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Carboniferous Ammonoids of the Taimyr Peninsula

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Abstract—Carboniferous ammonoids from the Taimyr Peninsula (Russian Arctic) are described for the first time. Despite its rare occurrence, the ammonoid fauna is of great importance for the regional stratigraphy. Scientific names of ammonoids are given according to the modern systematic scheme, three biostratigraphic assemblages that specify the age of cephalopod-bearing strata are established. New species such as *Glaphyrites taimyricus* Konovalova et Borissenkov, sp. nov. from the upper part of the Makarovskaya Formation of the Western Taimyr and *Kayutoceras pogrebitskyi* Borissenkov et Kutygin, sp. nov. from the Olen'ynskaya Formation of the Central Taimyr are described.

Keywords: Carboniferous, ammonoids, Taimyr
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This work is based on the results of processing of a part of an extensive collection of L.S. Librovitch, a well-known Russian expert on Paleozoic ammonoids, an employee of Geological Committee (VSEGEI, St. Petersburg). This collection is compiled from the collections of 1940s–1950s that were provided to Leonid Sigismundovich Librovitch for determination by geologists from different regions of the USSR. The preserved part of the collection relating to the Taimyr Peninsula was generously provided us by Professor A.V. Popov. In addition, we have used samples from the collection stored in Diamond and Precious Metal Geology Institute, Siberian Branch, Russian Academy of Sciences, Yakutsk.

Finds of ammonoids from the Carboniferous deposits of the Taimyr are rare. Despite the fact that all of ammonoids were found more than half a century ago, their descriptions and images have never been published, although the scientific names of ammonoids are often used in the literature devoted to the stratigraphy of the Taimyr Peninsula (Popow, 1965; Shishlov, 2010; Sobolev, 1999; Ustritsky and Chernyak, 1963, 1967), in production reports and explanatory notes to the State Geological Maps, where they are referred to when justifying the age of regional and local stratons.

The basis of the modern stratigraphic subdivision of the Carboniferous formations on the Taimyr Peninsula was laid by G.E. Chernyak (1960) and by V.I. Ustritsky and G.E. Chernyak (1963, 1967) and was developed later in the works of A.P. Romanov (1991), N.N. Sobolev (1999), A.N. Onishchenko et al. (2000), and S.B. Shishlov (2010). The paleontological characteristics of the deposits are given in the works of M.F. Solovieva (foraminifers), T.A. Dedok (brachiopods), and Yu.G. Rogozov (corals) (*Opornyi*..., 1972). In the Carboniferous, the modern territory of the Taimyr Peninsula experienced serious structural and tectonic transformations, accompanied by the granitoid magmatism and the change in the sedimentation regime (Vernikovsky, 1996). As a result, Carboniferous deposits throughout the region are clearly divided into two subdivisions: the lower carbonate and upper terrigenous. They are confined to three structural facies zones, where their thickness and lithological composition may vary widely (Fig. 1).

Most of ammonoids were found in deposits of the Zeledeevo unit and the Makarovskaya Formation (Western Taimyr, the northern part of the Dixon structural-facial zone) (Fig. 1). The most complete section of these stratons, including localities of cephalopods, is located in the Uboinaya River basin. The localities of ammonoids occur 6.9 and 8.6 km upstream of the river mouth (Figs. 1, 2; points A1, A2). The section is based on the description of a series of outcrops in the lower reaches of the Uboinaya River. As the description of the section was previously published only in a brief form (Ustritsky and Chernyak, 1963), we present more complete data using the archi-

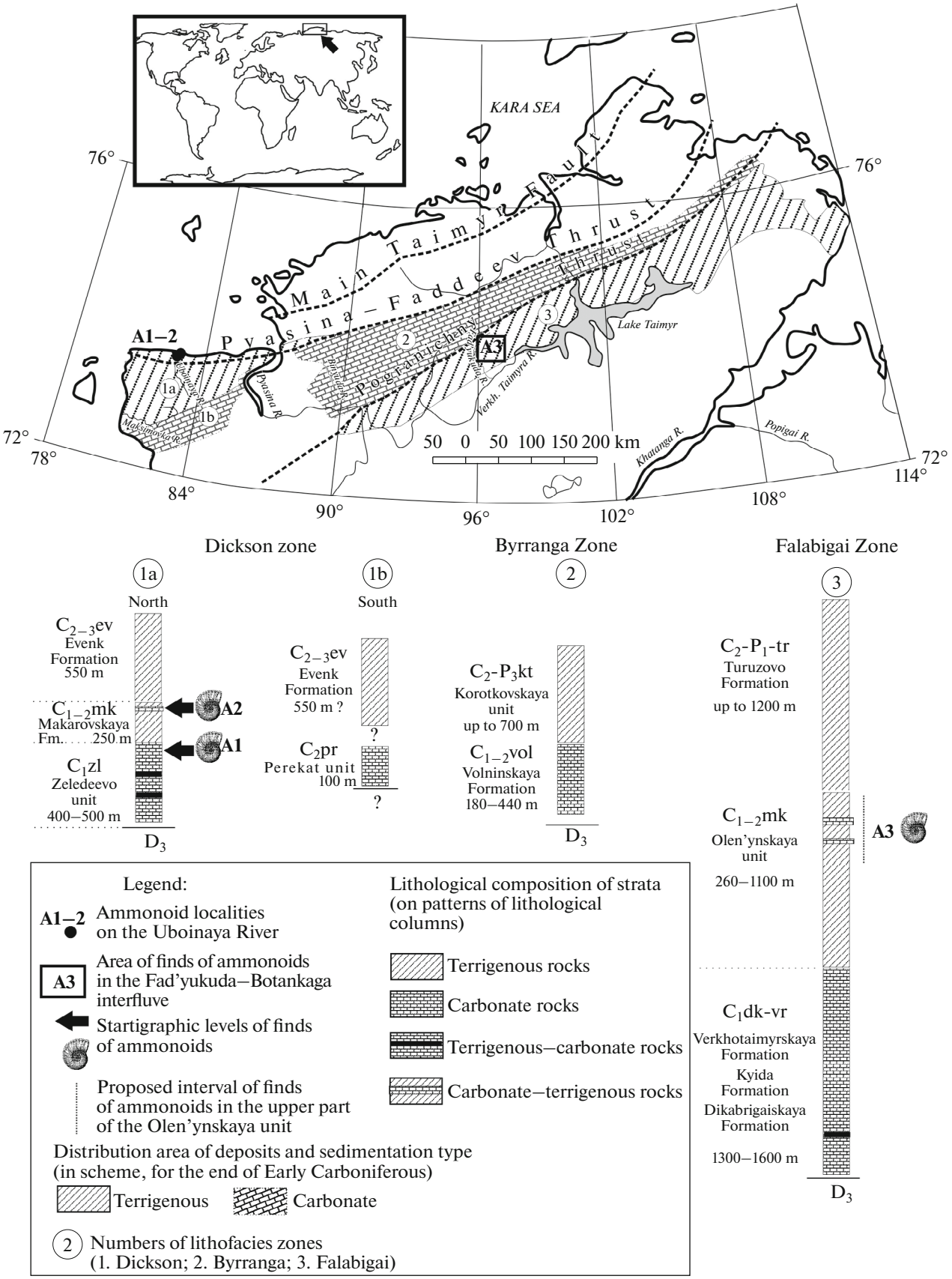


Fig. 1. Distribution scheme and major sections of the Carboniferous deposits of the Taimyr. The main ammonoid localities are shown.

val materials of V.E. Ushakov, D.N. Fedotov, and V.K. Razin, who studied this section (sampling sites 1009 and 56) in the late 1950s. The identifications of ammonoids are made by the authors of this article, unless otherwise indicated. The scientific names of ammonoids that were widely used in the above literature are in brackets here and below; the beds in the section are described from the bottom upwards.

