the same locality, latex casts, ×10: (6) holotype PIN, no. 4919/20-198: (6a) apertural and (6b) lateral views; (7) paratype PIN, no. 4919/20-341; (8) paratype PIN, no. 4919/20-199; (9) paratype PIN, no. 4919/20-13: (9a) oblique top and (9b) lateral views; (10) specimen PIN, no. 4919/20-63 (paratype).

Plate 18

whereas the outline of the spire is almost straight (Pl. 17, figs. 11, 12; pl. 18, fig. 5).

A few shell imprints reflect sharp, wrinkled growth lines (Pl. 18, fig. 5). Apparently, the shell had lost the external layer before burial.

O c c u r r e n c e. Volga–Ural Region, Lower Kazanian, Krasnyi Yar Beds; Upper Kazanian Substage, Prikazan, Verkhnii Uslon, and Morkvashi beds.

M a t e r i a l. Eight specimens from the Lower Kazanian Substage, locality no. 4919/20; and 19 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Arribazona lata **(Netchaev, 1894)**

Plate 17, fig. 9

Murchisonia lata: Netchaev, 1894, p. 337, pl. 12, figs. 7 and 9.
Loxonema sp. 2: Netchaev, 1894, p. 365, pl. 12, fig. 47.
Arribazona lata: Mazaev, 2015, p. 945, pl. 26, figs. 13 and 14; pl. 27, figs. 1–12; pl. 28, fig. 1; pl. 29, fig. 12.

D e s c r i p t i o n. See Mazaev, 2015, p. 945.

D i m e n s i o n s in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-2	>7.8	>3.9

R e m a r k s. Occurrences of this species in the Lower Kazanian Stage of the Volga–Ural region are relatively rare. Shells of most specimens found are strongly rounded. In the collection, this species is represented by a few specimens.

O c c u r r e n c e. Volga–Ural Region: Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage: Prikazan, Verkhnii Uslon, and Morkvashi beds.

M a t e r i a l. Four specimens from the Lower Kazanian Substage: two from locality no. 4919/20 and two from locality no. 4919/32, and also 71 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Anomphalidae Wenz, 1938

Genus *Anomphalus* Meek et Worthen, 1867

Anomphalus barskovi **Mazaev, 2015**

Plate 18, figs. 3 and 4

Straparollus permianus: Tchernyshev, 1885, p. 83, pl. 2, fig. 6; Netchaev, 1894, p. 351, pl. 12, figs. 12, 15, 21, and 22; Yakovlev, 1899, p. 20, pl. 4, fig. 4 (non *Straparollus permianus* King, 1850).
Anomphalus barskovi: Mazaev, 2015, p. 952, pl. 30, figs. 1–5.

D e s c r i p t i o n. See Mazaev, 2015, p. 952.

D i m e n s i o n s in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-192	3.1	3.8
4919/20-194	3.4	4.5
4919/20-203	2.1	3.0
4919/20-353	4.2	>4.8

R e m a r k s. In contrast to numerous finds of this species in the locality of the Upper Kazanian Substage, in the Lower Kazanian Substage, the species is relatively rare. All specimens from locality no. 4919/20 are represented by imprints of very small shells.

O c c u r r e n c e. Volga–Ural Region: Lower Kazanian: Kamyshla and Krasnyi Yar beds; Upper Kazanian Substage: Prikazan, Pechishchi, Verkhnii Uslon, and Morkvashi beds.

M a t e r i a l. Fourteen specimens from the Lower Kazanian Substage, locality no. 4919/20, and also 74 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Holopeidae Wenz, 1938

Subfamily Gyronematinae Knight, 1956

Genus *Klavlia* Mazaev, gen. nov.

E t y m o l o g y. From the town of Klyavlino, Samara Region.

T y p e s p e c i e s. *Klavlia klavlia* Mazaev, gen. et sp. nov.; Russia, Samara Region; Middle Permian, Kazanian Stage, Lower Kazanian, Krasnyi Yar Beds.

D i a g n o s i s. Shell turbiform, with spire distinctly raised over last whorl. Cross section of initial whorls almost rounded and, on last whorls, lateral whorl surface bounded by two weak rounded carinae; another carina running on basal surface near umbilicus. Ornamentation of thin threadlike ribs. Umbilicus pitlike.

C o m p a r i s o n. The new genus is distinguished from *Cinclidonema* Knight, 1945 by the spire raised over the last whorl and the absence of the collabral ornamentation. It differs from *Omphalonema* Grabau, 1936 in the finer ornamentation.

R e m a r k s. More detailed comparisons with *Omphalonema* are impossible because of the absence of important diagnostic characters of this genus established by Grabau (1936) based on very poorly preserved material. Despite the similarity of the shell outlines in both genera, *Omphalonema* has spiral ribs of various thicknesses, the absence of the umbilicus, and apparently massive columella.

S p e c i e s c o m p o s i t i o n. Type species.

Klavlia klavlia **Mazaev sp. nov.**

Plate 18, figs. 6–10

E t y m o l o g y. From the town of Klyavlino, Samara Region.

H o l o t y p e. PIN, no. 4919/20-198, shell imprint; locality no. 4919/20: Samara Region, village of Kamyshla, limestone road cut near a fire service station; Lower Kazanian, Krasnyi Yar Beds.

