The family Orthonemidae (Gastropoda) from Middle and Upper Carboniferous of the Central part of Russian Plate

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Some murchisoniid gastropods from the Middle and Upper Carboniferous of the Central part of Russian Plate

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ABSTRACT. The species of the genera *Vebericochlis* Licharew, *Orthonema* Meek et Worthen, and *Cibecuia* Winters are mentioned for the first time from the Middle and Upper Carboniferous of the Central part of Russian Plate. The genera *Vebericochlis* and *Cibecuia* have been previously known only from the Permian. One species of *Vebericochlis*, 6 species of *Orthonema* and 2 species of *Cibecuia*, with the new species *O.* ***borovskensis*** sp. nov., *O.* ***paulum*** sp. nov., *O.* ***simplex*** sp. nov., *C.* ***sinelnikovae*** sp. nov., and *C.* ***magnum*** sp. nov., are described from the studied region. In addition, *Vebericochlis maclayi* Licharew, 1967 and *Orthonema silinae* (Licharew, 1975), which were not found in the studied region but are important for diagnostics of these genera, are described herein. The morphology of the genera is considered in detail. Based on the morphological characters of different species of *Orthonema,* the genus is referred to the murchisoniid gastropods. The studied genera are placed in the family Orthonemidae Nützel et Bandel, 2000, the later is revised and assigned to the superfamily Murchisoniacea Koken, 1896.

This paper continues the study of the murchisoniid gastropods from the Middle and Upper Carboniferous of the Central part of the Russian Plate [Mazaev, 2001]. Three genera: *Orthonema* Meek et Worthen, 1862, *Vebericochlis* Licharew, 1967, and *Cibecuia* Winters, 1956 were found in the region for the first time. Moreover, *Vebericochlis* and *Cibecuia,* which were previously known only from the Permian, are for the first time recorded in the Carboniferous units. The total of 9 species are recognized from the studied region, and 5 of them are new. In addition, two species: *Vebericochlis maclayi* Licharew, 1967 and *Orthonema silinae* (Licharew, 1975) are revised and redescribed here. These two species were not found in the studied region, but their teleoconchs possess very important characters for the diagnoses of the genera. Three genera studied herein are assigned to Orthonemidae Nützel et Bandel, 2000. The important data on teleoconch morphology of the type genus of the family have been obtained, and the diagnoses of the genus and family are changed. The Orthonemidae, which have been originally proposed as family of Caenogastropoda, are assigned here to the suborder Murchisonioidei Cox et Knight, 1960.

Over 160 specimens from the Moscow Basin and Oksko-Tzninskiy Swell have been studied. The specimens sporadically occur in the offshore sublittoral facies together with other diverse and abundant skeletal remains. The material (except several moulds of *Cibecuia* ***magnum*** sp. nov., including No. 4471/65/2, Fig. 5 Q) is represented by imprints and has been studied using their latex moulds. Some imprints have distinctly preserved fine growth lines. Few of them show complete apertural margin with a slit, and juvenile whorls with fine ornamentation. The material described here is housed in the Paleontological Museum of the Russian Academy of Sciences, collection No. 4471.

Rather well preserved shells from the Myachkovian Provincial Stage of the East Urals and from the Upper Carboniferous and Lower Permian of Middle Asia were also studied in the Central Geological Museum (CGM), St.–Petersburg, collections No. 9758 and No. 8336. This material was described in detail by Licharew [1967, 1968, 1975].

Morphology

The apertural margin of gastropod shell usually includes numerous characters which are important for its diagnostics. Since the shells of murchisoniid gastropods with completely preserved apertural margin are seldom found, we can deduce its structure only from the growth lines. The study of them is of the key position in the paper, especially for the genus *Orthonema.* This genus currently includes numerous species with considerable variation in the growth line patterns.

Originally, when Meek and Worthen [1861] established the genus, they particularly emphasized that the type species, *O. salteri* (Meek et Worthen, 1861), has straight, orthocline growth lines. This character was reflected in the name of the taxon. *O. frequens* Licharew, 1968 has a similar pattern of the growth lines (Fig. 1 A). Another species, *O. inoratum* Knight, 1934 was figured [Knight, 1934, pl. 57, fig. 1 d] with sharp shallow labral sinus (Fig. 1 B). *O. marvinwelleri* Knight, 1934 possesses narrow and obviously deep labral sinus placed just below the

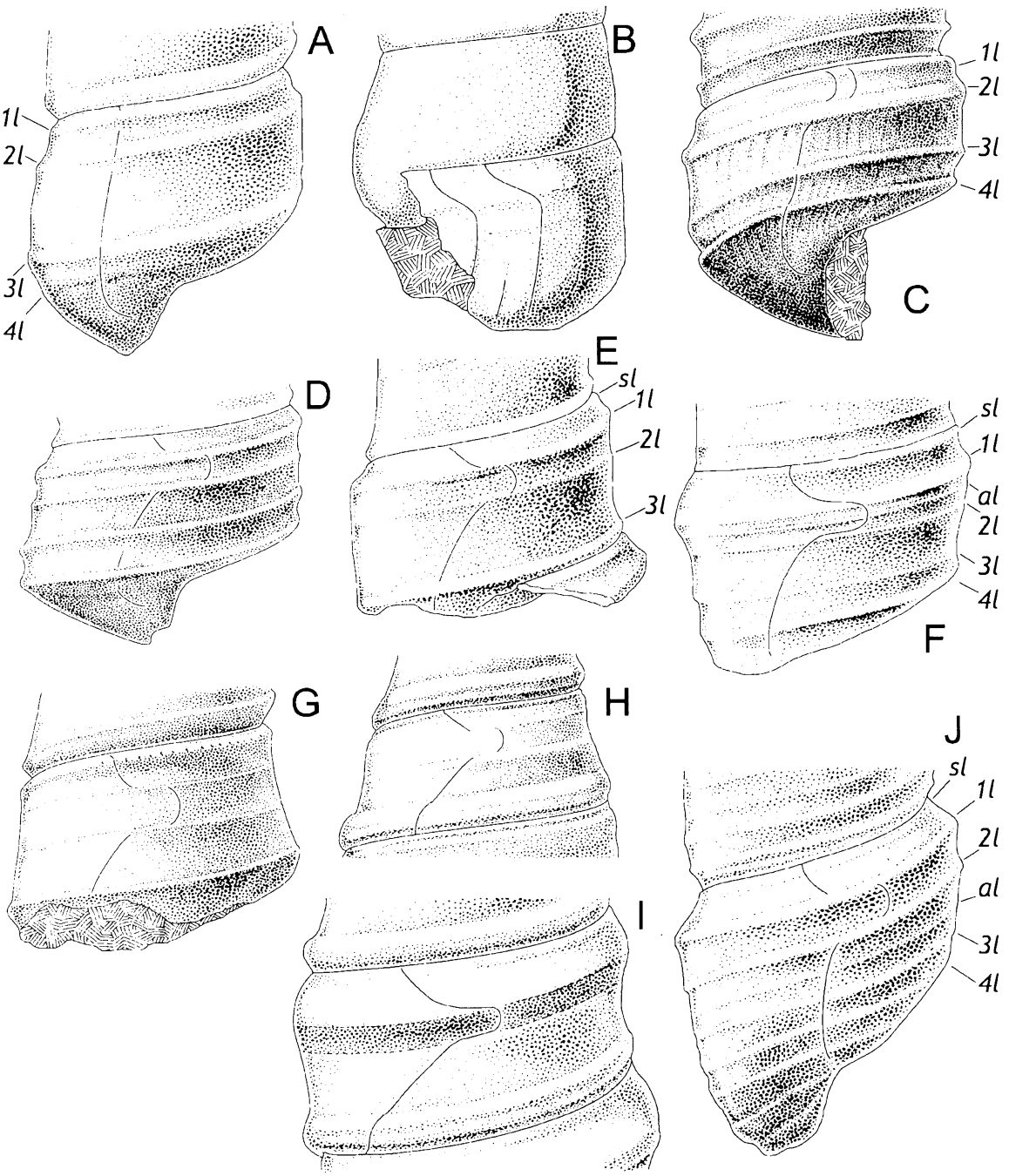


FIG. 1. The morphology of adult whorls: A – *Orthonema frequens* Licharew, 1968, No. 4471/6/34; B — *Orthonema inoratum* Knight, 1934, after Knight [1934, pl. 57, fig. 1d]; C — *Orthonema marvinwelleri* Knight, 1934, No. 4471/50/30; D – *Orthonema* ***simplex*** sp. nov., No. 4471/2/13; E – *Orthonema cochleoides* (Yin, 1932), No. 4471/2/24; F – *O. silinae* (Licharew, 1975), No. 109 (CGM, coll. No. 9758); G – *Cibecuia* ***sinelnikovae*** sp. nov., No. 4471/22/9; H, I – *Cibecuia* ***magnum*** sp. nov., No. 4471/78/50 adult whorls and last whorls; J – *Vebericochlis arguta* (Licharew, 1975), No. 193 (CGM, coll. No. 9758). *sl* – sutural lira; *al* – additional lira; *1l*, *2l*, *3l*, and *4l*: first, second, third, and fourth main spiral lira.

РИС. 1. Морфология взрослых оборотов: A – *Orthonema frequens* Licharew, 1968, No. 4471/6/34; B — *Orthonema inoratum* Knight, 1934, по Найту [1934, pl. 57, fig. 1d]; C — *Orthonema marvinwelleri* Knight, 1934, No. 4471/50/30; D – *Orthonema* ***simplex*** sp. nov., No. 4471/2/13; E – *Orthonema cochleoides* (Yin, 1932), No. 4471/2/24; F – *O. silinae* (Licharew, 1975), No. 109 (CGM, coll. No. 9758); G – *Cibecuia* ***sinelnikovae*** sp. nov., No. 4471/22/9; H, I – *Cibecuia* ***magnum*** sp. nov., No. 4471/78/50 взрослые обороты и последние обороты; J – *Vebericochlis arguta* (Licharew, 1975), No. 193 (CGM, коллекция No. 9758). *sl* – пришовное ребро; *al* – дополнительное ребро; *1l*, *2l*, *3l* и *4l*: первое, второе, третье и четвертое основное ребро.

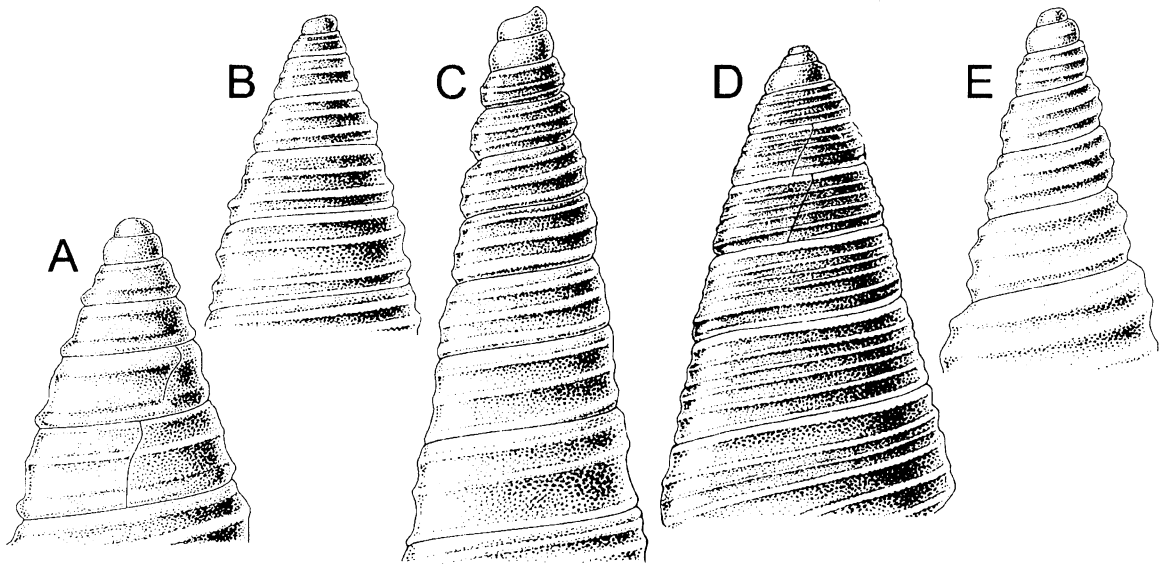


FIG. 2. The morphology of juvenile whorls: A – *Orthonema frequens* Licharew, 1968, No. 4471/79/184; B – *Orthonema marvinwelleri* Knight, 1934, No. 4471/85/74; C – *Orthonema cochleoides*, (Yin, 1932), No. 4471/79/173; D – *Orthonema silinae* (Licharew, 1975), No. 264 (CGM, coll. No. 9758); E – *Vebericochlis arguta* (Licharew, 1975), No. 4471/73/26.