The most ancient ammonoid assemblage was described with a confidence from the upper part of the Zeledeevo init, which was established by Romanov in 1991. Until this time, these deposits were mapped as Viséan. The following rock complexes are exposed 6.9 km upstream from the Uboinaya River mouth (N 73°35′14.66″, E 82°25′36.86″; point A1 in Figs. 1, 2; sampling site 1009):

Zeledeevo unit (upper part), the numbers indicate the members distinguished in the section:

(1) Limestones, dark gray, clayey pelitomorphic thinly-bedded. Thickness, 18 m;

(2) Limestones, gray, organogenic, indistinctly bedded. Pogrebitsky, Grikunov, and Zakharov described the following ammonoids (identifications by Librovitch) from this member (*Geologicheskaya*..., 1960): *Praedaraelites* sp., *Goniatites* ex gr. *striatus* [=*Paraglyphioceras striatum* (Sow.)], *Prolecanites* cf. *serpentinus* (Phillips), *Beyrichoceras* cf. *phillipsi* [=*Bollandites phillipsi* (Bisat)], *Sagitoceras* cf. *acutum* [=*Girtyoceras acutum* (Hind)]. Thickness, 20–25 m;

(3) Limestones, gray, clayey, sometimes silty, thinly- and moderately-bedded with interbeds of dark-gray calcareous siltstones and mudstones (0.1–0.3 m thick), which constitute up to 30–40% of the total thickness of this member [along the strike of the member, finds of ammonoids (*Goniatites* sp.) are known from limestones cropping out in the mouth of Akhmetovka, however we were not provided with this material]. Thickness, 50 m;

(4) Limestones, gray, cryptocrystalline, thickly bedded, indistinctly laminated. Thickness, 30 m;

(5) Limestones, gray, cryptocrystalline, moderately bedded, alternating with dark-gray clayey thinly-bedded limestones with singly interlayers (0.3–0.5m) of dark gray calcareous mudstones. Thickness, 77 m;

(6) Limestones, pale gray, cryptocrystalline, thickly-bedded, with subordinate interbeds of dark gray moderately-bedded limestones, partially recrystallized. Such fossils as brachiopods *Chonetipustula carringtoniana* Dav. and ammonoids *Lusitanoceras* sp. [*Goniatites* aff. *uralensis*] were collected in the upper part of the member. Thickness, 20–25 m.

The total thickness is 225 m.

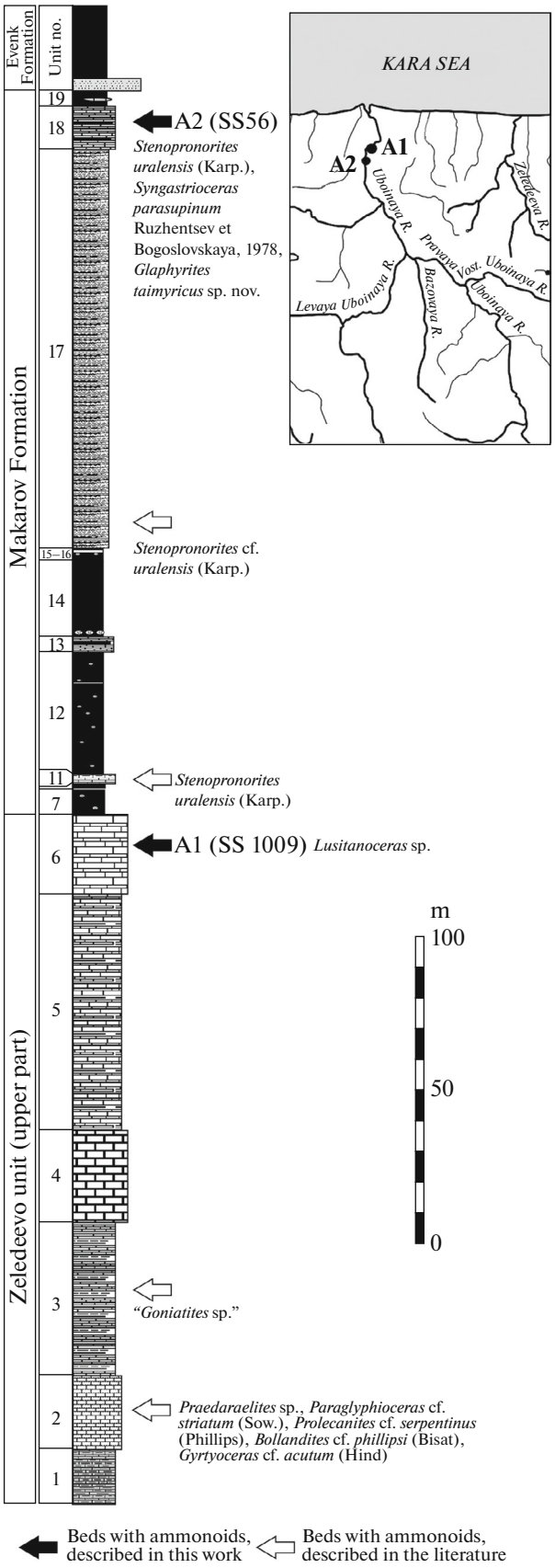


Fig. 2. Stratigraphic column of the Carboniferous deposits cropping out in the Uboinaya River valley (Based on the materials of V.I. Ushakov, V.V. Fedotov, and V.K. Razin, 1957).

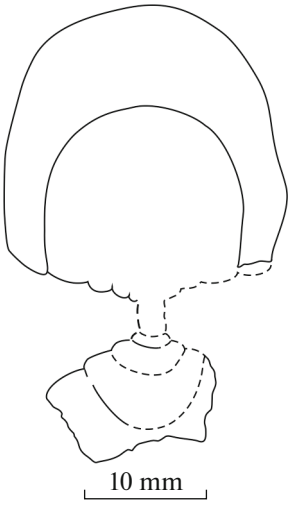


Fig. 3. Cross section of *Lusitanoceras* sp., spec. TsNIGR Muzei no. 17/13311; Western Taimyr, Uboinaya River, s.s. (hereinafter sampling site) 1009, collections by V.I. Ushakov, V.V. Fedotov, and V.K. Razin, 1957.

Unfortunately, we were not provided with ammonoids from Member 2 of the section described above. The fate of these materials is unknown. Based on Librovitch's identifications, this assemblage can be reliably attributed to the Late Viséan.