D e s c r i p t i o n. The shell is thin, turbiniform, of 5–6 rounded whorls. The suture is distinct, very thin, and impressed. The spire is distinctly raised over the last whorl; the ratio of its height to the shell height is approximately two-fifths. The pleural angle is 65°–75°. In the last two whorls, the whorl cross section becomes trapezoid. The lateral surface is almost flat, weakly convex, less commonly, concave, bounded by weak rounded carinae. The upper whorl surface is distinctly convex, sometimes weakly angular. The basal whorl surface is convex, with a distinct rounded circumumbilical carina. The entire shell surface is covered by very fine threadlike spiral ribs separated by narrow spaces, the width of which is comparable to that of the ribs. Growth lines are very thin, almost straight. They are inclined prosoclinally from the suture at 30° to the shell axis, weakly opisthocyrtic. The aperture is rounded trapezoid in cross section. The columellar lip is long, thin, straight, relatively sharply becoming a thin basal lip. The thin palatal lip adjoins the upper part of the basal surface, forming a relatively wide parietal ramp.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-56 (paratype)	>4.8	5.0
4919/20-63 (paratype)	>5.5	5.9
4919/20-118 (paratype)	5.0	4.5
4919/20-198 (holotype)	5.0	4.7
4919/20-341 (paratype)	5.0	≈4.8

V a r i a b i l i t y. The profile of the whorl upper surface varies from moderately convex to slightly angular in the middle part. The position of the suture in the last whorls is relatively variable.

M a t e r i a l. Nineteen specimens from the type locality.

Family Platyceratidae Hall, 1859

Genus *Stuckenbergispira* Mazaev, 2015

Stuckenbergispira kazanensis Mazaev, 2015

Plate 18, figs. 1 and 2

Capulus permocarbonicus: Netchaev, 1894, p. 355, pl. 12, figs. 23 and 24 (non *Capulus permocarbonicus* Stuckenberg, 1898).

Stuckenbergispira kazanensis: Mazaev, 2015, p. 957, pl. 32, figs. 1–7.

D e s c r i p t i o n. See Mazaev, 2015, p. 957.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-57	–	6.0
4919/20-235	–	7.6

O c c u r r e n c e. Volga–Ural Region: Lower Kazanian: Baitugan and Krasnyi Yar beds; Upper Kazanian Substage: Prikazan and Verkhnii Uslon Beds.

M a t e r i a l. Eight specimens from Lower Kazanian Substage: seven from locality no. 4919/20, one from locality no. 4919/34, and also 28 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Naticopsidae Waagen, 1880

Genus *Naticopsis* McCoy, 1844

Naticopsis permica Netchaev, 1894

Plate 19, figs. 4–7

Naticopsis permica: Netchaev, 1894, p. 353, pl. 12, figs. 17 and 18; Mazaev, 2015, p. 957, pl. 32, fig. 9; pl. 33, figs. 1–5.

Natica minima: Netchaev, 1894, p. 354, pl. 11, figs. 13, 14, and 16 (non *Natica minima* Brown, 1841).

Naticopsis oblatus: Winters, 1963, p. 45, pl. 5, figs. 14a–14c.

D e s c r i p t i o n. See Mazaev, 2015, p. 957.

D i m e n s i o n s i n m m: (height and width vary considerably, while the shell orientation changes only slightly).

Specimen no.	Shell height	Maximum diameter
4919/20-280	8.5	8.4
4919/20-281	6.1	>6.2
4919/20-282	8.1	>8.2
4919/20-283	8.8	8.6
4919/20-291	7.5	7.0

R e m a r k s. Like specimens from the Upper Kazanian samples, specimens from locality no. 4919/20 have both flattened (Pl. 19, figs. 4a, 4b) and massive, very convex calluses (Pl. 19, figs. 5a, 6a, 7b) and also various types of the apertural margin near the suture: either almost straight (Pl. 19, fig. 5b), or sharply curved (Pl. 19, figs. 6b, 7a). Evidently, these morphological features should be interpreted as intraspecific variability. The callus surface in some specimens is covered by numerous tubercles (Pl. 19, fig. 7b); this character is for the first time recorded for this species. The position of the suture also varies: it either closely approaches the point of the whorl periphery, or is considerably higher than the point of periphery, and also intermediate variants. All the above variations of characters emphasize the polymorphism of this species.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Baitugan and Krasnyi Yar beds; Upper Kazanian Substage: Prikazan, Verkhnii Uslon, and Morkvashi beds. Eastern Arizona, Supai Formation.

M a t e r i a l. Twenty specimens from the Lower Kazanian Substage: 19 from locality no. 4919/20, one from locality no. 4919/30, and also 46 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Naticopsis koljanuriensis Mazaev, 2015

Plate 19, fig. 8

Naticopsis koljanuriensis: Mazaev, 2015, p. 960, pl. 32, fig. 8.

D e s c r i p t i o n. The shell is small, relatively massive, approximately of three–four rapidly expanding whorls, elongated along the axis; the height of the aperture is slightly more than three-fourths of the shell height. The whorl surface is small. Each successive whorl joins slightly below the periphery of the preceding. The suture is very thin. The aperture is elongated, with a pointed upwards parietal canal. The apertural plane is inclined at 15°. The ratio of the aperture height to its width is about 1.4. The columellar lip is in shape of a narrow and massive turnout, in general weakly curved, although in its lower part, at the transition to the basal lip, is curved sharply archlike; inclined to the shell axis at 30°. The growth lines are fine and weak, almost straight; inclined prosoclinally at 15° to the shell axis.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/30-4	3.5	2.9

C o m p a r i s o n. This species differs from *N. conica* Licharew, 1968 in the evenly rounded whorl profile and the small size.