РИС. 2. Морфология ювенильных оборотов: A – *Orthonema frequens* Licharew, 1968, No. 4471/79/184; B – *Orthonema marvinwelleri* Knight, 1934, No. 4471/85/74; C – *Orthonema cochleoides*, (Yin, 1932), No. 4471/79/173; D – *Orthonema silinae* (Licharew, 1975), No. 264 (CGM, coll. No. 9758); E – *Vebericochlis arguta* (Licharew, 1975), No. 4471/73/26.

upper suture (Fig. 1 C). A more pronounced sinus characterizes *O.* ***simplex*** sp. nov., *O. cochleoides* Yin, 1932 (Fig. 1 D, E), *O. nacazawai* Batten [Batten, 1985, fig. 26], and *O. subtaeniatum* (Geinitz, 1866) [Anderson, Hoare, Sturgeon, 1985, fig. 3.10]. The same type of the growth lines is also observed in numerous specimens of *O. silinae* (Licharew, 1975). Moreover, the hardly impressed growth lines on the last whorl of two largest shells from the type series exactly reflect the depth of the sinus (Figs. 1 F, 5 E). At the moment this is the first material evidencing that some species of the genus had a real slit on the apertural margin. Generally the growth lines of many species currently included in *Orthonema* are similar to those of *Stegocoelia* [Mazaev, 2001, Fig. 1], *Vebericochlis* (Fig. 1 J) and *Taosia* [Girty, 1939; figs. 1-2].

The growth lines on the shells of murchisoniid genera usually do not indicate the depth of the sinus. At the same time, the findings of shells of murchisoniid gastropods with completely preserved apertural margins are exceptionally rare. Therefore our knowledge about the presence and structure of slit is mainly speculative. Indeed, the specimens of *Stegocoelia* with a real slit were reported only recently [Mazaev, 2001]. It is a unique case that the growth lines of two figured herein specimens of *Cibecuia* ***magnum*** sp. nov. (Figs. 1 I, 5 N, R) and one specimen of *Orthonema silinae* (Figs. 1 F, 5 E) distinctly show a deep slit and two specimens of *Vebericochlis arguta* demonstrate imprints of apertural margin with slit (Figs. 3 H, I). This is the first reported material which demonstrates a real slit for these genera. The structure of these slits is generally similar to *Stegocoelia acutiformis* Mazaev, 2001 [Mazaev, 2001, Fig. 2 M]. Generally the depth of the slits is nearly twice more than the width, the margins of the slits are nearly parallel or slightly flared forward.

It is very important note, that growth lines of murchisoniid gastropods, except for *Orthonema,* have nearly similar and stable pattern. The species currently included in *Orthonema* demonstrate unusual variability of growth line patterns, which however form a successive row from strongly sinuous lines (reflecting a deep slit) to almost orthocline growth lines.

At the same time, the inverse succession of growth lines pattern can be traced in the ontogenesis of *Orthonema.* Thus, on juvenile whorls of *O. silinae* growth lines lack sinus, are slightly concave just below suture, then almost straight or slightly opisthocyrt, extending opisthoclinally across the rest of the whorl (Fig. 2 A, D). The distinct sinus appears only on 6th or 7th whorl. Thus the slit (the character of a high level importance, higher than genus level) develops only at adult stages. The gradual development of the sinus in ontogenesis is known also for some other slit-bearing gastropods. So, the distinct sinus on growth lines appears in some species of *Haliotis* and *Scissurella* at nearly half or one whorl after sinusigera, and the growth lines are almost straight or gently curved [Bandel 1982, taf. 4, fig. 1; taf. 10. figs. 9, 10; taf. 11, fig. 6].

It is highly possible that the apertural margin of *Orthonema inoratum, O. salteri, O. frequens* retains neanic characters in ontogenesis. It is also possible that the loss of slit is connected with reduction of its functional significance for advanced murchisoniid gastropods.

The presence of the slit on outer lip of murchisoniid gastropods indicates that a pair of ctenidia inside the mantle cavity were located on opposite sides of the slit, with the anal opening between them, as in the Pleurotomariacea [Knight et al., 1960: *I*290]. At the same time, the living position of the shell influenced water current in right and left sides of the mantle cavity and consequently the size of ctenidia. The considerable difference in the size of the ctenidia on the right and left sides in conispiral zygobranch gastropods is widely known [Golikov, Starobogatov, 1975: 189]. In contrast to conispiral shells, the axis of high-spired shell of murchisoniid gastropods was nearly parallel to substrate [Linsley, 1978: 204, fig. 14]. This position lead to still more asymmetry in the mantle cavity. As a result, the functional significance of right ctenidium diminished in still more extent than it occurs in conispiral Pleurotomariidae and Scissurellidae. This is reflected in appearance of distinct incipient canal at abapical end of aperture in some murchisoniid gastropods and in shift of the slit to suture in Late Paleozoic murchisoniids. Indeed, all taxa of the group that had appeared since the Middle Carboniferous had the selenizone placed above mid-whorl, distinctly shifted to suture, whereas the earliest murchisoniids possessed selenizone placed on mid-whorl or below it. This is a distinctive trend in evolution of murchisoniid gastropods. For some unknown reasons the shift of sinus and variations in growth line pattern are mostly displayed among representatives of *Orthonema*. For example, the sinus on the shells of *O. marvinwelleri* is placed so closely to suture (Fig. 1 C) that the right ctenidium must have been reduced. The anal opening must have been displaced towards suture, and original symmetry of mantle complex is thus destroyed. Two nearly symmetrical water currents directed from right and left sides should be changed to one current which enters the basal part of the aperture. However, the distinct siphonal notch and parieto-palatal canal have never developed in this group. It is possible that the changes in the mantle cavity lead to loss of slit necessity, and it does not develop in ontogenesis. The apertural margin of these species retained neanic characters which is reflected by growth lines. At the same time, other characters (whorl profile, ornamentation, position of the sinus, when known) indicate that all species *Orthonema* are closely allied.

The ornamentation of *Orthonema* is very similar to that of *Stegocoelia, Vebericochlis,* and *Taosia.* These genera differ from each other mainly by their whorl profile. Whorl face of these genera is ornamented with four main spiral lirae (Fig. 1, *1l, 2l, 3l, 4l*) and concave selenizone delimited by the first and second spiral lirae.

However, some genera deviate from this scheme. For instance, from one to all main spiral lirae of some species of *Orthonema* can be less prominent or even lost (*O. silinae,* Fig. 5 D, E; *O. cochleoides,* Fig. 5 F, H; *O. frequens,* Fig. 4 A-C, F, G, H). The main spiral lirae of many species of *Orthonema,* as well as *Vebericochlis arguta,* are divided into upper and lower pairs, while the other species of the genera demonstrate evenly disposed main spiral lirae, which is typical also of most species of *Stegocoelia*, and *Taosia.* Another type of ornamentation has a row of nodes instead of the main spiral lira, which may be observed in *Taosia crenulata* Girty, 1939 and *Vebericochlis maclayi.* The development of nodose ornamentation in shells of *Vebericochlis* is considered here as a species level feature.

Besides the main four spiral lirae, an additional weak spiral lira placed between the second and third main lirae is also present (Fig. 1, *al*). This feature is known for few species of *Stegocoelia, Vebericochlis* [*S. gzheliensis* Mazaev, 2001, *S. laschmaensis* Mazaev, 2001, *V. arguta* (Fig. 1 J)]. Another additional spiral lira may be placed in selenizone between first and second lirae. This feature is observed in several species of *Stegocoelia, Vebericochlis* and *Orthonema* [*S. knighti* (Licharew, 1975) *S. gzheliensis* Mazaev, 2001, *V. maclayi* (Fig. 3 J), *O. silinae* (Fig. 1 F, Fig. 5 E)]. The additional sutural lira (Fig. 2, *sl*) was described in some species of *Stegocoelia* [Mazaev, 2001: 138], and it is observed in *Orthonema silinae* (Fig. 5 D, E) and *O. cochleoides* (Fig. 5 J).

The development of spiral ornamentation at the whorl base is known only for the species of *Stegocoelia* and *Vebericochlis*. The number of basal lirae varies from absence up to six, and it is a rather good diagnostic feature at the species level.

The species of *Orthonema* with deep and narrow sinus possess a slightly concave selenizone which is placed between the first and second main lirae and ornamented with fine lunulae. The same selenizone can be observed in *Stegocoelia, Taosia, Vebericochlis*, and *Goniasma* Thomlin, 1930 (the latter genus has selenizone below mid-whorl).

Two species, *Orthonema salteri* and *O. frequens,* have orthocline growth lines and therefore have no selenizone, but in these species the upper pair of main lirae are of the same strength and are separated by the same interspace as in species with selenizone.

The characters discussed above are the features of adult shells. However, the ontogenetic change of whorl profile and ornamentation is prominent in these genera and it provides separation of juvenile and adult whorls. The ontogenetic changes in shells of *Orthonema* are considerable. The differences between juvenile and adult whorls may be so striking that identification of the shell fragments is full of confusion. Thus, Licharew erroneously described the juvenile whorls of *O. silinae* as *Geolcomia rara* Licharew, 1975 [Licharew, 1975: 115] and *Geolcomia* (?) sp. indet. *a.* Licharew, 1975 [Licharew, 1975: 116]. In fact, the 7th to 8th juvenile whorls of *O.*

silinae have a larger apical angle, and lacking shoulders. Moreover, the first five whorls are ornamented by six spiral lirae (Fig. 2 D). The juvenile whorls of another specimen of *Orthonema* that was identified by Pan and Erwin [2002: 44] as Genus and Species indeterminate *A* also have a larger apical angle. The morphology of the specimen is similar to juvenile whorls of *O. marvinwelleri* (Fig. 2 B). The whorl faces of both specimens are nearly flat and ornamented by three spiral lirae. The juvenile whorls of *O. frequens* have almost the same structure, but the second lira is absent (Fig. 2 A). The juvenile whorls of *O. cochleoides* are also ornamented by three spiral lirae, but the whorl profile is rounded (Fig. 2 B). Thus, the morphology of the juvenile whorls of *Orthonema* is rather variable. The juvenile whorls of *Vebericochlis* are well preserved only in several specimens of *V. arguta*. They are rather similar to *O. cochleoides* in ornamentation and profile (Fig. 2 E). These various juvenile whorls distinctly differ from those of *Stegocoelia, Hermosanema* and *Concinnispira* which possess closely placed second and third lirae forming an angular whorl profile [Mazaev 2001: 138, 140].