The ammonoids from Member 6 were first identified by Librovitch as *Goniatites* aff. *uralensis* Librovitch (Ustritsky and Chernyak, 1963). Later, this species was mentioned by Popow in the archive repost of the Research Institute of the Arctic Geology (NIIGA) as *Goniatites uralensis* Librovitch. It is necessary to point out that this species called *nomen nudum* has never been described and depicted. The material, which was used by Librovitch as the basis for distinguishing this taxon, was collected in the Early Carboniferous deposits of the Southern Urals (Urgala River, near the settlement of Urgala) and mentioned only in the work (Librovitch, 1947). In terms of the sculpture, morphology, and features of ontogenetic development (initial evolute stages) (Fig. 3), the specimens, we were provided with (Pl. 5, figs. 11, 12), are similar to the representatives of genus *Lusitanoceras*, known from the Late Viséan. The evolute whorls at the initial stages of growth (from 3 to 5 whorls) are a characteristic feature of *Lusitanoceras*. The youngest genus *Dombarites*, common in the terminal Viséan and Serpukhovian and very similar to *Lusitanoceras* in terms of shell morphology, development of the lobe line and sculpture, the evolute stage is absent (Nikolaeva and Konovalova, 2005). Despite the fact that the lobe line was not preserved on ammonoids from the material under consideration, we ascribe these forms with a confidence to the genus *Lusitanoceras*. The representatives of the genus *Lusitanoceras* are widespread in the Upper Viséan of Western Europe and Northern Africa. Within the territory of Russia, this genus is known from the Late Viséan (the upper part of the Beyrichoceras–Goniatites Genozone) deposits of the Southern Urals (the locality near the village of Novosamarskaya, Sakmara River), Sub-Polar Urals (Bolshaya Nadota River, bioherm massif of Mt. Olysya) and Novaya Zemlya (Bogoslovskaya, 1966; Kuzina and Yatskov, 1999; Nikolaeva and Konovalova, 2005; Skomski et al., 2004), where they were found together with representatives of the genus *Goniatites*. Based on this, one can draw a conclusion that forms *Lusitanoceras* sp. from the top of the Zeledeevo unit characterize the upper part of the Viséan Stage, namely, the upper part of the Beyrichoceras–Goniatites Genozone, distinguished by V.E. Ruzhencev and M.F. Bogoslovskaya (1971) that correspond to zones P2A (Great Britain), Go1 (Germany), and Lusitanoceras–Lyrogoniatites Genozone (North Africa and Portugal).

Apart from *Lusitanoceras*, the Early Carboniferous deposits of Western Taimyr have yielded *Prolecanites*, *Beyrichoceras*, and *Goniatites*, which were mentioned by Ustritsky and Chernyak (1967). Moreover, representatives of these genera are widespread in the interval of the Beyrichoceras–Goniatites Genozone. It is probable that these collections are lost in fact. We were provided only by two samples of thinly-bedded silty–sandy limestone from the Maksimovka River mouth area (Fig. 1) collected during the expedition of E.M. Lyutkevich in 1937. The samples contained a few rather large (up to 5–6 cm in diameter) narrow evolute shells. The preservation of these shells enables us to assume that they belong to the order Prolecanitidae, common in the Carboniferous and Permian periods.

The younger ammonoid assemblage in the Uboinaya River section (Figs. 1, 2 sampling site A2) was collected from the stratigraphically higher deposits of the Makarovskaya Formation (Fig. 2), 6.6 km from the river mouth (N 73°34′12.03″, E 82°22′23.91″).

Makarovskaya Formation:

(7) Mudstones, black, calcareous, with siderite nodules, schistose. Thickness, 8 m;

(8) Sandstone, gray, quartz–feldspar, indistinctly laminated. Thickness, 0.5 m;

(9) Mudstones, black, calcareous with siderite nodules, schistose, with interbeds (up to 0.1 m) of dark gray siltstones. Thickness, 2 m;

(10) Limestones, dark gray, clayey. Ammonoids: [*Stenopronorites uralensis (*Karp.)]. Thickness, 2.5–3 m;

(11) Mudstones, black calcareous, thinly laminated with small pyrite nodules. Thickness, 40 m;

(12) Mudstones, black calcareous, alternating with dark gray clayey limestones. Thickness, 4–5 m;

(13) Mudstones, black calcareous, with small pyrite nodules and rare interbeds of dark gray calcareous siltstones (up to 0.2 m). In the lower part are black siderite flat-spherical nodules (from 0.5 to 1.0 m). Thickness, 25 m;

(14) Sandstones, dark gray, silty, calcareous. Thickness, 0.3 m;

(15) Mudstones, black, calcareous, with rare pyrite concretions. Thickness, 2.5–3 m;

(16) Sandstone, dark gray, fine-grained to silt-grain size, calcareous. Thickness, 1 m;

(17) Mudstone, black, calcareous, with abundant pyrite and siderite concretions (5–6 cm), siltstones, dark gray, calcareous (0.005 to 0.2–0.3 m) and fine-grained sandstones (0.2–0.5 m) monotonically alternating. Siltstones in the lower part of the member contain ammonoids *Goniatites* sp. and *Stenopronorites* cf. *uralensis* (Karp.). Thickness, 125–130 m;

(18) Limestone, dark gray, clayey, with rare interbeds of black, calcareous, pyritized mudstones. Ammonoids: *Stenopronorites uralensis* (Karpinsky), *Syngastrioceras parasupinum* Ruzhencev et Bogoslovskaya, *Glaphyrites taimyricus* sp. nov. [*Stenopronorites* aff. *uralensis*, *Syngastrioceras orientale*, *Goniatites* ex gr. *granosus* Port.]. Thickness, 12–14 m;

(19) Mudstones, black, calcareous, pyritized, with interbeds (up to 0.4 m) of dark gray calcareous thinly-bedded siltstones with rare lenses (up to 5–10 cm) of dark gray clayey limestones. Thickness, 5 m.

The total thickness is 240–250 m. Higher in the section, there are "barren" terrigenous deposits of the Evenk Formation.

There are different ideas on the taxonomic composition and the age of ammonoids from bed 18. Whereas *Stenopronorites uralensis* is actually beyond question, Ruzhencev identified the second taxon as *Syngastrioceras orientale* Yin, 1935, and Librovitch identified it as *Goniatites* ex gr. *granosus* Porthlock, 1843 (Ustritsky and Chernyak, 1963). Correspondingly, the age of enclosing deposits was identified as the Middle Carboniferous in the first case and as the Early Carboniferous in the second. Later, the additional material was collected. Popow described already three species from the Uboinaya River section (production report of 1965): *Stenopronorites uralensis*, *Syngastrioceras orientale*, *Goniatites* ex gr. *granosus* that created further uncertainties. Inconsistence of these identifications assumes the possibility of a wider interpretation of the age interval of country deposits from the Early Carboniferous to the Moscovian Stage.

It is evident that the material from the studied bed includes all (or nearly all) samples known to our predecessors. In addition, we were provided with some labels with identifications by Librovitch. Thus, we were able to correlate unambiguously the previous identifications with specific specimens to be convinced that all ammonoids studied from the upper part of the Makarovskaya Formation (Uboinaya River) can be ascribed to three species: *Stenopronorites uralensis* (Karpinsky, 1889), *Syngastrioceras parasupinum* Ruzhencev et Bogoslovskaya, 1978, and *Glaphyrites taimyricus* sp. nov.