R e m a r k s. This species is very rare, which could be related to its small size. The aperture morphology, which is here described for the first time, contradicts the assignment of this species to the genus *Naticopsis*. The Lower Kazanian specimen is twice as large as the holotype, differs in the straighter growth lines, which are possibly related to their definitive state.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian, Baitugan Beds; Upper Kazanian Substage, reef bodies of the Nemda River region.

M a t e r i a l. One specimen from locality no. 4919/30 and one from the Upper Kazanian Substage (see Mazaev, 2015).

Family Neritidae Rafinesque, 1935

Genus *Neritaria* Koken, 1892

Neritaria kamyshlensis Mazaev, sp. nov.

Plate 19, figs. 1–3

E t y m o l o g y. From the village of Kamyshla.

H o l o t y p e. PIN, no. 4919/20-279; shell imprint; locality no. 4919/20: Samara Region, village of Kamyshla, limestone road cut near a fire service station; Lower Kazanian, Krasnyi Yar Beds.

D e s c r i p t i o n. The shell is very small, of five relatively rapidly expanding evenly rounded whorls. The suture is distinct, impressed, lies below the periphery point of the preceding whorl. The spire is distinctly raised. The aperture height is slightly over two-thirds of the shell height. The shell surface is smooth. The aperture is slightly oblique and slightly elongated in cross section. The parietal canal is wide and shallow. The columellar lip is long, arched, in the lower part tubelike, turned out and, in the upper part, gradually becoming a thin parietal lip; the transition to the basal lip is relatively sharp. The margin of the outer lip is thin, but with one or two massive collabral thickenings in the aperture parallel to its edge. The umbilicus, if present, is pitlike, closed by a turned out edge of the columellar lip. The growth lines are thin, distinct, almost straight, prosocline, inclined at 15°–20° to the shell axis.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-279 (holotype)	7.3	6.3
4919/20-322 (paratype)	7.6	6.6
4919/20-323 (paratype)	8.2	7.2

C o m p a r i s o n. The external shell outline of the new species generally coincides with that of the shells of *N. candida* (Kittl, 1894) (see Tong and Erwin, 2001, pl. 4, figs. 11–19), from which it differs in the more strongly elongated shell and smaller size, while having the same number of whorls.

R e m a r k s. This is the first record of the genus *Neritaria* from the Permian.

M a t e r i a l. Four specimens from the type locality.

Family Palaeostylidae Wenz, 1938

Genus *Palaeostylus* Mansuy, 1914

Palaeostylus planoverticum (Netchaev, 1894)

Plate 20, figs. 1 and 2

Loxonema planoverticum: Netchaev, 1894, p. 364, pl. 12, fig. 45.

Palaeostylus planoverticum: Mazaev, 2015, p. 962, pl. 34, figs. 1–9.

D e s c r i p t i o n. See Mazaev, 2015, p. 962.

E x p l a n a t i o n o f P l a t e 19

Figs. 1–3. *Neritaria kamyshlensis* sp. nov.; Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, latex casts (except Fig. 1g), ×6: (1) holotype PIN, no. 4919/20-279: (1a) apertural, (1b) oblique top, and (1c) lateral views, (1d) mold; (2) specimen PIN, no. 4919/20-322: (2a) apertural and (2b) lateral views; (3) specimen PIN, no. 4919/20-323: (3a) lateral and (3b) apertural views.

Figs. 4–7. *Naticopsis permica* Netchaev, 1894; the same locality, latex casts, ×6: (4) specimen no. 4919/20-283: (4a) apertural and (4b) lateral views; (5) specimen no. 4919/20-282: (5a) apertural and (5b) lateral views; (6) specimen no. 4919/20-280: (6a) apertural and (6b) lateral views; (7) specimen no. 4919/20-281: (7a) lateral and (7b) apertural views.

Figs. 8. *Naticopsis koljanuriensis* Mazaev, 2015, specimen PIN, no. 4919/30-4, fossilized shell; Udmurtia, Alnashskii District, village of Blagodat', Baitugan Beds, ×15; coll. V.K. Golubev: (8a) reversed apertural, (8b) apertural, and (8c) lateral views.

Plate 19

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-12	>4.0	1.8
4919/19-151	⩾7.0	3.0

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage: reef bodies in the Nemda and Verkhnii Uslon beds.

M a t e r i a l. Three specimens from the Lower Kazanian Substage, locality no. 4919/20; and 19 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Soleniscidae Knight, 1931

Genus *Bulimorpha* Whitfield, 1882

Bulimorpha lavrskyi Mazaev, 2015

Plate 20, fig. 3

Bulimorpha lavrskyi: Mazaev, 2015, p. 968, pl. 36, figs. 8 and 9; pl. 37, fig. 3.

D e s c r i p t i o n. See Mazaev, 2015, p. 968.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-340	⩾11.0	>4.2

O c c u r r e n c e. Volga–Ural Region, Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage: Prikazan and Verkhnii Uslon Beds.

M a t e r i a l. Two specimens from the Lower Kazanian Substage, locality no. 4919/20 and locality no. 4919/33, and 13 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Meekospiridae Knight, 1956

Genus *Meekospira* Ulrich in Ulrich and Scofield, 1897

Meekospira symmetrica (King, 1850)

Plate 20, fig. 5

Macrocheilus symmetricus: King, 1850, p. 221, pl. 16, figs. 32 and 33; Trechmann, 1925, p. 136.