The protoconch morphology of the genera described herein appears to be rather similar to that of *Stegocoelia* consisting of one to three smooth rounded whorls. Unfortunately the preservation of the studied material does not allow to describe its morphology in detail. At present, the protoconch morphology of murchisoniid gastropods is insufficiently known. The protoconchs of *Cibecuia* and *Vebericochlis* have not been reported. The protoconchs of *Orthonema zionensis* Nützel, and *Orthonema* sp. have been described and figured by Nützel [Nützel 1998: 202, 203, pl. 33, F-G, H-I]. Their morphology appears to be similar to protoconch of *Cerithioides* sp. described in the same work [Nützel 1998: 203, pl. 33, J-K]. However, two lower closely spaced lirae on the weakly angular juvenile whorls of the specimens, justify their assignment to *Stegocoelia, Concinnispira* or *Hermosanema* [Mazaev 2001: 138, 140]. Virtually the same situation takes place in *Microlampra heshanensis* Pan et Erwin, 2002 [Pan, Erwin, 2002: 10, figs. 6.2-6.6]. The protoconch of that species is similar to protoconchs of the species mentioned above.

Obviously the single protoconch that surely belongs to *Orthonema* was figured by Pan and Erwin [2002: 44, figs. 22.1-22.3]. This specimen, however, was designated by the authors as Genus and Species indeterminate *A*. The spiral lirae of the specimen are regularly placed on the first juvenile whorl, and then separated in two pairs, which is typical for *Orthonema*. The protoconch of the specimen consists of a single smooth rounded whorl without basal lira; the sinusigera is not observed.

It is interesting that the protoconchs of *Platyzona luculenta* Pan et Erwin, 2002 [Pan, Erwin, 2002: 17, figs. 9.7-9.10] are similar to the protoconchs of *Cerithioides* in the structure of sinusigera, but they consist of 1.5 whorl and have no basal spiral lira.

In contrast to discussed above genera, the shells of *Cibecuia* demonstrate a minimum number of spiral elements. These elements are represented by keels, distinct selenizone and, in some cases, numerous fine spiral lirae on the shell base and weaker spiral lirae on the whorl face at gerontic stages (Fig. 5, Q, R). The genus *Cibecuia* is similar to *Arribazona* Kues 1990, and *Concinnispira* Zernetskaja 1983 in lacking spiral lirae on whorl face and having flattened selenizone delimited by a pair of fine striae. These taxa are distinguished by their whorl profiles only and in contrast to *Cerithioides* Haughton, 1859, their selenizone band is always placed above the mid-part of the whorl face. The drum-like whorl profile of *Cibecuia* is formed by small shoulder and massive lower angulation, the selenizone is shifted down from suture and not connected with the shoulder (if present) (Fig 1 G, H). However, on the last whorls of unusually large shells of *C.* ***magnum*** sp. nov., the selenizone is placed just below the massive rounded shoulder developed instead of a narrow subsutural ramp of earlier whorls (Fig. 1 H, I). The ornamentation of juvenile whorls of *Cibecuia* remains undescribed. The single poorly preserved specimen of *C.* ***magnum*** sp. nov. shows rounded juvenile whorls ornamented by three spiral lirae (Fig. 5 O).

Taxonomy

Although specimens of *Cibecuia* and *Vebericochlis* with preserved slit have never been reported, their assignment to murchisoniid gastropods was undoubted. It is considered that the growth lines and selenizone distinctly show that they are slit-bearing shells. To the contrary, the systematic position of *Orthonema* has been a subject of much discussion and debate. Since the work of Knight [1934] *Orthonema* was considered as genus closely related to Recent turritellid gastropods [Knight et al., 1960; Anderson et al., 1985; Batten, 1985; Erwin, 1988, Ponder, Warén, 1988]. On the other hand, numerous authors assigned *Orthonema* to acanthonematid gastropods, but the systematic position of the group has been changed repeatedly. Wenz [1938] considered it as a subfamily of Loxonematidae. Tracey et al. [1993] tentatively placed Acanthonematidae in Murchisonoidea. Nützel [1998] argued that Acanthonematidae is the cerithomorph sister group of the order Ptenoglossa, and probably related to the Cerithioidea, Murchisonioidea, and Pleurotomarioidea. Recently Nützel and Bandel [2000] confessed that the family Acanthonematidae is not a good choice for the placement of *Orthonema*. Based on the study of protoconch morphology, they assigned the genus to the order Cerithiomorpha Golikov et Starobogatov, 1975. Four genera *Knightella* Longstaff, 1933, *Paleostylus* Mansuy, 1914, *Spiromphalus* Hayasaka, 1939 and *Metorthonema* Erwin, 1988, were considered to be closely related to *Orthonema* and the new family Orthonemidae was proposed for them. Another new family, Goniasmidae, was established for the slit-bearing genera: *Goniasma, Stegocoelia*

and *Cerithioides*. Nützel and Bandel noted that caenogastropods could be recognized by their protoconch morphology, whereas the teleoconch morphology is often homeoplastic in this group [Nützel, Bandel, 2000: 558].

However, the transfer of these genera to Cerithiomorpha based on protoconch morphology only is not well enough grounded. First, the protoconchs of murchisoniid gastropods are still poorly known. As it was shown in morphological part of the paper, the specimens assigned by Nützel [1998] to *Orthonema* should be referred to another taxon (*Stegocoelia, Concinnispira* or *Hermosanema*). The single reported protoconch that certainly may be recognized as *Orthonema* consists, however, of only a single whorl. At the same time Nützel and Bandel noted heliciform shape of the protoconch as diagnostic character of the family Orthonemidae [Nützel, Bandel, 2000: 564]. Second, there are different Recent groups of gastropods, which include mollusks with both planktonic and benthic larvae. The type of larval development is correlated with the number of protoconch whorls. Therefore, the protoconch morphology may be homeoplastic in several groups, and various morphological features of teleoconch also should be take into account.

The genera discussed here (included most species of *Orthonema*) had a slit and therefore are considered here as zygobranch gastropods and referred to the order Pleurotomariiformes Thiele, 1925.

As it was demonstrated in morphological part of the paper, species currently included in *Orthonema* have many common characters with *Stegocoelia*, *Vebericochlis* and *Taosia*, and these genera are probably closely allied. The latter three genera were previously included in Murchisoniidae. However, their selenizone is distinctly shifted to suture. This feature is treated here as conspicuous character which separates all Late Paleozoic murchisoniid. All murchisoniid genera that have appeared since the Middle Carboniferous possess this character: *Stegocoelia*, *Vebericochlis, Taosia, Orthonema, Altadema* Kues, 2002, *Concinnispira*, *Hermosanema* Kues et Batten, 2001, *Cibecuia*, *Arribazona*, *Ferganispira* Licharew, 1967, *Loxosonia* Batten, 1985. Based on this character, a new family of the suborder Murchisonioidei should be proposed. Because *Orthonema* is included in listed above taxa and it previously was proposed as the type genus [Nützel, Bandel, 2000], this family should be named Orthonemidae. I believe that the family Orthonemidae has derived in the Early Carboniferous as the logical perfection of the murchisoniid stock (Plethospiridae – Murchisoniidae — Orthonemidae). The Goniasmidae Nützel et Bandel, 2000 is considered here as junior synonym of Murchisoniidae. Three genera, *Knightella* Longstaff, 1933, *Paleostylus* Mansuy, 1914, *Spiromphalus* Hayasaka, 1939, which were transferred to Orthonemidae [Nützel, Bandel, 2000], have characters which allied them to loxonematid gastropods. Therefore, these genera are excluded from Orthonemidae.

Order Pleurotomariiformes Thiele, 1925

Suborder Murchisonioidei Cox & Knight, 1960

Superfamily Murchisoniacea Koken, 1896

Family Orthonemidae Nützel et Bandel, 2000

Type genus – *Orthonema* Meek et Worthen, 1862.

Diagnosis. High-spired shells, ornamentation consists of spiral elements and selenizone band or selenizone band only; selenizone placed above midwhorl face; growth lines fine, extending prosoclinally above selenizone, forming lunulae at selenizone, below the selenizone prosocyrt, and extending opisthoclinally across remainder whorl; growth lines of species with neanic features possesses shallow labral sinus or almost straight.

Included genera: *Orthonema* Meek et Worthen, 1862, *Metorthonema* Erwin, 1988, *Stegocoelia* Donald, 1889, *Taosia* Girty, 1939, *Vebericochlis* Licharew, 1967, *Altadema* Kues, 2002, *Concinnispira* Zernetskaja, 1983, *Hermosanema* Kues et Batten, 2001, *Cibecuia* Winters, 1956, *Arribazona* Kues, 1990, *Ferganispira* Licharew, 1967, *Loxosonia* Batten, 1985.

Genus *Vebericochlis* Licharew, 1967

Stegocoelia (Vebericochlis): Licharew, 1967: 69.

Type species – *Stegocoelia (Vebericochlis) maclayi* Licharew, 1967.

Diagnosis. Shell high-spired, anomphalous. Protoconch conical, of 1 or 2 smooth whorls. Juvenile whorls nearly rounded or almost straight, ornamented with three or four spiral lirae with equal interspaces between them. Face of adult whorls with narrow subsutural ramp forming shoulder. Shell surface below shoulder slightly rounded or straight, ornamented with four main spiral lirae, upper lira marking the shoulder. Additional weak spiral lira may be placed on selenizone and between second and third main spiral lirae. Some spiral lirae may be expressed as rows of nodes. Selenizone band concave, smooth, with weak lunula of growth lines, bordered by first and second main spiral lirae. Whorl face gradually passing into basal side near fourth lirae. Basal side slightly rounded, smooth or ornamented with spiral lirae. Growth lines fine, extending prosoclinally at subsutural ramp, forming lunulae at selenizone, below the selenizone prosocyrt, and extending opisthoclinally across remainder whorl.

Discussion. Originally *Vebericochlis* was erected as subgenus of *Stegocoelia* [Licharew, 1967]. In the previous paper [Mazaev 2001] the taxa *Stegocoelia*, *Taosia*, and *Vebericochlis* gained the generic rank. The difference of the whorl profile provides distinction of these genera. On the other hand, the genus shares some features with *Orthonema* and

Stegocoelia. The species of *Vebericochlis*, like some *Orthonema* species, have distinct shoulder with selenizone placed just below it. Like species of *Stegocoelia*, the shells of *Vebericochlis* lack the basal angulation and their shell base is nearly rounded and slightly elongated.

This genus currently includes two species: *Vebericochlis arguta* (Licharew, 1975) and *V. maclayi* (Licharew, 1967). *Vebericochlis arguta* was originally described from the Urals as a species of *Stegocoelia*. This is the only species of the genus sporadically encountered in Moscovian Stage of the studied region. The type species *Vebericochlis maclayi* is known only from the Central Asia and it is described and figured here for more precise definition of morphological features of the genus.

Vebericochlis arguta (Licharew, 1975)
(Figs. 1 J, 2 E, 3 A – I)

Stegocoelia (*Hypergonia*?) *arguta*: Licharew, 1975: 72, 73, pl. XI, fig. 7; *Stegocoelia* (*Hypergonia*?) *sclaris*: Licharew, 1975: 72, pl. X, fig. 16.

Types. Holotype No. 139, Central Geological Museum, St.–Petersburg, collection No. 9758.

Type locality. Eastern Flank of the Urals, Karabolka River, outcrops near Ust'-Karabolka village, Myachkovian Provincial Stage, Moscovian Stage.