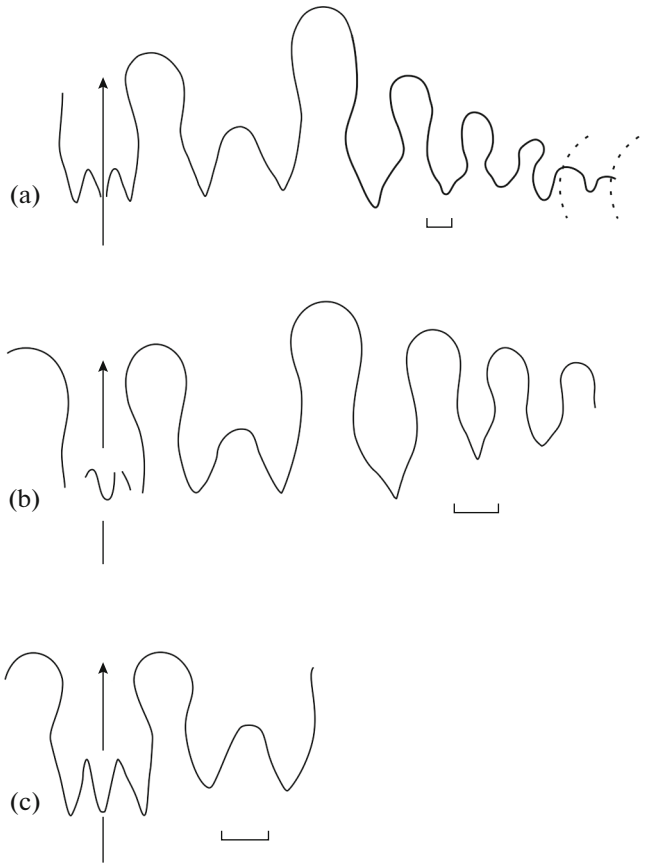


Fig. 4. Sutures of representatives of *Stenopronorites*: (a, b) *S. uralensis* (Karpinsky, 1889): (a) spec. TsNIGR Muzei no. 20/13311 at W ~ 10 mm; (b) spec. TsNIGR Muzei no. 21/13311 at W ~ 9.5 mm; Western Taimyr, Uboinaya River, collections by V.I. Ushakov, V.V. Fedotov, and V.K. Razin, 1957., s.s. 56; (c) *Stenopronorites* sp., spec. TsNIGR Muzei no. 15/13311; Central Taimyr, Mokhovoi Creek., s.d. 620, collections by Y.E. Pogrebitsky. Scale bar 1 mm.

In general, according to the development level of ammonoid suture, there is no difference between the Taimyr representatives of *Stenopronorites uralensis* (Pl. 5, fig. 6; Figs. 4a, 4b) and ammonoids found in the Southern Urals and Novaya Zemlya. In our opinion, there are no grounds to attribute Taimyr forms to the new species. Accordingly Librovitch's identification in the open nomenclature (aff.) should be denounced. *Stenopronorites uralensis* is widespread in the Late Serpukhovian and Early Bashkirian (from Fayettevillea–Delepinoceras Genozone and Delepinoceras bressoni Zone to Bilinguites–Cancelloceras Zone) in deposits of the Southern Urals, Kazakhstan, Central Asia, as well as Novaya Zemlya (Kuzina and Yatskov, 1999; Nikolaeva, 1994; Ruzhencev and Bogoslovskaya, 1971, 1978; etc.).

In terms of the parameters of a shell, the forms that we identified as *Syngastrioceras parasupinum* are simi-

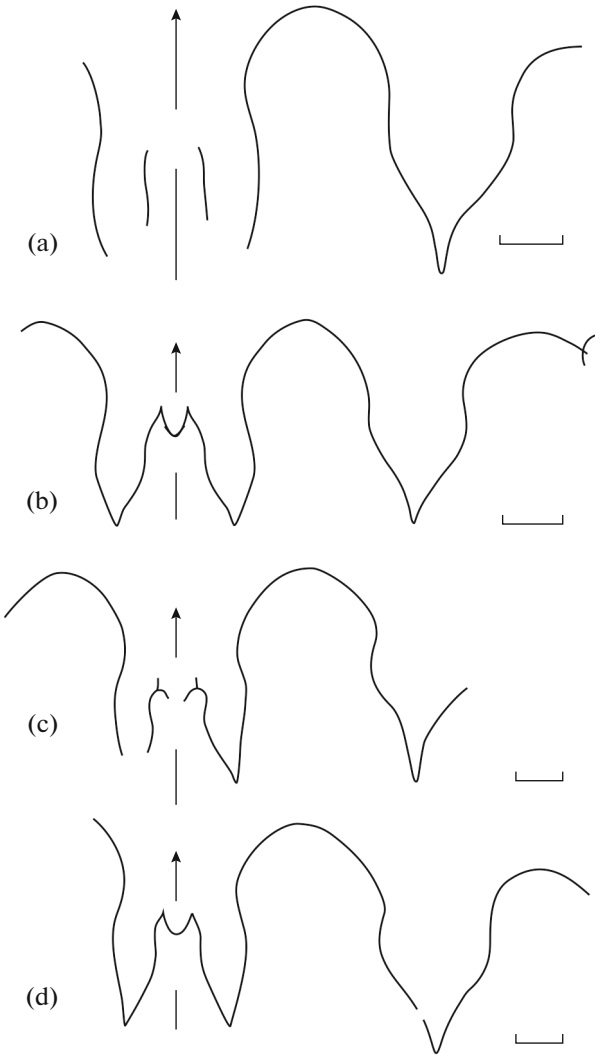


Fig. 5. Sutures of *Syngastrioceras parasupinum* Ruzhencev et Bogoslovkaya, 1978: (a) spec. TsNIGR Muzei no. 26/13311 at W = 13.0 mm, (b) spec. TsNIGR Muzei no. 26/13311 at W = 14.7 mm, (c) spec. TsNIGR Muzei no. 29/13311 at W = 16.0 mm, (d) spec. TsNIGR Muzei no. 29/13311 at W = 16.0 mm; Western Taimyr, Uboinaya R., s.s. 56, collections by V.I. Ushakov, V.V. Fedotov, and V.K. Razin, 1957. Scale bar 1 mm.

lar to the type species but somewhat differ from it in the shape of suture (Fig. 5; Pl. 5, fig. 4).

Measurements in mm and retios of the *Syngastrioceras parasupinum* species from the Taimyr Peninsula and Southern Urals

Specimen no.	L	H	W	LU	W/L	H/L	LU/L
26/13311	18.0	6.7	16.2	5.0	0.90	0.37	0.28
holotype 2195/150	22.2	8.4	20.5	7.0	0.92	0.38	0.32

They have narrower ventral lobe (Wvl/Hvl = 0.76 vs. 0.87) and less defined lobes on the first lateral saddle, but, in our opinion, these features can be determined by a degree of preservation of the material. This species is known from Bilinguites–Cancelloceras Genozone of the Southern Urals, the last genozone in the Early Bashkirian, where it occurs in the sections together with index species.

The forms, some of which were previously identified by Librovitch as *Goniatites* ex gr. *granosus*, belong the new species *Glaphyrites taimyricus* sp. nov. (see description below). The genus *Glaphyrites* is placed in the group of slowly evolving genera and has a wide stratigraphic distribution from the Upper Serpukhovian Stage of the Lower Carboniferous to the Lower Sakmarian Stage of the Lower Permian.

Based on the above data, the ammonoid assemblage from the upper part of the Makarovskaya Formation can be ascribed to the Early Bashkirian Bilinguites–Cancelloceras Zone.