Turbonilla symmetrica: Geinitz, 1861, p. 46, figs. a and b.

Macrocheilus sp.: Trechmann, 1913, p. 216.

Macrocheilus symmetrica: Pattison, 1967, p. 179; 1977, p. 217; Hollingworth and Barker, 1991, p. 360, text-figs. 19, 20, and 22.7–22.8.

Meekospira symmetrica: Mazaev, 2015, p. 973, pl. 37, figs. 4–7.

D e s c r i p t i o n. See Mazaev, 2015, p. 973.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-140	8.1	⩾3.2

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage, Prikazan Beds (reef bodies in the Nemda River region), Verkhnii Uslon Beds.

M a t e r i a l. One specimen from the Lower Kazanian Substage, locality no. 4919/20, and also 11 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Meekospira baytuganensis Mazaev, sp. nov.

Plate 20, fig. 6

E t y m o l o g y. From the Baitugan River, Samara Region.

H o l o t y p e. PIN, no. 4919/29-23, locality no. 4919/29; Samara Region, Kamyshlinskii District, quarry in the northern vicinity of the village of Tatarskii Baitugan; Lower Kazanian, base of the Baitugan Beds.

D e s c r i p t i o n. The shell is small fusiform and elongated. The shell has at least four relatively rapidly expanding whorls. The protoconch has at least two

E x p l a n a t i o n o f P l a t e 2 0

Figs. 1 and 2. *Palaeostylus planoverticum* (Netchaev, 1894); Samara Region, Kamyshla, locality no. 4919/20, Krasnyi Yar Beds, latex casts, ×8: (1) specimen PIN, no. 4919/20-144; (2) specimen PIN, no. 4919/20-12.

Fig. 3. *Bulimorpha lavrskyi* Mazaev, 2015, specimen PIN, no. 4919/20-340, the same locality, latex cast, ×7.

Fig. 4. *Ninglangella? samarensis* sp. nov., holotype PIN, no. 4919/20-90, the same locality, latex cast, ×10.

Fig. 5. *Meekospira symmetrica* (King, 1850), specimen PIN, no. 4919/20-140, the same locality, latex cast: (5a) lateral view, ×7; (5b) oblique top view, x 20; (5c) lateral view, ×20.

Fig. 6. *Meekospira baytuganensis* sp. nov., holotype PIN, no. 4919/29-23, fossilized shell, lateral view; Samara Region, Tatarskii Baitugan, locality no. 4919/29; Baitugan Beds: (6a) ×7 and (6b) ×20.

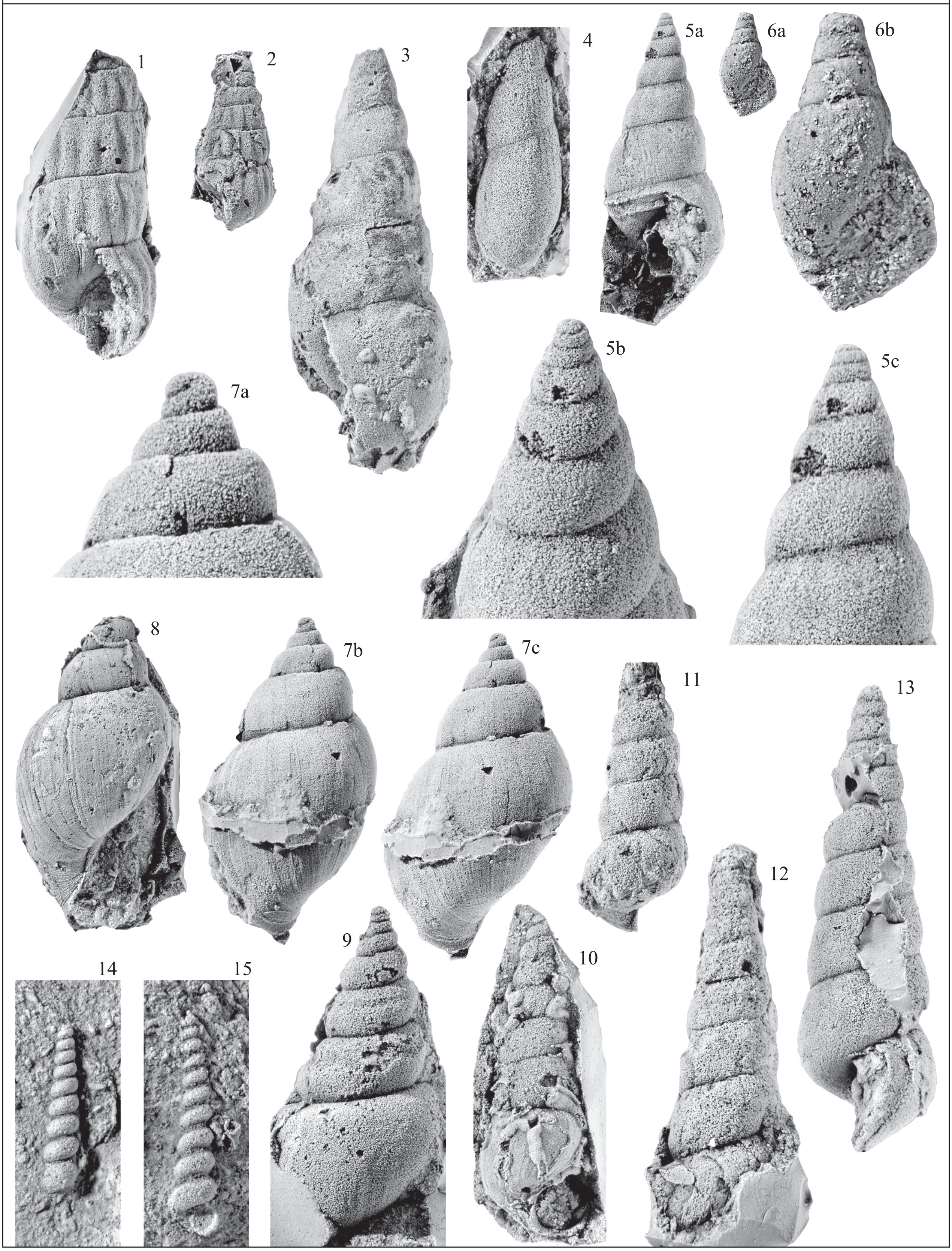
Figs. 7 and 8. *Permocossmannina kabanovi* Mazaev, 2015, latex casts; the same locality: (7) specimen PIN, no. 4919/20-358: (7a) protoconch and initial whorls, ×30; (7b, 7c) lateral view with the shell turned around the axis, ×10; (8) specimen PIN, no. 4919/20-151.