Description. High-spired shell of medium size, with up to 11 shouldered, nearly straight-sided or slightly convex whorls, suture grooved, not deep. Protoconch of about 2 smooth rounded whorls. Juvenile whorls ornamented with 3 or sometimes with 4 spiral lirae with equal interspaces bands between them. Initial juvenile whorls nearly rounded, last nearly straight-sided, inclined to shell axis at up to 10°. Adult whorls with sharply angular shoulder marked by first main spiral lira and separated from suture by flattened subsutural ramp inclined at about 50°. Its width equal to width of selenizone or slightly larger at mature stage. Sutural lira absent or very weak on last whorl. Below shoulder whorl face flat or slightly convex, nearly parallel to shell axis, ornamented by 4 main spiral lirae grouped in upper and lower pairs, interspace between pairs almost twice wider than interspace in each pair. Addition weak lira appears between the pairs on last whorls. Selenizone placed just below shoulder, concave, bounded by first and second lirae. Whorl face gradually passing into basal side near fourth lirae. Basal side smooth or ornamented with up to 3 spiral lirae on last whorls with equal interspaces between them. Aperture suboval in shape, with incipient siphonal notch and well developed slit placed just below shoulder. The slit twice deeper than wide. Outer and inner lips thin, columella moderately long, almost straight. Growth lines very thin, prosocline above selenizone and prosocyrt below selenizone. Selenizone band smooth, with very fine lunula of growth lines.

Discussion. The large number of the studied specimens shows a wide range of intraspecific variability. The pleural angle varied from 12 to 27°, the whorl face profile below shoulder also changes from straight to slightly concave.

The species is similar to *V. maclayi* but differs from it by irregularly placed main spiral lirae usually grouped in the upper and lower pairs on the last whorls.

Measurements (mm):

Specimen	Height	Max. diameter
4471/73/26	14.0	5.0
4471/73/17	13.0	2.5
4471/73/52	10.0	3.5
4471/73/56	15.0	5.5
4471/73/54	6.0	2.5
4471/73/50	4.5	2.5
4471/73/16	7.0	2.5

Material examined: 48 specimens. Loc. 26 – 2 specimens; loc. 38 – 1 specimen; loc. 73 – 38 specimens; loc. 74 – 1 specimen; loc 82. – 6 specimens.

Occurrence. Central part of the Russian Plate: Kashirian and Myachkovian Provincial Stages; Eastern flank of the Urals: Myachkovian Provincial Stage.

Vebericochlis maclayi (Licharew, 1967)
(Figs. 3 J, K)

Stegocoelia (Vebericochlis) maclayi Licharew, 1967: 69, pl. XV, figs. 1 – 8; *Stegocoelia (Hypergonia) ambigua* Licharew, 1967: 64, pl. XIV, figs. 8 – 14.

Types. Holotype No. 170, Central Geological Museum, St.–Petersburg, collection No. 8336.

Type locality. Kara-Chatyr Ridge, outcrop No. 5, Uzbekistan; Asselian Stage.

Description. High-spired shell of medium size with, up to 11 slightly shouldered, slightly convex whorls, suture grooved, shallow. Protoconch not preserved. Juvenile whorls straight-sided, inclined to shell axis at up to 10°, ornamented with 3 spiral lirae with equal interspaces between them. Adult whorls with angular shoulder marked by first main spiral lira and separated from suture by narrow flattened subsutural ramp inclined at about 50°. Its width slightly less than width of selenizone. Sutural lira absent. Below the shoulder, whorl face slightly convex in profile, ornamented by 4 main spiral lirae separated by equal interspaces. Two lower spiral lirae may be developed as rows of nodes. Selenizone placed just below shoulder, concave, bordered by first and second lirae. Some specimens show additional weak lirae at lower part of selenizone. Whorl face gradually passing into basal side near fourth lirae. Basal side smooth or ornamented in upper part with up to 3 spiral lirae. Aperture suboval in shape, with incipient siphonal notch. Slit not preserved. Outer and inner lips thin, columella slightly arched or straight. Growth lines very thin, badly preserved, prosocline above selenizone and prosocyrt below selenizone. Selenizone band smooth, with very fine lunula of growth lines.

Discussion. The species is known from type lo-

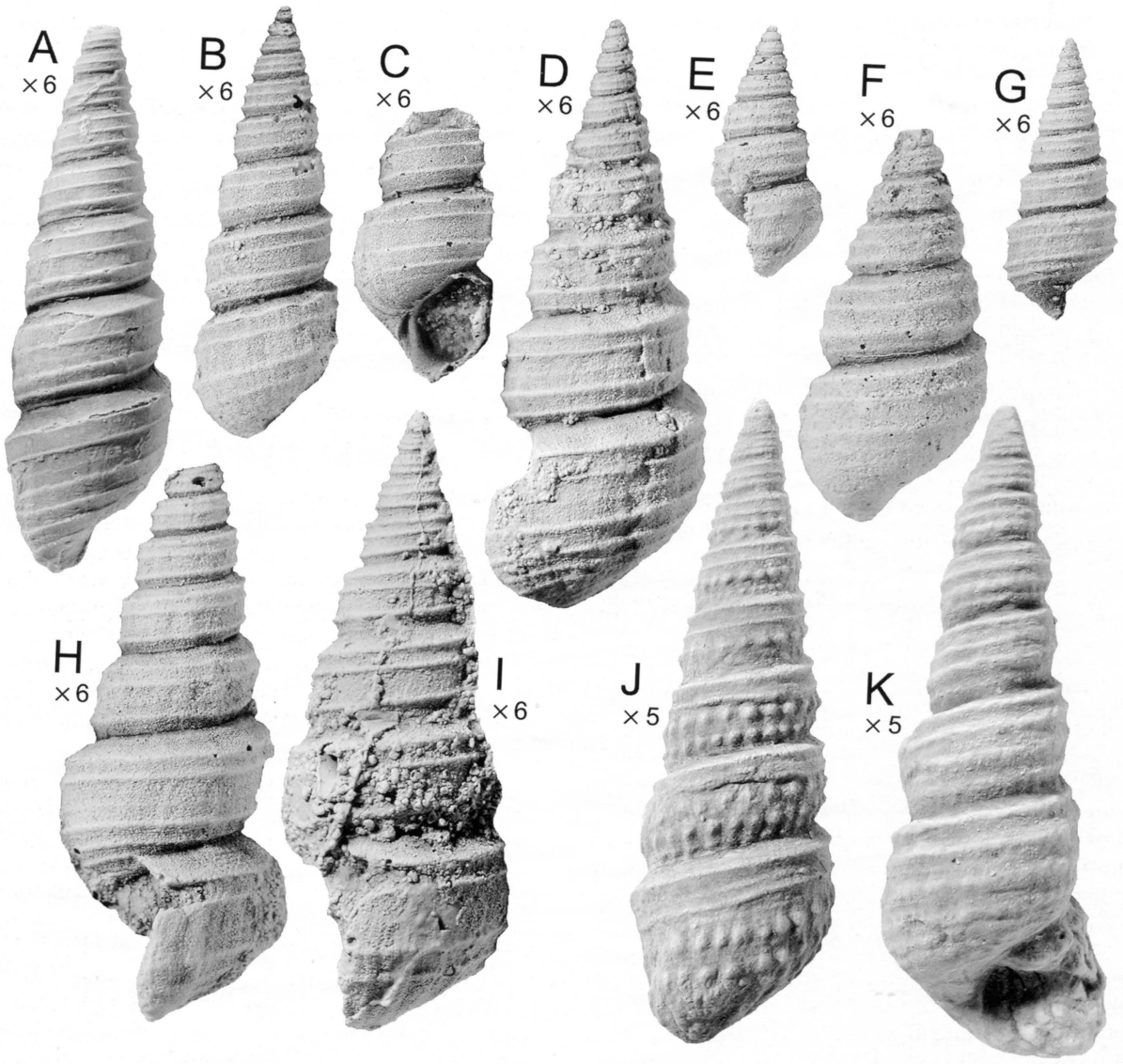


FIG. 3. A-I – *Vebericochlis arguta* (Licharew, 1975): A – holotype No. 139, (CGM, coll. No. 9758), Eastern flank of the Urals, Myachkovian Provincial Stage; B, C – abapertural and apertural views No. 4471/73/52, D-I: No. 4471/73/26, No. 4471/73/54, No. 4471/73/5, No. 4471/73/16, No. 4471/73/17, No. 4471/73/56, Jambirno quarry, Kashirian Provincial Stage; J, K – *Vebericochlis maclayi* (Licharew, 1967), J – holotype No. 170, K – No. 149 (holotype of *Stegocoelia (Hypergonia) ambigua* Licharew, 1967), (CGM, coll. No. 8336), Kara-Chatyr Ridge, Asselian Stage.

РИС. 3. A-I – *Vebericochlis arguta* (Licharew, 1975): A – голотип No. 139, (CGM, coll. No. 9758), Восточный склон Урала, мячковский горизонт; B, C – вид с обратной стороны устью и вид со стороны устья No. 4471/73/52, D-I: No. 4471/73/26, No. 4471/73/54, No. 4471/73/5, No. 4471/73/16, No. 4471/73/17, No. 4471/73/56, Ямбирный карьер, каширский горизонт; J, K – *Vebericochlis maclayi* (Licharew, 1967), J – голотип No. 170, K – No. 149 (голотип *Stegocoelia (Hypergonia) ambigua* Licharew, 1967), (CGM, coll. No. 8336), хребет Кара-Чатыр, ассельский ярус.

cality only. Reexamination of the type material of *Stegocoelia (Hypergonia) ambigua* Licharew, 1967 from the same locality suggests that this species is a junior synonym of *V. maclayi*. Most specimens recognized by Licharew as *S. ambigua* are very similar to *V. maclayi* but lack the nodular ornamentation. However, some of them, including the holotype (Fig. 3 K) have very weak nodes on two lower lirae of the last whorls. Some specimens of *V. maclayi* possess nodose rows with tendency to develop obscure lirae. After comparison of type material of both species, the degree of development of nodes was considered as unstable feature with wide intraspecific variation. Since Licharew proposed the nodose ornamentation as a subgeneric character, the diagnosis of the genus has been changed.

Measurements (mm):

Specimen	Height	Max. diameter
170 holotype	18.2	6.5
165	18.7	5.8
149	18.6	5.9

Material examined: over 20 specimens.

Occurrence. Kara-Chatyr Ridge, Uzbekistan; Asselian Stage.

Genus *Orthonema* Meek et Worthen, 1862

Orthonema: Meek, Worthen, 1862: 146; Knight, 1934: 435; Knight, 1941: 220; Knight et al., 1960: *I*317; Anderson et al., 1985: 1012; Batten, 1985: 18, Erwin, 1988: 567.

Geolcomia Licharew, 1975: 115.

Type species – *Eunema*? *salteri* Meek et Worthen, 1861.

Diagnosis. Shell high-spired, anomphalous. Protoconch conical, of 1 or 2 smooth rounded whorls. Juvenile whorls nearly rounded or almost straight, ornamented usually with 3 or up to 6 spiral lirae with equal interspaces between them. Adult whorls barrel-like, with distinct shoulder and variously developed basal angulation. Subsutural shelf narrow. Whorl face parallel to shell axis, straight, slightly convex or concave. Shell surface ornamented with 4 main spiral lirae with equal interspaces between them, or grouped in upper and lower pairs. Additional weak spiral lira may be placed between first and second spiral lirae. Basal side slightly rounded, smooth or ornamented by fourth main lira. The growth lines fine, with variously developed labral sinus; without sinus orthocline, with well developed sinus extending prosoclinally on subsutural ramp, forming lunulae between first and second main spiral lirae, below the second main lira extending opisthoclinally across remainder whorl.