To the east, within the central structural–facies zone (called the Byrranga Zone in this work) are no reliable finds of ammonoids. Here, the section of the Carboniferous deposits has a relatively small thickness. Ustrisky and Chernyak (1967) mentioned the finds of *Cravenoceras* goniatites in the Falabigaisky horizon, in the Binyuda River basin, a right tributary of the Pyasina River. According to recently accepted stratigraphic schemes (Sobolev, 1999), this horizon corresponds to the Perkatnin unit, which, in our opinion, is an incomplete stratigraphic equivalent of the Volnino Formation (Fig. 1). The find of *Cravenoceras* is evidence of the Serpukhovian age of country deposits that does not contradict the foraminifer-based estimation of the age range. However, there are no references and details in the work (1967) and it will be possible to check these data by repeated collection of ammonoids.

The known localities of Carboniferous ammonoids in Central Taimyr are confined to the Falabigaisky structural–facies zone. All localities are concentrated within a relatively small area in the Fad'yukuda–Botankaga interfluve area, left tributaries of Verkhnyaya Taimyra River (Fig. 1, A3), and are mostly characterized by finds of single shells. Unfortunately, we have no exact coordinates of these localities. Within this territory, the formation of the Carboniferous deposits has the maximum thickness (Fig. 1). Previously, the Middle Carboniferous part was attributed to the Makarovo Formation by analogy with Western Taimyr. However, as difference in the structure of the Upper Paleozoic sections within the Dikson and Falabigai structural–facies zones became more and more evident, the question of distinguishing these beds as an independent straton came up. The name "Falabigaisky Formation" was proposed relatively recently when performing the geological mapping of the new generation (Proskurnin et al., 2015). However, this name appears to be most unfortunate due to evident association with the Falabigaisky horizon, the age (Serpukhovian) and exclusively carbonate composi-

tion of rocks of which do not correspond to the Middle Carboniferous carbonate–terrigenous deposits. Therefore, we consider the Middle Carboniferous deposits of Central Taimyr as a part of the Olen'ynskaya unit, distinguished by Shishlov (2010) as an age analog of the Makarov Formation. Moreover, there were no paleontological finds made in the reference section of the Olen'ynskaya unit located to the east ("formation" after Shishlov). This section is different from that in the Fad'yukuda River basin in exclusively terrigenous composition. A detailed section of the interval under consideration in the distribution area of ammonoids has not been yet compiled. The archive materials of Yu.E. Pogrebitsky and S.E. Gulin, devoted to this problem, were reported in the explanatory note to the State Geological Map (*Gosudarstvennaya* ..., 1997). The lower part of the interval under consideration (220 m) is composed of limestones with siltstone interbeds. The conditionally middle part is composed of calcareous siltstones with a single limestone member, the upper part is composed of calcareous siltstones, mudstones, and a single thin limestone interlayer (1.5 m). The limestones of the lower part yielded brachiopods and foraminifers *Asteroarchaediscus subbaschkiricus* Reitl., *Planoarchaediscus absimilis* Soss., and *Neoarchaediscus dubius* Soss.; the limestone interlayer in the upper part yielded bivalve mollusks *Astartella permocarbonica* (Tscher.) and brachiopods *Krotovia* cf. *tuberculata* Moeller, *Achunoproductus achunowensis* Step., and *Spiriferella turusica* Tschern. Unfortunately, the exact positions of finds in the section are unknown. Nevertheless, taking into account the age data, based on finds of brachiopods and foraminifers, one can confine the distribution interval of ammonoids to the middle and upper parts of the Makarovskaya Formation horizon (Olen'ynskaya unit). Moreover, one can assume that at least in the Mokhovoi Creek locality ammonoids were collected in the above-described limestone bed as shell fragments of brachiopods and bivalve mollusks were preserved in the studied samples.

The studied ammonoids were collected by Pogrebitsky in 1963 in black silty limestone (the upper part of the Makarovskaya Formation horizon) from the locality on the Mokhovoi Creek, a left tributary of the Fad'yukuda River (SS 620). In total five shells belonging to new species *Kayutoceras pogrebitskyi* sp. nov. (see description below) were collected. Apart from this species, we have found a shell fragment of *Stenopronorites* sp. with a fragment of the suture (Fig. 4c).

In 1962, V.P. Orlov found two specimens in the Levlya River (a right tributary of the Bolshaya Botankaga River), identified by Popow (1965) as *Yakutoceras trianguliumbilicatum* (Popow) [=*Orulganites trianguliumbilicatus* (Popow)]. Later, this identification was used in the explanatory notes of the State geological maps of different scales. We have only one preserved specimen of this species from this locality (Pl. 5, fig. 10). It greatly differs from the species *Orulganites trianguliumbilicatus* in the low whorls and open umbo that are characteristic features of other orulganitid species, *Yakutoceras aldanicum* Librovitch in Popow. The latter is widespread in deposits of the Upper Bashkirian substage of the Verkhoyansk Region and Kolyma–Omolon region (Andrianov, 1985; Popow, 1970; Sobolev et al., 1998).

In 1962, Ustritsky found 5 specimens in the Fad'yukuda River basin (s.s. 136 g/126 k), which were identified by Popow as *Eoasianites* cf. *angulatum* (Girty). Goniatites from this sample have signs that are characteristic of the species *Syngastrioceras paraglobosum* Sobolev, 1998, previously described at the lower boundary of the Solonchansk horizon (Upper Bashkirian substage) of Western Verkhoyansk Region (Sobolev et al., 1998). This species has a specific morphology of the shell (steep umbilical side), suture (very narrow, in the upper part constricted, lateral lobe) and sculptures (radial–two-sinus constrictions) (Fig. 6). All the above finds indicate the Late Bashkirian age of the country deposits.

Two species important for the regional stratigraphy were found in the stratigraphically higher deposits and should not be left unmentioned. We have not studied this material and, unfortunately, we have no data on the current preservation of this material. Nevertheless, these data can supplement, with some reserve, the characteristics of the fauna under consideration. It was noted in the archive materials by Pogrebitsky that *Phaneroceras lenticulare* Plummer et Scot, 1937 (identification made probably by Popow) was found near the lower boundary of the Turuzovo Formation (a left tributary of the Fad'yukuda River). The species can be easily diagnosed and, if there is no error in the stratigraphic reference of this find, the lower boundary of the Turuzovo Formation lies in the Moscovian Stage interval that is quite consistent with the Late Bashkirian age of the above-described finds from the Olen'ynskaya unit.

The goniatite shell was found in the upper part of the Turuzovo Formation, in the Fad'yukuda River basin. Popow ascribed this find to the new species *Glaphyrites incavus* Popow (Ustritsky and Chernyak, 1963), but did not report any descriptions or images of the Taimyr species. It should be noted in this connection that the genus *Glaphyrites* existed from the Early Carboniferous to the early Sakmarian Stage of the Early Permian. Currently, this genus contains 69 valid species. It was already repeatedly proposed that many of them in reality belong to other genera and even other families. In addition, it is not unthinkable that the identification made by Popow is erroneous. Therefore, this find can not provide a reliable estimate of the age of country deposits.