Fig. 9. *Donaldina dubia* Mazaev, 2015; specimen PIN, no. 4919/20-91, latex cast, ×10; the same locality.

Figs. 10–13. *Streptacis subgracilis* (Netchaev, 1894), the same locality, latex casts, ×10: (10) specimen PIN, no. 4919/20-240; (11) specimen PIN, no. 4919/20-75; (12) specimen PIN, no. 4919/20-191; (13) specimen PIN, no. 4919/20-348.

Figs. 14 and 15. *Streptacis*? sp. 2. Samara Region, Tatarskii Baitugan, locality no. 4919/29, Baitugan Beds, molds, ×10: (14) specimen PIN, no. 4919/29-24; (15) specimen PIN, no. 4919/29-25.

Plate 20



planispiral whorls. Its maximum diameter is 0.4 mm. The spire outline is slightly concave. The ratio of the whorl width to its height on the second teleoconch whorl is 2. The ratio of the shell height to the aperture height is 1.8. The lateral whorl surface is smooth, almost straight in profile. The surface of the last whorl is evenly convex. The suture is thin, distinct, and impressed. The aperture is droplike. The columella is long and helicoid.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/29-23	2.7	≈1.3

Comparison. The new species is distinguished from *M. symmetrica* and *M.? solenisciforma* Nutzel et Pan, 2005 by the higher first teleoconch whorls with a flat surface, and by the wider and flattened protoconch (see Nutzel and Pan, 2005, text-fig. 5.2).

Remarks. The species is represented by only one young specimen; the number of teleoconch whorls is four. Despite the small size, the present characters are sufficient to identify the species. The external apertural lip is poorly preserved.

Material. Holotype.

Genus *Ninglangella* Pan et Erwin, 2002

Ninglangella? samarensis Mazaev, sp. nov.

Plate 20, fig. 4

Etymology. From the Samara Region.

Holotype. PIN, no. 4919/20-90; shell imprint; locality no. 4919/20: Samara Region, village of Kamyshla, limestone road cut near a fire service station; Lower Kazanian, Krasnyi Yar Beds.

Description. The shell is small, fusiform, and strongly elongated. The teleoconch whorls are moderately convex, generally smooth with weak, relatively wide collabral ribs with narrow intercostal spaces. As the shell grows, the rib length decreases and, in the last whorl, is not more than one-fourth of its height, while in the preceding whorl, half of its height. The whorls expand very rapidly. The ratio of the whorl width to its height is approximately 1 : 1. The suture is very thin, shallow, inclined at 23°.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-90	⩾4.3	1.6

Remarks. The genus *Ninglangella* until now included only the type species. The species morphology is known from the protoconch and first teleoconch whorl, while the morphology of the definitive whorls is not known (Pan and Nützel, 2002; Nützel and Pan, 2005). In contrast, the species described here lacks a protoconch and the first teleoconch whorls. Nevertheless, among mycospirids, the development of the collabral ornamentation is a very specific character; therefore, the placement of this species in *Ninglangella* seems a likely option. The holotype is represented by an imprint of 2.5 last teleoconch whorls.

Material. Holotype.

Family ?Tubiferidae Cossmann, 1895

Genus *Permocossmannina* Mazaev, 2015

Permocossmannina kabanovi Mazaev, 2015

Plate 20, figs. 7 and 8

Permocossmannina kabanovi: Mazaev, 2015, p. 976, pl. 39, fig. 16.

Description. See Mazaev, 2015, p. 976.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-358	5.7	3.2

Remarks. Compared to the type material, the specimens described here are larger in size. In contrast to the previously described Upper Kazanian specimens, the shell surface is well preserved, due to which the last two whorls show fine orthocline growth lines and also a distinct, relatively deep, impressed suture. The protoconch diameter is within the previously indicated parameters (0.36 mm). The apertural morphology of this species remains unknown. The shell surface is, perhaps, eroded, which is typical of this locality. If that is so, the well-developed growth lines and suture depth are strengthened by this.