Discussion. Six species of *Orthonema* are recognized in the region, 3 of them are new. Since several specimens of *O. silinae* (Licharew, 1975) known only from the Urals possess very important features for understanding the morphology and synonymy of the genus, the species is described and figured herein. Three species: *O. marvinwelleri* Knight, 1934, *O. frequens* Licharew, 1968, and *O. cochleoides* (Yin, 1932) previously known from North America, Ferghana Valley (Uzbekistan), and nw China correspondingly, are rather widely spread in the studied region. The species *O.* ***simplex*** sp. nov., *O.* ***borovskensis*** sp. nov., and *O.* ***pigmaea*** sp. nov. are represented by single specimens and obviously are endemic.

Orthonema frequens Licharew, 1968
(Figs. 1 A, 2 A, 4 A – J)

Orthonema frequens: Licharew, 1968: 42, pl. XII, figs. 1-17; *Orthonema* cf. *frequens*: Licharew, 1975: 119, pl. XIX, fig. 16.

Types. Holotype No. 369, Central Geological Museum, St.–Petersburg, collection No. 8336.

Type locality. Kara-Chatyr Ridge, outcrop No. 5, Uzbekistan; Asselian Stage.

Description. Shell small or medium sized (8.5 mm high in studied region and up to 18.5 mm high in type locality), high-spired, consists of at least 15 barrel-like whorls, anomphalous. Suture distinct, shallow. Pleural angle from 8 to 27°. Protoconch conical, of 1 or 2 smooth whorls. Face of juvenile whorls nearly concave, inclined to shell axis at about 20°, ornamented usually with 3 spiral lirae with equal interspaces between them, upper and lower lirae placed just near sutures, middle lira not developed or weak. Adult whorls ornamented with 4 spiral lirae grouped in upper and lower pairs of equal width. Fourth lira usually covered by subsequent whorl and suture placed between third and fourth lirae. Interspace between pairs wider interspaces of any pair by 4 or 6 times. Interspace between pairs consists of most part of whorl face, slightly concave, flattened or slightly convex in profile. Subsutural ramp very narrow, shoulder marked by first or second lira and its position may change in ontogenesis several times. Interspace between suture and first lirae equal to band between first and second lirae or smaller. Basal angulation marked by third lirae. Basal side weakly rounded, smooth or ornamented by fourth lira. At different ontogenetic stages some lirae may be weakly developed or disappear. Growth lines fine, without labral sinus, orthocline or inclined at about 5°. Aperture suboval, outer lip thin, inner lip thickened, columella slightly arched.

Discussion. The abundant material (nearly 1000 specimens) from Kara-Chatyr Ridge and 25 specimens from the studied region show wide range of intraspecific variability. The shells from Kara-Chatyr Ridge (Fig. 4, I, J) are larger than the shells from the Russian Plate. The wide range of intraspecific variability has been also noted by Batten [1995: 29] for *O. salteri* from Texas and by Kues and Batten, [2001: 52] for New Mexico. Shells of both species vary in size, number of whorls, pleural angle, profile of whorl faces, suture position, development of spiral lirae.

The specimens of *O. frequens* are very difficult to distinguish from *O. salteri*. Licharew [1968: 43] notes that the taxon is possibly a subspecies of *O. salteri*. Indeed, there are specimens with distinct drum-like whorls among the studed material, which are quite similar to *O. salteri*. Obviously, the single difference between these species is only the whorl profile. Generally, the whorl profile of *O. frequens* is more rounded, while the whorl profile of *O. salteri* is concave or straight and less rounded. In addition, the whorls of *O. frequens* are slightly flaring down.

Some specimens from studied region and from Kara-Chatyr Ridge lack spiral lirae, so Licharew considered them as var. *laevis*. The specimens with fully absent spiral ornamentation are present in the studied material (Fig. 4, H), along with the specimens that lost only the first and fourth lirae (Fig. 4, A, B, G). The shells with such characters were found at different stratigraphic levels along with the shell of the same species with developed ornamentation. Therefore, it is difficult to give any taxonomic significance to this feature.

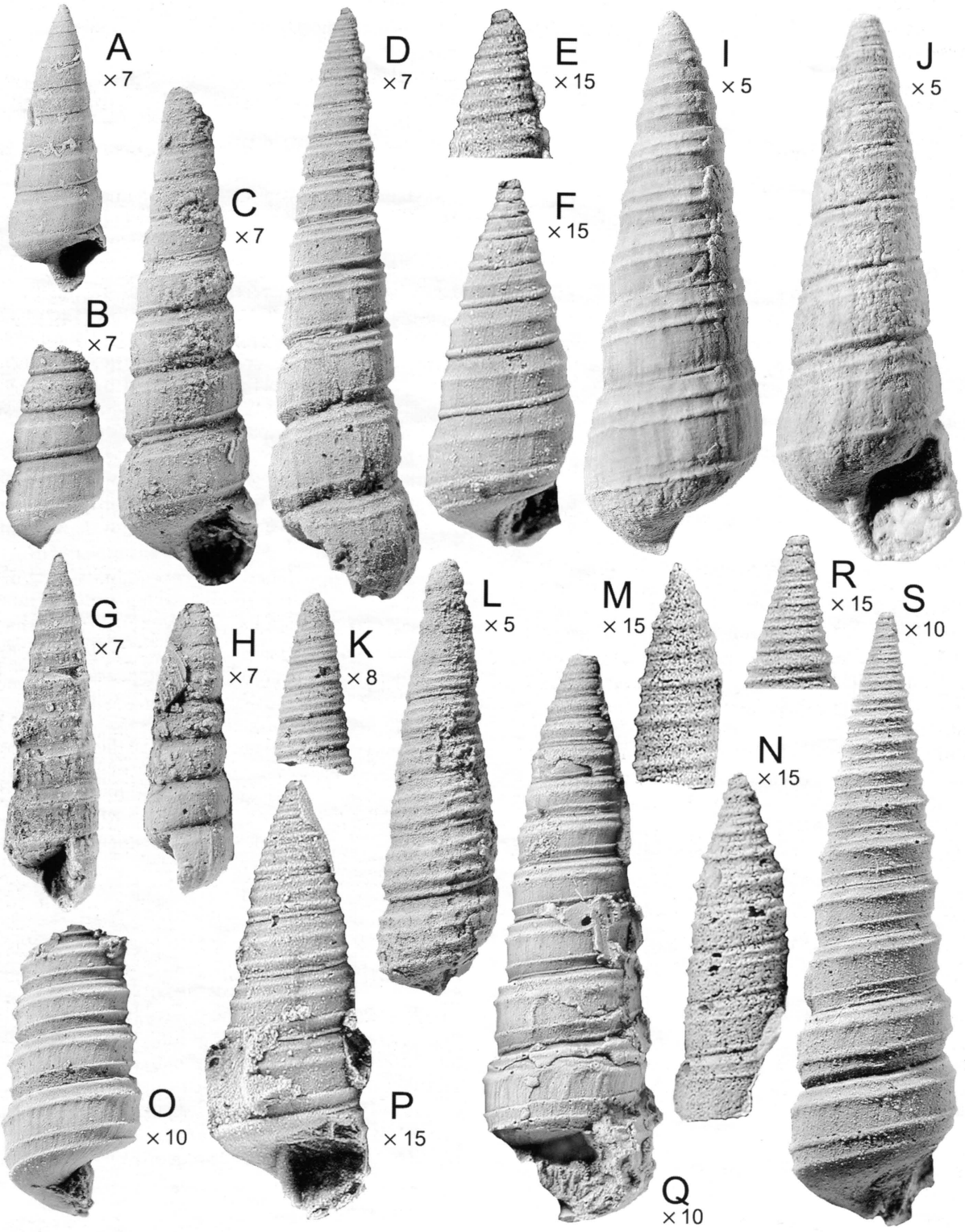


FIG. 4. A-J – *Orthonema frequens* Licharew, 1968, A-C – No. 4471/6/37, No. 4471/6/34, No. 4471/6/57, Gzhel quarry, Amerevian Provincial Stage, D-E – No. 4471/85/9, Akishino quarry, Korobcheevo Formation, F – No. 4471/79/184, G – No. 4471/80/7, Akishino quarry, Domodedovo Formation, H – No. 4471/18/240, Afanasievo quarry, Ratmirovo Formation, I – No. 371, J – holotype No. 369, (CGM, coll. No. 8336), Kara-Chatyr Ridge, Asselian Stage; K-L – *Orthonema* ***borovskensis*** sp. nov., K – paratype No. 4471/94/42, L – holotype No. 4471/94/41, outcrop near Borovsk, Verejan Provincial Stage; M-N – *Orthonema* ***paulum*** sp. nov., M – paratype No. 7741/74/8, N – holotype No. 7741/74/11, Maleevo quarry, Podolskian Provincial Stage; O-S – *Orthonema marvinwelleri* Knight, 1934, O-Q – No. 4471/50/30, No. 4471/50/32, No. 4471/50/136, Domodedovo quarry, Korobcheevo Formation, R-S – No. 4471/85/74 Akishino quarry, Korobcheevo Formation.

Measurements (mm):

Specimen	Height	Max. diameter
4471/6/37	7.2	2.3
4471/85/9	13.6	3.4
4471/79/184	4.2	1.6

Material examined: 25 specimens. Loc. 3 – 10 specimens; loc. 6 — 5 specimens; loc. 18 – 2 specimens; loc. 20 — 2 specimens, loc. 75 – 1 specimen; loc. 79 — 1 specimen; loc. 80 – 1 specimen; loc. 82 – 1 specimen; loc. 84 – 1 specimen; loc. 85 – 1 specimen.

Occurrence. Central part of the Russian Plate: Myachkovian, Krevyakinian, Rechitzian and Amerevian Provincial Stages. Central Asia, Kara-Chatyr Ridge: Kasimovian Stage, Asselian Stage. Eastern flank of the Urals: Myachkovian Provincial Stage.

Orthonema ***borovskensis*** Mazaev, sp. nov.
(Figs. 4 K, L)

Types. Holotype: No. 4471/94/41, paratype: No. 4471/94/42.

Type locality. Kaluga Region, Borovsk, right bank of Protva River opposite to Pafnutievski monastery, outcrops on the road, yellow dolomitic limestone, Verejan Provincial Stage.

Description. Shell medium sized (15.5 mm high), high-spired, consists of at least 11 barrel-like whorls, anomphalous. Suture fine, distinct, very shallow. Protoconch and juvenile whorls unknown. Adult whorls ornamented with four spiral lirae with equal interspaces between them. Subsutural ramp equal to these interspaces in width, flattened or slightly concave, inclined to shell axis at up to 27°, forming shoulder which is obscure at upper whorls and distinct at lasts whorls. Shoulder marked by first lira. Basal angulation marked by fourth lira. Whorls covered by subsequent whorls just below fourth lira. Whorl face between upper and basal angulation slightly convex. Whorl base also slightly convex with, obscure lira placed basal angulation. Growth lines not preserved.

Discussion. This species is similar to *O.* ***simplex*** sp. nov. in regularly placed spiral lirae, but distinctly differs by more rounded whorls and obscure lira at the base.

Measurements (mm):

Specimen	Height	Max. diameter
4471/94/41 holotype	15.5	4.3

Material examined: 2 specimens from type locality.

Occurrence. Type locality only.

Etymology. The species is named after Borovsk town near which the species is collected.