Thus, based on the above data, Carboniferous ammonoids from the Taimyr Peninsula can be ascribed with a confidence to three age assemblages in the study area:

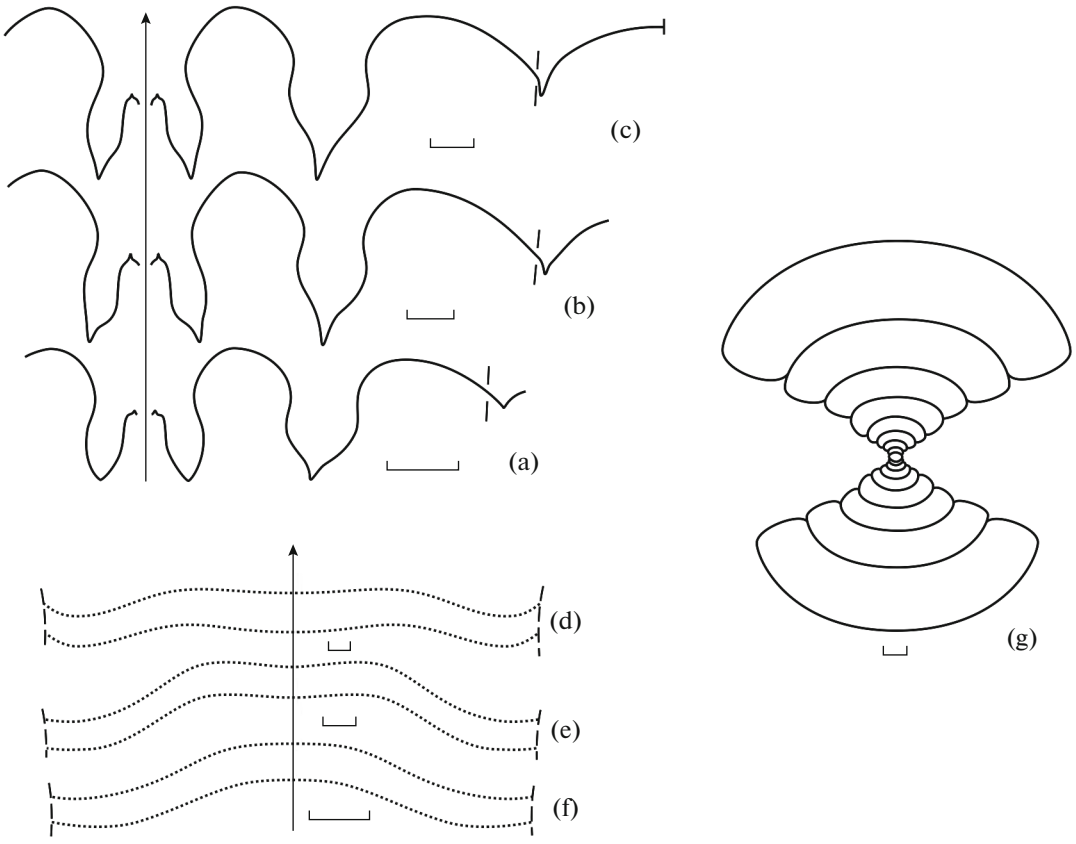


Fig. 6. Sutures (a–c), shape of constrictions (d–f), and cross-section (g) *Syngastrioceras paraglobosum* Sobolev, 1998: (a) spec. IGABM SO RAN no. 175/51-1 at L = 8.5 mm, W = 7.7 mm, H = 2.8 mm; (b) spec. IGABM SO RAN no. 175/52-3 at W = 13 mm, H = 5.2 mm; (c) spec. IGABM SO RAN no. 175/52-2 at L~15 mm, W = 13.5 mm, H = 5.5 mm; (d), spec. IGABM SO RAN no. 175/52-4 at W~19 mm, H = 7.4 mm; (e) spec. IGABM SO RAN no. 175/52-3 at L = 14 mm, W = 12.7 mm, H = 5 mm; (f) spec. IGABM SO RAN no. 175/52-4 at W~19 mm, H = 7.4 mm; (g) spec. IGABM SO RAN no. 175/52-2 at L = 16.8 mm; Central Taimyr, Fad'yukuda River basin; Bashkirian Stage; Sample 136g/126k, collections by V.I. Ustritsky, 1962. Scale bar 1 mm.

(1) Lower Carboniferous, Upper Viséan, Beyrichoceras-Goniatites Genozone, upper part of the Zeledeevo Formation, Western Taimyr. The assemblage includes forms determined by the authors of this article as *Lusitanoceras* sp. Apart from these species, Librovitch's data allow the representatives of the genera *Praedaraelites*, *Paraglyphioceras*, *Bollandites*, and *Girtyoceras* from the upper part of the Zeledeevo Formation that are not described in this work to be ascribed to this assemblage. However, it is evident that these data need to be verified.

(2) Middle Carboniferous, Lower Bashkirian, Bilinguites–Cancelloceras Genozone, upper part of the Makarovskaya Formation, Western Taimyr: *Stenopronorites uralensis*, *Syngastrioceras parasupinum* Ruzhencev et Bogoslovskaya, *Glaphyrites taimyricus* sp. nov.

(3) Middle Carboniferous, Upper Bashkirian, Diaboloceras–Axinolobus Genozone, upper part of the Olen'inskaya Formation, Central Taimyr: *Yakutoceras aldanicum* Librovitch in Popow, *Syngastrioceras paraglobosum* Sobolev, 1998, *Kayutoceras pogrebitskyi* sp. nov., *Stenopronorites* sp.

Collections are stored in the Chernyshev Central Geological Research Museum (CGRM) (St. Petersburg, no. 13311) and in the geological museum of Diamond and Precious Metal Geology Institute SB RAS (IDPMG SO RAN, Yakutsk no. 55 and no. 175). Images were taken by R.V. Kutygin (IDPMG SO RAN) and S.V. Bagirov (PIN RAS).

SYSTEMATIC PALEONTOLOGY

Family Glaphyritidae Ruzhencev et Bogoslovskaya, 1971

Genus *Glaphyrites* Ruzhencev, 1936

***Glaphyrites taimyricus* Konovalova et Borissenkov, sp. nov.**

Plate 5, figs. 1–3

Etymology. From the Taimyr Peninsula.

Holotype. Chernyshev Central Geological Research Museum, no. 1/13311; Western Taimyr, Uboinaya River, outcrop 56; Member 18, Sample 56/2; Early Bashkirian, Bilinguites–Cancelloceras Genozone.