Occurrence. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage, Verkhnii Uslon Beds.

Material. Two specimens from locality no. 4919/20 and two specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Donaldinidae Bandel, 1994

Genus *Donaldina* Knight, 1933

Donaldina dubia Mazaev, 2015

Plate 20, fig. 9

Loxonema fasciata: Netchaev, 1894, p. 359, pl. 12, figs. 42 and 43 (non *Loxonema fasciata* King, 1850).

Loxonema altenburgensis: Netchaev, 1894, p. 360, pl. 12, fig. 41 (non *Loxonema altenburgensis* Geinitz, 1848).

Donaldina dubia: Mazaev, 2015, p. 978, pl. 37, fig. 9; pl. 39, figs. 1–9, pl. 40, figs. 1–3; text-fig. 14.

Description. See Mazaev, 2015, p. 978.

Dimensions in mm:

Specimen no.	Shell height	Maximum diameter
4919/20-91	>6.0	>3.0

R e m a r k s. The collection contains only a few imprints of poor preservation from locality no. 4919/20. It is possible that this species is present in the Baitugan Beds, although the shells molds found on the surface of the carbonate nodules in locality no. 4919/29 only approximately resemble the shell shape of this species.

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage, Verkhnii Uslon and Morkvashi beds.

M a t e r i a l. One specimen from the Lower Kazanian Substage, locality no. 4919/20; and 165 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Family Streptacididae Knight, 1931

Genus *Streptacis* Meek, 1871

Streptacis subgracilis (Netchaev, 1894)

Plate 20, figs. 10–13

Loxonema subgracilis: Netchaev, 1894, p. 362, pl. 12, fig. 44.
Streptacis subgracilis: Mazaev, 2015, p. 981, pl. 40, figs. 6 and 7.

D e s c r i p t i o n. See Mazaev, 2015, p. 981.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/20-348	8.4	2.5

O c c u r r e n c e. Volga–Ural Region; Lower Kazanian Krasnyi Yar Beds; Upper Kazanian Substage, Verkhnii Uslon Beds.

M a t e r i a l. Five specimens from the Lower Kazanian Substage, locality no. 4919/20; and 11 specimens from the Upper Kazanian Substage (see Mazaev, 2015).

Streptacis? sp. 2

Plate 20, figs. 14 and 15

D e s c r i p t i o n. The shell is very small, slender, and turriculate, of ten and more whorls. The whorl section is evenly rounded. The ratio of the whorl width to its height varies from approximately 1.6 to 1.7.

D i m e n s i o n s i n m m:

Specimen no.	Shell height	Maximum diameter
4919/29-24	>3.0	0.7
4919/29-25	>4.0	0.9

R e m a r k s. This species occurs in mass quantities on the surfaces of the carbonate nodules in locality no. 4919/29. All specimens almost entirely lack shells. The placement of this species in *Streptacis* is quite tentative. Previously, another species described in open nomenclature from the Upper Kazanian deposits was also tentatively assigned to this genus. To avoid confusion in the taxonomic lists of Kazanian gastropods, the species described here is designated as no. 2.

M a t e r i a l. Twelve specimens from locality no. 4919/29.

LOCALITIES OF EARLY KAZANIAN GASTROPODS

(R.T.) Republic of Tatarstan, (S.R.) Samara Region, (R.U.) Republic of Udmurtia)

4919/20. R.T., Kamyshlinskii District, village of Kamyshla, Vostochnaya ul., outcrop opposite the fire service station; 54°7′14″ N, 52°9′5″ E, Krasnyi Yar Beds.

4919/23. R.T., Kamyshlinskii District, outcrop in the southern vicinity of the village of Chuvashskii Baitugan, east of the cemetery. 54°5′48″ N, 52°17′40″ E; base of the Baitugan Beds.

4919/29. R.T., Kamyshlinskii District, quarry in the northern vicinity of the village of Tatarskii Baitugan, 54°6′44″ N, 52°16′19″ E; base of the Baitugan Beds.

4919/30. R.U., Alnashskii District, village of Blagodat', Pervye Prudki gully (Bed 20-22 after Golubev, 2001); Baitugan Beds.

4919/31. R.T., western vicinity of the town of Elabuga, quarry southeast of the village of Kolosovka, 55°46′15″ N, 51°57′30″ E; basal part of the section, top of the a monolith bed of “negative oolites,” Baitugan Beds.

4919/32. R.T., Leninogorskii District, Karkali quarry, 54°31′14″ N, 52°12′0″ E; Pil'nyi Kamen', Kamyshla Beds.

4919/33. R.U., Alnashskii District, southeast of the village of Romashkino, local quarry near the dam on the Toima River; 56°8′47″ N, 52°29′47″ E; Baitugan Beds.

4919/34. R.T., northeastern vicinity of the town of Mendeleevsk, Bondyuga quarry; 55°55′20″ N, 52°19′20″ E, gray, light brown sandy limestones with bivalves (Bed 12-14 after Golubev, 2001); Baitugan Beds.

ACKNOWLEDGMENTS

I am sincerely grateful to T.B. Leonova (PIN, for all-out support, critical reviewing, and editing of the paper). I am also grateful to N.M. Kadlets (TsNIGRM) for providing access to and help with the collections of the Chernyshev Museum.

REFERENCES

Barbot de Marnie, N., Geognostic trip to northern provinces of Russia, *Zap. Imp. Mineral. Ob-va, Ser. 2,* 1868, vol. 3, pp. 204–283.