[**Описание.** Раковина среднего размера (15,5 мм в высоту), высококоническая, состоит по крайней мере из 11 боченковидных оборотов, без пупка. Шов тонкий, четкий, очень мелкий. Протоконх и ювенильные обороты не сохранились. Взрослые обороты орнаментированы четырьмя спиральными ребрами с равными межреберными пространствами меду ними. Подшовная площадка имеет одинаковую ширину с межреберными пространствами, плоская или слегка вогнутая, наклонена к оси раковины до 27°, формирует плечо, неясное на верхних оборотах и четкое на последних. Плечо маркируется первым спиральным ребром. Нижнее плечо маркируется четверым спиральным ребром. Обороты перекрываются последующими оборотами сразу под четвертым ребром. Боковая поверхность между верхним и нижним плечом слабо выпуклая. Базальная поверхность также слабо выпуклая, с нечетким спиральным ребром, расположенным под швом. Линии роста не сохранились.]

Orthonema ***paulum*** Mazaev, sp. nov.
(Figs. 4 M, N)

Types. Holotype: No. 4471/74/11, paratype: No. 4471/74/8.

Type locality. Maleevo quarry, Ryazan Region; light packstone below cross-layered grainstone unit in lower part of section, Podolskian Provincial Stage.

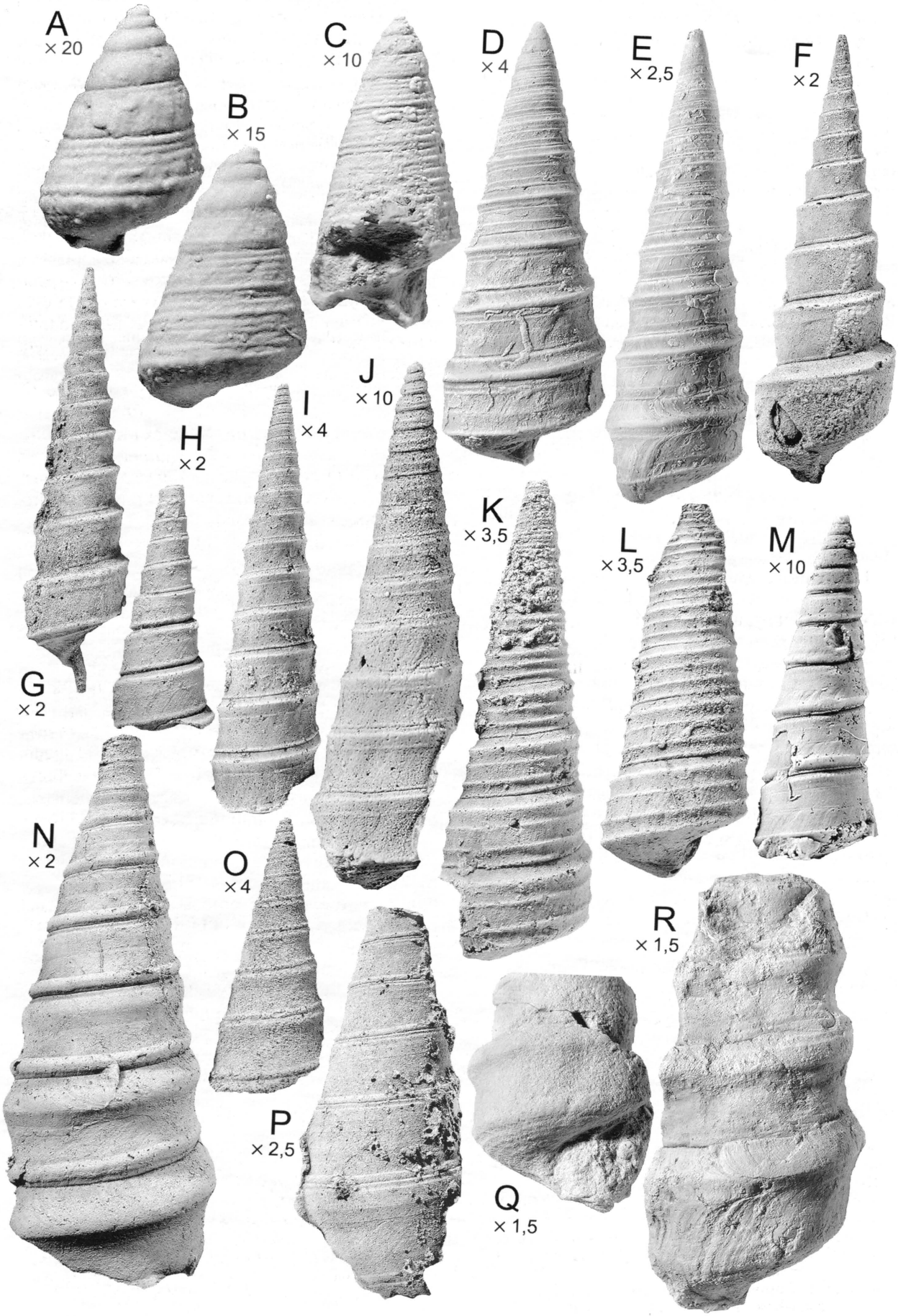
Description. Shell of very small size (up to 4 mm high), high-spired, consists of about 10 drum-like whorls, sutures very thin and shallow. Protoconch badly preserved, apparently consists of two rounded whorls. Four or five juvenile whorls conical, ornamented with 3 spiral lirae, first and third lirae fine, placed accordingly near upper and lower sutures, second lira very massive, forming keel, placed in the middle between first and third lirae. Faces of adult whorls almost straight, parallel to shell axis, ornamented with 3 spiral lirae of equal size, 2 upper lirae forming upper pair, third lira placed just above suture, distance between second and third lirae larger by 2-3 times than interspace of upper pair. Subsutural ramp twice narrower than interspace of upper pair. Shoulder marked by first lirae. Growth lines, whorls base and aperture not preserved.

Discussion. This species is similar to *Orthonema* ? *retrosum* Licharew, 1975, but differs from it by massive middle lira on juvenile whorls.

Measurements (mm):

Specimen	Height	Max. diameter
4471/74/11 holotype	4.0	1.3
4471/74/8 paratype	3.0	1.0

FIG. 4. A-J – *Orthonema frequens* Licharew, 1968, A-C – No. 4471/6/37, No. 4471/6/34, No. 4471/6/57, Гжельский карьер, амеревский горизонт, D, E – No. 4471/85/9, Акишинский карьер, коробчеевская свита, F – No. 4471/79/184, G – No. 4471/80/7, Акишинский карьер, домодедовская свита, H – No. 4471/18/240, Афанасьевский карьер, ратмировская свита, I – No. 371, J – голотип No. 369, (CGM, coll. No. 8336), хребет Кара-Чатыр, ассельский ярус; K-L – *Orthonema* ***borovskensis*** sp. nov., K – паратип No. 4471/94/42, L – голотип No. 4471/94/41, обнажение около Боровска, верейский горизонт; M-N – *Orthonema* ***paulum*** sp. nov., M – паратип No. 7741/74/8, N – голотип No. 7741/74/11, Малеевский карьер, подольский горизонт; O-S – *Orthonema marvinwelleri* Knight, 1934, O-Q – No. 4471/50/30, No. 4471/50/32, No. 4471/50/136, Домодедовский карьер, коробчеевская свита, R-S – No. 4471/85/74 Акишинский карьер, коробчеевская свита.


A
× 20
B
× 15
C
× 10
D
× 4
E
× 2,5
F
× 2
G
× 2
H
× 2
I
× 4
J
× 10
K
× 3,5
L
× 3,5
M
× 10
N
× 2
O
× 4
P
× 2,5
Q
× 1,5
R
× 1,5

Material examined: Type material only.

Occurrence. Type locality only.

Etymology. *Paulum* (Latin). – small.

[**Описание.** Раковина очень маленькая (до 4 мм в высоту), высококоническая, состоит по крайней мере из 10 цилиндрических оборотов, шов очень тонкий и мелкий. Протоконх плохой сохранности, по-видимому состоит из двух округлых оборотов. Ювенильные обороты в количестве до пяти, конические в очертаниях, орнаментированы тремя спиральными ребрами, первое и третье спиральное ребро тонкие, расположены соответственно около верхнего и нижнего швов, второе ребро очень массивное, образует киль между первым и третьим ребрами. Боковая поверхность взрослых оборотов почти прямая, параллельная оси раковины, орнаментирована тремя спиральными ребрами одинаковых размеров, два верхних ребра формируют верхнюю пару, третье ребро расположено сразу над швом, расстояние между вторым и третьим ребрами больше межреберного пространства верхней пары в два или три раза. Подшовная площадка в два раза уже межреберного пространства верхней пары. Верхнее плечо обозначено первым ребром. Линии роста, основание оборотов и устье не сохранились.]

Orthonema marvinwelleri Knight, 1934
(Figs. 1 C, 2 B, 4 O – S)

Orthonema marvinwelleri: Knight, 1934: 444, pl. 57, figs. 3 a-c; Knight, 1944: 477, pl. 195, figs. 3, 4.

Types. Holotype: Yale Peabody Museum No. 13944. Paratype: No. 13945.

Type locality. Base of the Pawnee limestone at loc. 6 in the St. Louis outlier.

Description. Shell small (up to about 10 mm high), high-spired, consists of up to 17 drum-like whorls, with fine and shallow suture, anomphalous. Protoconch consists of two smooth rounded whorls. Three or four juvenile whorls subconical, ornamented with 3 spiral lirae separated by concave interspaces of about equal size. First lira placed just near suture, second lira equal to it in thickness and placed on mid-part of whorl face, third lira massive, placed just above lower suture. Adult whorls face ornamented with 4 spiral lirae of equal size, grouped in upper and lower pairs, first lira placed just near suture or slightly shifted from it, surface between pairs flat or slightly concave, approximately twice wider than width of pairs. Shoulder marked by second lira, band between first and second lirae inclined to shell axis at up to 27°. Suture very fine and shallow, placed just below fourth lira. Base of body whorl weakly convexed, smooth. Growth lines relatively rough, forming fine lunulae between upper lirae, below second lira slightly prosocyrt, inclined at about 10°. Labral sinus distinct, shallow and narrow, placed between first and second lirae. Aperture close to parallelogram in shape, outer lip thin, inner lip thickened, columella moderately long, almost straight or slightly arched.

Discussion. This species is very similar to *O. salteri* and *O. frequens*, but the fourth lirae of two last species is placed on the base, while *O. marvinwelleri* has the fourth lira at the whorl face; moreover the growth lines of *O. marvinwelleri* show distinct labral sinus. The very narrow subsutural ramp distinctly distinguishes *O. marvinwelleri* from *O. nakazawai* Batten, 1985.

Measurements (mm):

Specimen	Height	Max. diameter
4471/50/32	5.2	1.8
4471/50/136	9.4	3.0
4471/85/74	10.7	3.0

Material examined: 48 specimens. Loc. 22 – 4 specimens; loc. 23 — 4 specimens; loc. 24 – 11 specimens; loc. 28 — 1 specimen, loc. 40 – 2 specimens; loc. 50 — 15 specimens; loc. 54 – 1 specimen; loc. 70 – 2 specimens; loc. 74 – 1 specimen; loc. 85 – 7 specimens.

Occurrence. Missouri, St. Luis: Desmoinesian; Central part of the Russian Plate: Myachkovian Provincial Stage.