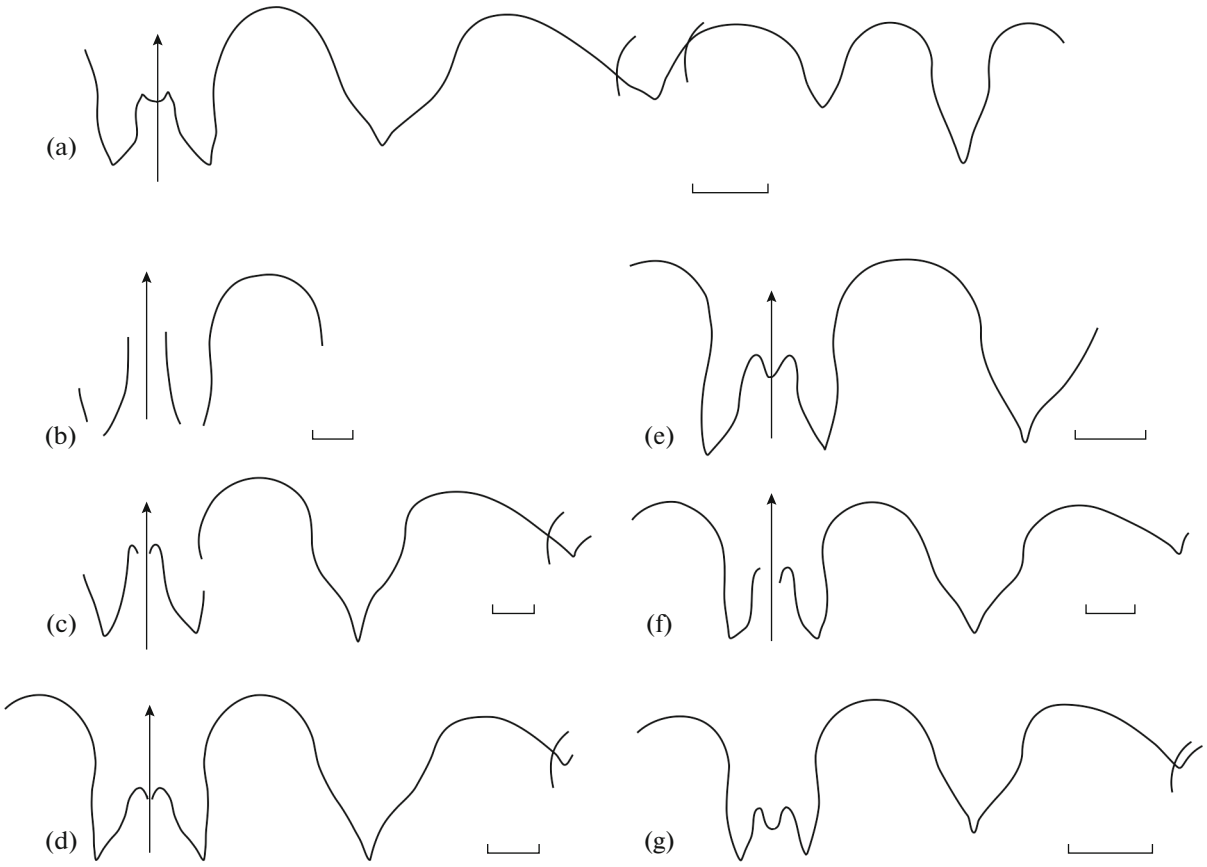


Fig. 7. Sutures *Glaphyrites taimyricus* sp. nov.: (a) spec. TsNIGR Muzei no. 2/13311 at W = 12.0 mm, (b) spec. TsNIGR Muzei no. 8/13311 at B ~ 9.2 mm, W = 18.5 mm, (c) spec. TsNIGR Muzei no. 8/13311 at H ~ 6.9 mm, W = 18.3 mm, (d) spec. TsNIGR Muzei no. 5/13311 at H = 5.3 mm, W = 10.5 mm, (e) holotype TsNIGR Mus. no. 1/13311 at H = 4.1 mm, W = 9.3 mm, (f) spec. TsNIGR Muzei no. 5/13311 at H = 5.0 mm, W = 8.2 mm, (g) spec. TsNIGR Muzei no. 3/5/13311 at W = 5.0 mm; Western Taimyr, Uboinaya R., s.s. 56, collections by V.I. Ushakov, V.V. Fedotov, and V.K. Razin, 1957. Scale bar 1 mm.

M o r p h o l o g y. Shell pachycone, with very involute whorls. Ventral side is slightly convex. Lateral sides are distinct. Umbilical edge is distinct. Umbilical slope steep, narrow, and slightly convex. Umbo from moderately narrow to medium, deep.

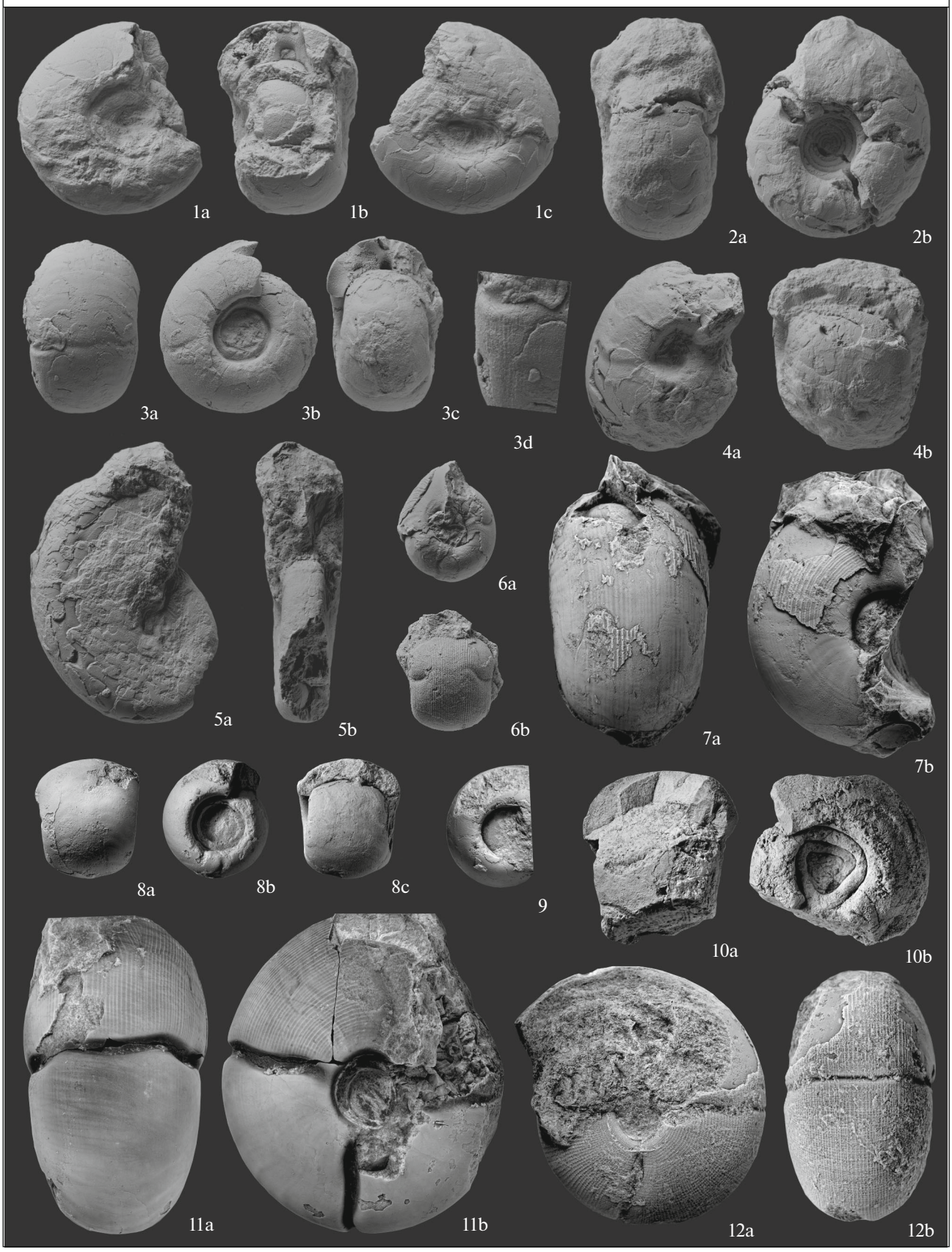
M e a s u r e m e n t s i n m m a n d r a t i o s

Specimen no.	L	H	W	LU	W/L	H/L	LU/L
1/13311	13.4	5.1	9.1	4.3	0.68	0.38	0.32
3/13311	10.6	–	6.5	4.7	0.61	–	0.44
7/13311	15.5	6.5	9.6	5.1	0.62	0.42	0.33
28/13311	24.0	–	13.0	9	0.54	–	0.38
5/13311	~16.6	5.75	11.0	4.5	0.66	0.34	0.27
30/13311	13.0	4.5	9.0	4.0	0.69	0.34	0.31

S c u l p t u r e is preserved fragmentary (Pl. 5, fig. 3d). It is represented by thin striae of growth and ultrathin but distinct lyres, which covered the entire shell surface from one umbilical edge to the other. The shell cores with a diameter more than 10 mm show thin constrictions, up to three per whorl, which on the ventral side form a flat lobe, complicated by a small sinus. Striae of growth have the same orientation as constrictions.