Dickins, J.M., *Eurydesma and Peruvispira from the Dwyka Beds of South Africa*, 1961, vol. 4, no. 1, pp. 138–148.

Esaulova, N.K., Stratotype of the Sokian Horizon of the Lower Kazanian Substage near the village of Baitugan (Sok River), in *Stratotipy i opornye razrezy verkhnei permi Povolzh'ya i Prikam'ya* (Stratotypes and Reference Sections of the Upper Permian of the Volga and Kama Regions), Kazan: Ekotsentr, 1996, pp. 70–74.

Esaulova, N.K. and Burov, B.V., Kazanian Stage, in *Geologiya Tatarstana: Stratigrafiya i tektonika* (Geology of Tatarstan: Stratigraphy and Tectonics), Burov, B.V., Ed., Moscow: GEOS, 2003, pp. 154–166.

Fletcher, H.O., The Permian gastropods of New South Wales, *Rec. Austral. Mus.,* 1958, vol. 24, no. 10, pp. 115–164.

Forsh, N.N., Kazanian Stage in the vicinity of Kuibyshev, in *Materialy po geologii Permskoi sistemy Evropeiskoi chasti SSSR* (Data on the Geology of the Permian System of the European Part of the USSR), Nalivkin, D.V., Ed., Moscow: Gosudarstv. Nauchno–Tekhnich. Izdat. Neftyan. Gor.–Topl. Lit., 1940, pp. 59–74.

Forsh, N.N., Stratigraphy and facies of the Kazanian Stage of the Middle Volga Region, *Tr. Vsesoyuzn. Nauchno-Issled. Geol.-Razved. Inst. Nov. Ser.,* 1951, vol. 45 (Geology of the Volga Region), pp. 34–80.

Forsh, N.N., Permian deposits: Ufa Formation and Kazanian Stage, *Tr. Vsesoyuzn. Nauchno-Issled. Geol.-Razved. Inst. Nov. Ser.,* 1955, vol. 92, pp. 1–156.

Forsh, N.N., Shallow marine and lagoon deposits of the Kazanian Basin in the eastern Russian Platform, in *Del'tovye i melkovodno-morskie otlozheniya* (Deltaic and Shallow Marine Deposits), Moscow: Akad. Nauk SSSR, 1963, pp. 187–193.

Geinitz, H.B., *Dyas oder die Zechstein Formation und das Rothliegende,* Leipzig, 1861.

Golovkinsky, N.A., On the Permian Formation in the central part of the Kama–Volga Basin, *Mater. Geol. Ross.,* 1868, vols. 1 and 2, pp. 1–146.

Golubev, V.K., Event stratigraphy and correlation of marine deposits in the Kazanian Stage of the stratotypic region, *Stratigr. Geol. Korrelyatsiya*, 2001, vol. 9, no. 5, pp. 40–58.

Grabau, A.W., Early Permian fossils of China: Part 2. Fauna of the Maping Limestone of Kwangsi and Kweichos, *Paleontol. Sin. Ser. B,* 1936, vol. 8, no. 4, pp. 1–441.

Hollingworth, N.T.J. and Barker, M.J., Gastropods from the Upper Permian Zechstein (Cycle 1) reef of north-east England, *Proc. Yorkshire Geol. Soc.,* 1991, vol. 48, pp. 347–365.

Ignatiev, V.I., On the gaps and stratigraphic unconformities in the Upper Permian and Lower Triassic deposits of the eastern Russian Platform, in *Geologiya Povolzh'ya i Prikam'ya* (Geology of the Volga and Kama Regions)*, Kazan*: Kazan. Gos. Univ., 1971, pp. 23–50.

Ignatiev, V.I., Bugulma horizon of the Lower Kazanian Substage of the Russian Platform, in *Materialy po stratigrafii verkhnei permi na territorii SSSR* (Data on the Stratigraphy of the Upper Permian of the USSR), Kazan: Kazan. Gos. Univ., 1977, pp. 220–231.

King, W., *A Monograph of the Permian Fossils of England. Palaeontographical Society Monograph,* 1850.

Knight, J.B., Cox, L.R., Keen, A.M., Batten, R.L., Yochelson, E.L., and Robertson, R., Systematic Descriptions, in *Treatise on Invertebrate Paleontology Part I, Mollusca,* Moore, R.C., Ed., Lawrence: Geol. Soc. Am. Univ. Kansas Press, 1960, pp. I169–I324.

Licharew, B.K., Fauna from the Permian deposits in the vicinity of the city of Kirillov, *Tr. Geol. Kom. Nov. Ser.,* 1913, vol. 85, pp. 1–99.

Licharew, B.K., Preliminary report on the geological studies in 1917 and 1918 in the Vaga River Basin, *Izv. Geol. Kom.,* 1919, vol. 38, no. 3, pp. 325–358.

Licharew, B.K., Materials to the knowledge of the fauna from the Upper Permian deposits of the Northern Region, *Tr. Glavn. Geol.-Razved. Upr. VSNKh SSSR,* 1931, no. 71, pp. 1–42.

Licharew, B.K., General geological map of the European part of the USSR: Sheet 69: Shenkursk-Vel'sk, *Tr. Vseross. Geol.-Razved. Ob"ed., NKTP SSSR,* 1933a, vol. 240, pp. 1–102.