FIG. 5. A-E – *Orthonema silinae* (Licharew, 1975): A, B – (paratype and holotype of *Geolcomia rara* Licharew, 1975) No. 262, No. 261, C – No. 264, D – No. 415, E – holotype No. 109, (CGM, coll. No. 9758), Eastern flank of the Urals, Myachkovian Provincial Stage; F-J – *Orthonema cochleoides* (Yin, 1932), F – No. 4471/78/51, Akishino quarry, Domodedovo Formation, G – No. 4471/21/10, Peski quarry, Korobcheevo Formation, H – 4471/2/24, Shchelkovo quarry, Amerevian Provincial Stage, I-J – No. 4471/79/59, No. 4471/79/173, Akishino quarry, Domodedovo Formation; K-L – *Orthonema* ***simplex*** sp. nov., K – holotype No. 4471/2/17, L – paratype No. 4471/2/13, Shchelkovo quarry, Amerevian Provincial Stage; M – *Cibecuia* ***sinelnikovae*** sp. nov., holotype No. 4471/22/9, Podolsk quarry, Korobcheevo Formation; N-R – *Cibecuia* ***magnum*** sp. nov., N – holotype No. 4471/78/50, Akishino quarry, Domodedovo Formation, O – No. 4471/39/10, sw Moscow, Research of city subway, Kashirian Provincial Stage, P – No. 4471/21/8, Peski quarry, Korobcheevo Formation, Q – No. 4471/65/2, Domodedovo quarry, Peski Formation, R – No. 212, (CGM, coll. No. 8336), Middle Asia, Kizil-Kia mountain, Lower part of Upper Carboniferous.

FIG. 5. A-E – *Orthonema silinae* (Licharew, 1975): A, B – (паратип и голотип *Geolcomia rara* Licharew, 1975) No. 262, No. 261, C – No. 264, D – No. 415, E – голотип No. 109, (CGM, coll. No. 9758), Восточный склон Урала, мячковский горизонт; F-J – *Orthonema cochleoides* (Yin, 1932), F – No. 4471/78/51, Акишинский карьер, домодедовская свита, G – No. 4471/21/10, Песковский карьер, коробчеевская свита, H – 4471/2/24, Щелковский карьер, амеревский горизонт, I-J – No. 4471/79/59, No. 4471/79/173 Акишинский карьер, домодедовская свита; K, L – *Orthonema* ***simplex*** sp. nov., K – голотип No. 4471/2/17, L – паратип No. 4471/2/13, Щелковский карьер, амеревский горизонт; M – *Cibecuia* ***sinelnikovae*** sp. nov., голотип No. 4471/22/9, Подольский карьер, коробчеевская свита; N-R – *Cibecuia* ***magnum*** sp. nov., N – голотип No. 4471/78/50, Акишинский карьер, домодедовская свита, O – No. 4471/39/10, Юго-запад Москвы, разработки метро, каширский горизонт, P – No. 4471/21/8, Песковский карьер, коробчеевская свита, Q – No. 4471/65/2, Домодедовский карьер, песковская свита, R – No. 212, (CGM, coll. No. 8336), Средняя Азия, гора Кизил-Кая, низы верхнего карбона.

Orthonema silinae (Licharew, 1975)
(Fig. 1 F, 2 D, 5 A – E)

Goniasma silinae: Licharew, 1975: 65, pl. IX, figs. 10 – 12; *Geolcomia rara*: Licharew, 1975: 115, pl. XIX, figs. 1 – 3; *Geolcomia* ? sp. indet. *a*; Licharew, 1975: 116, pl. XIX, fig. 4.

Types. Holotype No. 109, Central Geological Museum, St.–Petersburg, collection No. 9758.

Type locality. Eastern flank of the Urals, Karabolka River, outcrops near Ust'-Karabolka village, Myachkovian Provincial Stage, Moscovian Stage.

Description. Shell of large size (approximately 36 mm high), high spired, consists of at least 15 drum-like whorls, anomphalous. Protoconch consist of 2 or 3 smooth rounded whorls. Six or seven juvenile whorls subconical, ornamented with 6 fine spiral lirae, upper lira placed just below suture. On adult whorls upper lira developed as weak subsutural lira and placed just near suture, the second and fourth lirae forming upper pair bordering of selenizone, the third lira placed between them as a weak additional lira, the fifth and sixth lirae forming lower pair. Upper and lower pairs equal in width formed by first, second, third, and fourth main lirae. Subsutural ramp approximately equal to selenizone in width or slightly wider on last whorls, flattened or slightly concave, inclined to shell axis at up to 30°. Whorl face between upper and basal angulation straight to concave. Shoulder marked by first main lira, basal angulation marked by fourth main lira, these lirae comparatively massive. Fourth main lira may disappear on last whorls. Interspace between selenizone and lower pair of lirae nearly equal to selenizone on earlier whorls and almost twice wider than selenizone on last whorls. The suture very fine and shallow, placed just below fourth lira. Base of body whorl weakly convexed, smooth. Aperture suboval in shape, with incipient siphonal notch and well development slit placed just below shoulder. Slit twice deeper than wide. Columella almost straight or slightly arched. Growth lines very distinct, fine, prosocyrt and extended prosoclinally above selenizone, inclined to shell axis at about 45°; slightly prosocyrt and extended opisthoclinally below selenizone, inclined to shell axis at about 30°. Selenizone smooth, concave, with very fine lunulae of growth lines, may be ornamented with additional weak spiral lira.

Discussion. This species is known only from the type locality. It is redescribed here to demonstrate the important features justifying its assignment to the genus *Orthonema*. Few larger specimens show distinct growth lines that undoubtedly prove the presence of a true slit on the last whorl. The type series of *Geolcomia rara* Licharew, 1975 is considered here as juvenile shells of *O. silinae*. Since *G. rara* is the type species of *Geolcomia*, this genus is considered here as a junior synonym of *Orthonema*. All studied specimens demonstrate considerable changes in shell morphology during the ontogenesis. Seventh and eight juvenile whorls of *O. silinae* have larger apical angle than adult whorls and lack the shoulders. Moreover, the faces of the first five whorls are ornamented by six spiral lirae (Fig. 2 D). Holotype and paratype of *Geolcomia rara*, as well as the specimen of *Geolcomia* sp. *a* are figured here (Fig. 5 B, A, and C, correspondingly), the type material of *O. silinae* is also are figured (Fig. 5 D, E).

Measurements (mm):

Specimen	Height	Max. diameter
262	2.55	1.55
261	3.33	1.70
264	5.9	2.55
415	21.0	7.5
109 holotype	35.6	11.2

Material examined: 23 specimens.

Occurrence. Type locality only.

Orthonema cochleoides (Yin, 1932)
(Figs. 1 E, 2 C, 5 F – J)

Solenospira cochleoides: Yin 1932, p. 20, pl. II, figs. 21–23.

Types. Holotype: No. 4808, paratypes: No. 4807, 4709.

Type locality. Middle Carboniferous, Penchi Series. Monkou Formation, Monkou, Fi-I-Hsien, Kansu, North China.

Description. Shell large (up to about 45 mm high), high-spired, consists of up to about 20 drum-like whorls, anomphalous. Protoconch consists of about two smooth rounded whorls. Three or four juvenile whorls rounded in profile, ornamented with 3 distinct and fine spiral lirae with concave interspaces of equal size between them. Adult whorls shouldered, ornamented by 4 spiral lirae grouped in upper and lower pairs. First and third lirae fine on earliest whorls, becoming broad, low to obscure on last whorls. Second and fourth lirae fine, or may disappear on last whorls. Shoulder marked by first lira basal angulation marked by third lira. Interspace between pairs of lirae twice or more wider than selenizone. Subsutural ramp slightly convex, flattened, or concave in appearance, inclined to shell axis at about 30°, approximately equal in width to upper pair of lirae. Whorl face below shoulder concave or straight in profile, or slightly convex at lasts whorls, almost parallel to shell axis. Suture very fine and shallow, placed just below third lira. Base of body whorl almost straight, elongated downward, smooth or ornamented with fourth spiral lirae placed below basal angulation; additional rounded lirae may be placed near columella. Columella straight or spirally twisted, moderately long. Aperture oval in plane, with incipient siphonal notch, outer lip relatively thick, apparently with slit of unknown depth, placed just below shoulder. Growth lines fine to obscure, extending from upper suture to the shoulder prosoclinally; interspace band between upper pair of lirae smooth or ornamented with lunulae; on the whorl face below upper pair of lirae, growth lines straight, extending opisthoclinally, inclined to shell axis at up to 30°.

Discussion. This species is similar to *O. silinae* in the shell outline but distinctly differs by position of fourth lira and the shape of juvenile whorls and number of spiral lirae on them.

Kues and Batten [2001: 52, figs. 10.6–10.8] described specimens from Flechado Formation that have been identified as *Orthonema teliscopiforme* Erwin, 1988. I cannot find the distinct differences between this material and the shells described here, so all these specimens possibly belong to one species.

In the original description, Yin noted resemblance of *O. cochleoides* to *Murchisonia nikitini* Shtuckenberg [1905: 90, pl. XII fig. 10]. Unfortunately, the Shtuckenberg's types were lost during the World War II. The quality of original illustration of *Murchisonia nikitini* does not allow to make any conclusions.

Measurements (mm):

Specimen	Height	Max. diameter
4471/78/51	43.0	13.0
4471/21/10	40.5	10.0
4471/2/26	19.5	6.5
4471/79/59	21.0	5.0
4471/79/173	10.0	approx. 3.0

Material examined: 24 specimens: Loc. 2 – 10 specimens, loc. 8 – 2 specimens, loc. 16 – 1 specimen, loc. 21 – 1 specimen, loc. 24 – 1 specimen, loc. 39 – 1 specimen, loc. 47 — 1 specimen, loc. 54 — 2 specimens, loc. 74 – 1 specimen, loc. 78 – 2 specimens, loc. 79 – 2 specimens.

Occurrence. Central part of the Russian Plate: Kashirian, Myachkovian, Rechitzian and Amerevian Provincial Stages. North China, Kansu, Penchi Series, Middle Carboniferous.

Orthonema ***simplex*** Mazaev, sp. nov.
(Figs. 1 D, 5 K, L)

Types. Holotype: PM RAS, No. 4471/2/17, paratype: No. 4471/2/13.

Type locality. Shchelkovo quarry, Moscow Region; upper part of thick (2 m) unite yellow limestone, approximately 3.5 m above the top of motley shales; Amerevian Provincial Stage, Gzhelian Stage.

Description. High-spired shell of medium size (up to 18.5 mm high), consists of at least 15 drum-like whorls, anomphalous. Protoconch not preserved. Juvenile whorls badly preserved. Adult whorls shouldered, ornamented with 4 spiral lirae separated by concave bands of equal size. Subsutural ramp or slightly concave, equal to bands between lirae in width, inclined to shell axis at about at 30°. Whorl face below shoulder nearly straight in profile, inclined to shell axis at no more then 5°. Shoulder marked by first spiral lira, basal angulation marked by fourth spiral lirae. Suture very fine and shallow, placed just below fourth lira, sometimes succeeding whorl partly covering the lira. Whorl base weakly convexed, smooth. Columella short. Aperture subtrapezoid in plane, with incipient siphonal notch, outer lip apparently with slit of unknown depth, placed just below shoulder. Growth lines fine, extending at subsutural shelf prosoclinally, between first and second lirae forming fine lunulae, below second lira growth lines almost straight, extending opisthoclinally, inclined to shell axis at about 30°.

Discussion. This species is characterized by regularly placed spiral lirae and in this feature it is similar to *O.* ***borovskensis*** sp. nov. However it can be distinguished by almost straight whorl face in profile and smooth base.

Measurements (mm):

Specimen	Height	Max. diameter
4471/2/17 holotype	18.5	5.6
4471/2/16 paratype	14.5	5.0

Material examined: 2 specimens from type locality.

Occurrence. Type locality only.

Etymology. *Simplex* (Latin) – simple.

[**Описание.** Высококоническая раковина, среднего размера, (до 18,5 мм в высоту), состоит по крайней мере из 15 барабановидных оборотов, без пупка. Протоконх не сохранился. Ювенильные обороты плохой сохранности. Взрослые обороты с отчетливым плечом, орнаментированы четырьмя спиральными ребрами, разделенными вогнутыми межреберными полосками равных размеров. Подшовная площадка плоская или слегка вогнутая, равна по ширине межреберным полоскам, наклонена к оси раковины примерно на 30°. Боковая поверхность оборота под верхним плечом в профиле почти прямая, наклонена к оси раковины не более чем на 5°. Верхнее плечо маркировано первым спиральным ребром, нижнее плечо маркировано четвертым спиральным ребром. Шов очень тонкий и мелкий, расположен сразу под четвертым ребром, иногда последующий оборот частично перекрывает это ребро. Базальная поверхность слабо выпуклая, гладкая. Столбик короткий. Устье в плане трапециевидное, с едва заметным сифональным каналом, внешняя губа очевидно должна иметь щелевидный вырез неизвестной глубины, расположенную сразу под верхним плечом. Линии роста тонкие, направлены на подшовной площадке назад от шва к плечу, между первым и вторым ребрами образуют тонкие лунулы, ниже второго ребра линии роста прямые, направлены вперед и книзу, наклонены к оси раковины примерно на 30°.]

Genus *Cibecuia* Winters, 1956.

Cibecuia: Winters, 1956: 44; Knight et al., 1960: *I*293; Winters, 1963: 38; Batten, 1985: 9.

Type species – *Cibecuia cedarensis* Winters, 1956.

Diagnosis. High-spired shell, consists of numerous drum-like whorls, anomphalous. Protoconch of one smooth whorl. Whorl face of adult whorls straight or concave in profile, nearly parallel to shell axis or slightly inclined to it. Suture fine, distinct. Basal angulation well developed, distinctly separating face and base of whorls. Whorl face smooth, ornamented with lira or row of nodes below suture, which may form very small shoulder with narrow subsutural ramp. Selenizone flattened, bordered by

two fine striae, placed just above mid-whorl face. Whorl base moderately rounded, smooth or ornamented with spiral lirae. Growth lines distinct, fine, sometimes rough, prosocyrt and extended prosoclinally above selenizone, forming lunulae on selenizone, and slightly prosocyrt and extended opisthoclinally below selenizone.

Discussion. The genus previously included few species from the Permian of Arizona, western Texas, and Malaysia. Two new species described herein considerably extend the geographic and stratigraphic ranges of the genus. The new species are: *C.* ***sinelnikovae*** sp. nov. and *C.* ***magnum*** sp. nov. The shells of the latter species are characterized by unusually large size and have been previously described from Ferghana Valley (Uzbekistan) as *Ferganispira* sp. indet. [Licharew, 1967] and from New Mexico (U. S.) as *Orthonema* sp. 2 [Kues, Batten, 2001].

Cibecuia ***sinelnikovae*** Mazaev, sp. nov.
(Figs. 1 G, 5 M)

Types. Holotype No. 4471/22/9.

Type locality. Podolsk quarry; light fusuline grainstone with colonial corals, Domodedovo Formation, Myachkovian Provincial Stage, Moscovian Stage.

Description. High-spired shell of small size, consists of 10 drum-like whorls, anomphalous. Protoconch of one smooth rounded whorl. Juvenile whorls subconical, with slightly convex whorl face, suture deep, grooved. Whorl face of adult whorls slightly concave in profile. Suture fine, distinct. Shoulder very small, sharp, faintly noded, separated from suture by very narrow subsutural ramp which is more than 3 times narrower than selenizone. Basal angulation rounded and relatively massive, placed above suture. Selenizone flattened, flush with shell surface, bounded by 2 fine striae. Selenizone shifted from shoulder at distance slightly smaller than its width. Whorl base badly preserved, obviously weakly convexed, smooth. Growth lines distinct, fine, sometime rough, prosocyrt and extended prosoclinally above selenizone, inclined to shell axis at about 30°; forming very fine lunulae on selenizone band; slightly prosocyrt and extended opisthoclinally below selenizone, inclined to shell axis at about 30°.

Discussion. In spite the species is known only from the holotype, it possesses very peculiar features, in particular subsutural ramp, which distinctly distinguish it from other species of the genus.

Measurements (mm):

Specimen	Height	Max. diameter
4471/22/9 Holotype	6.6	2.4

Material examined: Holotype only.

Occurrence. Type locality only.

Etymology. This species is named in honor of V. N. Sinelnikova (Geological Institute of the Russian Academy of Sciences), who many years studied the Carboniferous gastropods from the studied region and obtained this specimen.

[**Описание.** Маленькая высококоническая раковина, состоит 10 барабановидных оборотов, без пупка. Протоконх из одного гладкого округлого оборота. Ювенильные обороты субконические, со слегка выпуклой поверхностью, шов глубокий, канальчатый. Поверхность дефинитивных оборотов в профиле слегка вогнутая. Шов тонкий, четкий. Плечо очень маленькое, острое, с мелкими бугорками, отделено от шва очень узкой подшовной площадкой, ее ширина в три раза меньше ширины селенизоны. Нижний киль округлый и относительно массивный, расположен над швом. Селенизона уплощенная, лежит в одной плоскости с поверхностью раковины, ограничена двумя тонкими полосками. Селенизона смещена от шва на расстояние немного меньшее, чем её ширина. Базальная поверхность плохой сохранности, очевидно слабо выпуклая, гладкая. Линии роста четкие, тонкие, иногда грубые, направлены назад от шва к селенизоне под углом к оси раковины около 30°; на селенизоне формируются тонкие лунулы; под селенизоной линии роста слегка выпуклые, направлены вперед и книзу под углом к оси раковины около 30°.]

Cibecuia ***magnum*** Mazaev, sp. nov.
(Figs. 1 H, I; 5 N – R)

Ferganispira sp. indet: Licharew: 1967: 52, tab. XVII, fig. 19; *Orthonema* sp. 2: Kues, Batten: 2001: 57, fig. 10.30.

Types. Holotype: No. 4471/78/50, paratype: No. 4471/78/74.

Type locality. Akishino quarry (near Laschma Village), Ryasan Region; light fusuline grainstone with colonial corals, Domodedovo Formation, Myachkovian Provincial Stage, Moscovian Stage.

Description. High-spired shell of large size (up to about 50 mm high), consists of at least 14 drum-like whorls, shouldered at mature stage, anomphalous. Protoconch not preserved. Juvenile whorls badly preserved, consist of three slightly convex whorls, ornamented with 3 spiral lirae. Whorl face of adult whorls concave in profile. Suture fine, grooved. Shoulder very small and sharply separated from suture by subsutural ramp represented by very narrow convex band inclined to shell axis at about 30°. Width of subsutural ramp twice smaller than width of selenizone. Basal angulation rounded and relatively massive, placed just above suture. Selenizone flattened, flush with or slightly above or below shell surface, bounded by 2 fine striae. Selenizone shifted from shoulder at distance equal to its width. On last whorls shoulder disappears and another massive and rounded shoulder is formed just above selenizone. Selenizone on these whorls shifted from suture at distance nearly twice larger than its width. Whorl base weakly convexed, ornamented with six evenly distributed obscure spiral lirae. Aperture in plane parallelogram-shaped, with incipient siphonal channel and slit placed below shoulder on last whorls. Depth of slit twice larger than width. Columella short, slightly arched. Growth lines very distinct, fine, prosocyrt and extended prosoclinally above selenizone, inclined to shell axis at about 35°; forming very fine lunulae on selenizone band; slig-

htly prosocyrt and extended opisthoclinally below selenizone, inclined to shell axis at up to 48°.

Discussion. Shell of the species has unusual size for the genus. It undergoes considerable changes during the ontogeny, particularly at mature stage. In addition, the species differs from other species of the genus by the absence of nodose sculptural elements.

Some specimens from Licharew's collection from Ferghana Valley are referred to this species, and one of them is figured here (Fig. 5 R). I also assume that *Orthonema* sp. 2 [Kues, Batten, 2001: 57, fig. 10.30] also belongs to this species.

Measurements (mm):

Specimen	Height	Max. diameter
4471/78/50 holotype	52.0	approx. 21.0
4471/39/10	14.0	approx. 6.0

Material examined: 19 specimens: Loc. 21 – 2 specimens, loc. 39 – 13 specimens, loc. 65 – 1 specimen, loc. 78 – 2 specimens; loc. 94 – 1 specimen.

Occurrence. Central part of the Russian Plate: Verejan, Kashirian, and Myachkovian Provincial Stages. Middle Asia, Lower part of Upper Carboniferous.

Etymology. *Magnum* (Latin) – large.

[**Описание.** Крупная высококоническая раковина (до 50 мм в высоту), без пупка, состоит по крайней мере из 10 барабановидных оборотов, которые на зрелой стадии имеют массивное плечо. Протоконх не сохранился. Ювенильные обороты плохо сохранились, образованы тремя слегка выпуклыми оборотами, орнаментированы тремя спиральными ребрами. Боковая поверхность взрослых оборотов в профиле вогнутая. Шов тонкий, канальчатый. Плечо очень маленькое и острое, отделено от шва подшовной площадкой, представляющей собой очень узкую вогнутую полоску, наклоненную к оси раковины под углом 30°. Ширина подшовной площадки в два раза меньше ширины селенизоны. Нижний киль округлый и относительно массивный, расположен сразу над швом. Селенизона уплощенная, лежит либо в одной плоскости с поверхностью раковины, либо выше или ниже нее, ограничена двумя тонкими полосками. Селенизона смещена от плеча на расстояние, равное её ширине. На последних оборотах плечо исчезает, и другое массивное округлое плечо формируется сразу над селенизоной. Селенизона на этих оборотах смещается от шва на расстояние, примерно в два раза большее её ширины. Базальная поверхность слабо выпуклая, орнаментирована шестью равномерно расположенными неясными спиральными ребрами. Устье в плане параллелограммовидное, с намечающимся сифональным каналом и вырезом, который на последних оборотах расположен сразу под верхним плечом. Глубина выреза в два раза больше его ширины. Столбик короткий, слегка изогнутый. Линии роста очень четкие, тонкие, направлены назад от шва к селенизоне под углом к оси раковины около 35°; на селенизоне формируют тонкие лунулы; под селенизоной слегка выпуклые, направлены вперед и книзу под углом к оси раковины около 48°.]

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Некоторые мурчисониевые гастроподы из среднего и верхнего карбона Центральной части Русской плиты

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Впервые отмечено присутствие видов *Vebericochlis* Licharew, *Orthonema* Meek et Worthen и *Cibecuia* Winters в среднем и верхнем карбоне Центральной части Русской плиты. Роды *Vebericochlis* и *Cibecuia* ранее были известны только из пермских отложений. Из изученного региона описан один вид рода *Vebericochlis*, шесть видов рода *Orthonema* и два вида рода *Cibecuia*, из них *O.* ***borovskensis*** sp. nov., *O.* ***paulum*** sp. nov. *O.* ***simplex*** sp. nov., *C.* ***sinelnikovae*** sp. nov. и *C.* ***magnum*** sp. nov. – новые виды. *Vebericochlis maclayi* Licharew, 1967 и *Orthonema silinae* (Licharew, 1975), не найдены в изучаемом регионе, но дополнительно описаны здесь, так как важны для диагностики этих родов. Морфология описанных здесь родов подробно рассмотрена. Основываясь на признаках разных видов *Orthonema,* этот род отнесен здесь к мурчисониевым гастроподам. Описанные роды включены в семейство Orthonemidae Nützel et Bandel, 2000, семейство ревизовано и отнесено к надсемейству Murchisoniacea Koken, 1896.