Licharew, B.K., Description of outcrops (Appendix to the "General Geological Map of the European Part of the USSR: Sheet 69: Shenkursk–Vel'sk"), *Tr. Vseross. Geol.-Razved. Ob"ed., NKTP SSSR,* 1933b, vol. 240, pp. 1–104.

Mazaev, A.V., Permian gastropods from the Kulogorsk Formation of the northern part of the Moscow Syneclise, *Paleontol. Zh.,* 2006, no. 4, pp. 42–53.

Mazaev, A.V., Upper Kazanian (Middle Permian) gastropods of the Volga-Urals Region, *Paleontol. J.,* 2015, vol. 49, no. 8, pp. 869–986.

Mazaev, A.V., Development of the genus *Baylea* (Gastropoda) in the Kazanian paleobasin (Middle Permian, the Volga–Ural Region), *Paleontol. Zh.,* 2016, no. 6, pp. 45–59.

Mazaev, A.V., The development of the genus *Biarmeaspira* (Gastropoda) in the Kazanian Paleobasin (Middle Permian, Volga–Ural Region), *Paleontol. Zh.,* 2017a, no. 3, pp. 3–13.

Mazaev, A.V., The role of fetalization in the morphogenesis of Kazanian gastropods (Middle Permian, Volga–Ural Region), *Paleontol. Zh.,* 2017b, no. 4, pp. 22–31.

Netchaev, A.V., Fauna from the Permian deposits of the eastern band of the European Russia, *Tr. Ob-va Estestvoispyt. Kazan. Imp. Univ.,* 1894, vol. 27, no. 4, pp. 1–503.

Nützel, A. and Pan, H.Z., Late Paleozoic evolution of the Caenogastropoda: Larval shell morphology and implications for the Permian/Triassic mass extinction event, *J. Paleontol.,* 2005, vol. 79, no. 6, pp. 1175–1188.

Pan, H.Z. and Nützel, A., Gastropods from the Permian of Guangxi and Yunnan Provinces, South China, *J. Paleontol. Memoir.,* 2002, vol. 56, pp. 1–49.

Pattison, J., Permian fossils: 1967, in *Geology of the Country between Durham and West Hartlepool,* Smith, D.B. and Francis, E.A., Eds., London: Mem. Geol. Surv. Gr. Brit., Engl. Wales, 1967, pp. 169–183.

Pictorsky, P., On the geological significance of the Soligalichesky Limestone, *Bull. Soc. Imp. Natur. Moscou,* 1867, vol. 40, no. 4, pp. 407–498.

Resheniya soveshchaniya po utochneniyu unifitsirovannykh stratigraficheskikh skhem verkhnego proterozoya i paleozoya Volgo-Ural'skoi neftegazonosnoi provintsii, sostoyavshegosya v Moskve, v VNIGNI, s 12 po 20 fevralya 1960 g. (Resolution of the Conference Devoted to the Specification of the Unified Stratigraphic Schemes of the Upper Proterozoic and Paleozoic of the Volga–Ural Oil-and-Gas-bearing Province, Moscow, February 12–20, 1960), Moscow: Gostoptekhizdat, 1962.

Solodukho, M.G. and Tikhvinskaya, E.I., Substantiation for the stratification of the Kazanian Stage into horizons, in *Materialy po stratigrafii verkhnei permi na territorii SSSR* (Data on the Stratigraphy of the Upper Permian of the USSR), Kazan: Kazan. Gos. Univ., 1977, pp. 187–219.

Taboada, A.C., Mory, A.J., Shi, G.R., Haig, D.W., and Pinilla, M.K., An Early Permian brachiopod–gastropod fauna from the Calytrix Formation, Barbwire Terrace, Canning Basin, Western Australia, *Alcheringa,* 2015, vol. 39, pp. 207–223.

Tchernyshev, F.N., Permian limestone of the Kostroma Province, *Gorn. Zh.,* 1885, vol. 1, pp. 80–115.

Tong, J. and Erwin, D.H., Triassic gastropods of the southern Qinling Mountains, China, *Smithsonian Contr. Paleobiol.,* 2001, vol. 92, pp. 1–47.

Trechmann, C.T., On a mass of anhydrite in the Magnesian Limestone of Hartlepool and on the Permian of south-east Durham, *quart. J. Geol. Soc. London,* 1913, vol. 69, pp. 184–218.

Trechmann, C.T., The Permian formation in Durham, *Proc. Geol. Ass.,* 1925, vol. 36, pp. 135–145.

Verneuil, E., in Murchison, R. J., Verneuil, E., and Keyeserling, R., *Geologie de la Russied' Europe,* 1845, vol. 2, pp. 1–512.

Waterhouse, J.B., Late Palaeozoic Mollusca and correlations from the south-east Bowen Basin, East Australia, *Palaeontogr. Abt. A,* 1987, vol. 198, nos. 4–6, pp. 129–333.

Weller, J.M., The gastropod genus *Yvania, Illinois State Geol. Surv.,* 1929, vol. 18, pp. 1–44.

Winters, S.S., Supai Formation (Permian) of eastern Arizona, *Geol. Soc. Am. Mem.,* 1963, vol. 89, pp. 1–99.

Yakovlev, N.N., Fauna from the Upper Paleozoic deposits of Russia: 1. Cephalopods and gastropods, *Tr. Geol. Kom. Nov. Ser.,* 1899, vol. 3, no. 15, pp. 1–140.

Translated by S. Nikolaeva