S u t u r e (Fig. 7). Ventral lobe is moderately wide for this species (Wvl/Hvl = 0.73 at W = 12.0 mm), with parallel, slightly convex sides in the mid of the shell. Branches of the ventral lobe are not wide, slightly acuminate at the base. Median saddle makes nearly a half of ventral lobe in young shells (H s/vl = 0.51 at H = 5.0 mm), the height of median saddle increases significantly with age reaching 0.68 of the height of lobe at W = 18.5 mm. The first lateral saddle widely rounded, roughly equivalent to the ventral lobe in width. The first lateral lobe is narrow, with slightly arcuate sides and a small mammillary tubercle at the bottom, equivalent to the ventral one in depth. The first lateral lobe of some specimens of this species varies slightly in width. The second lateral saddle high,

Plate 5


1a
1b
1c
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7a
7b
8a
8b
8c
9
10a
10b
11a
11b
12a
12b

widely rounded. A small angular umbilical lobe is on umbilical slope.

Comparison. This species differs from the majority of species in the relatively narrow for this genus pachycone shell (W/L = 0. 62 and 0.57 at L = 15.4 and 24.0, respectively). It differs from the species *G. tenuis* Kuzina, 1999 from the Upper Serpukhovian deposits of Novaya Zemlya, which is similar in the shell morphology, in the occurrence of lyres and another outlines of the ventral lobe: convex sides in the middle part, higher median saddle: Hs/Hl = 0.57 at W = 18.3 vs. 0.47 at W = 14.0, respectively. In terms of the sculpture, development, and morphology of suture this species is similar to *G. operosus* Sobolev, 1998 from the Upper Bashkirian deposits (conventionally Branneroceras–Gastrioceras Zone) of the Verkhoyansk Region (Sobolev et al., 1998), but it differs in the much wider umbo: Lu/L = 0.38 vs. 0.24 at L = 24.0 and 20.3 mm, respectively, and occurrence of three rather than one constriction per whorl . According to the morphology of the suture this species is similar to *G. popovi* Kuzina, 1999, but it differs from the latter in the wider umbo: Lu/L = 0.38 at L = 24.0 vs. 0.25 at L = 40 mm, and narrower shell (W/L = 0.54 vs. 0.75 at L = 24.0 and 40 mm, respectively), occurrence of a few constrictions per whorl. From *G. anguloumbilicatus* Plummer et Scott 1937 similar in the shape of the suture and the shell morphology, this species differs in the occurrences of lyres, developed on the entire surface of the shell.

Material. Eleven shells from bed 13 of the section in the Uboinaya River basin, sampling site 56; collections: Ushakov, Fedotov, Radin, 1957.

Family Orulganitidae Ruzhencev, 1965

Genus *Kayutoceras* Ruzhencev et Ganelin,1971

***Kayutoceras pogrebitskyi* Borissenkov et Kutygin, sp. nov.**

Plate 5, figs. 5, 6

Etymology. In honor of Yu. E. Pogrebitsky.

Holotype. Chernyshev Central Geological Research Museum, no. 12/13311, Central Taimyr, Fad'yukuda river basin; upper part (?) of the Olen'ynskaya Formation, Bashkirian Stage, Diaboloceras–Axinolobus Genozone

Morphology. Shell triangular–sphaerocone at early stages, with triangle coiling and perfectly involute whorls; rapidly develops into the pachycone one with moderately involute whorls. Ventral and lateral sides form the unified surface at the early stages with insignificant deflection along the lateral side. Umbilical edge is distinct. Umbilical slope is steep, narrow. Umbo is narrow, step.

Measurements in mm and ratios:

Specimen no.	L	H	W	LU	W/L	H/L	LU/L
10/13311	~40		~25		~0.60		
11/13311	15.0	6.55	12.95	3.85	0.86	0.44	0.26
Holotype 12/13311	12.8	4.1	10.4	3.32	0.81	0.32	0.26

Sculpture is represented by 85 or 86 distinct lyres extending from one umbilical edge to the other (at a diameter of shell, 15 mm). The thinner striae of growth create the reticular pattern of the sculpture. There are three constrictions per each whorl, more highly manifested in the shell core. Both constrictions and striae of growth have characteristic wave-shaped bend, forming indistinct ventral lobe, complicated by

Explanation to Plate 5

Figs. 1–3. *Glaphyrites taimyricus* sp. nov.: (1) spec. TsNIGR Muzei, no. 5/13311: (1a, 1c) lateral view, (1b) apertural view, × 2; (2) spec. TsNIGR Muzei, no. 7/13311: (2a) apertural view, (2b) lateral view, ×2.5; (3) holotype TsNIGR Muzei, no. 1/13311: (3a) ventral view, (3b) lateral view, (3c) apertural view, × 2, (3d) sculpture on the lateral view, ×4; Western Taimyr, Uboinaya River, Sample 56; Bashkirian Stage, Makarov Formation, Bilinguites–Cancelloceras Genozone.

Fig. 4. *Syngastrioceras parasupinum* Ruzhencev et Bogoslovkaya, 1978, spec. TsNIGR Muzei no. 26/13311: (4a) lateral view, (4b) apertural view, ×2; the same locality and age.

Fig. 5. Stenopronorites uralensis (Karpinsky, 1889), spec. TsNIGR Muzei no. 21/13311: (5a) lateral view, (5b) apertural view, ×1.5; the same age and locality.

Figs. 6–8. *Kayutoceras pogrebitskyi* sp. nov: (6) holotype spec. TsNIGR Muzei, no. 12/13311: (6a) ventral view, (6b) lateral view, ×1.3; (7) spec. TsNIGR Muzei, no. 11/13311: (7a) ventral view, (7b) lateral view, (7c) apertural view; (8) spec. TsNIGR Muzei, no. 10/13311: (8a) ventral view, (8b) lateral view, ×1.3; Central Taimyr, Fad'yukuda River, Mokhovoi Creek.; Sample 620; Bashkirian Stage, Olen'ynskaya unit, Diaboloceras –Axinolobus Genozone.

Figs. 9 and 10. *Syngastrioceras paraglobosum* Sobolev, 1998: (9) spec. IGABM SO RAN no. 175/52-1: (9a) ventral view, (9b) lateral view, (9c) apertural view, ×1.3; (10) spec. IGABM SO RAN no. 175/52-2 lateral view, ×1.3; Central Taimyr, Fad'yukuda River basin, Sample 136g/126k; Bashkirian Stage, Olen'ynskaya unit, Diaboloceras–Axinolobus Genozone; collections by V.I. Ustritsky, 1962.

Fig. 11. *Yakutoceras aldanicum* Librovitch in Popow, 1965, spec. IGABM SO RAN no. 55/504: (11a) apertural view, 11b, lateral view, ×1.3; Central Taimyr, basins of Bolshaya Botankaga and Levlya rivers, Sample 297v; Bashkirian Stage, Olen'ynskaya unit, Diaboloceras–Axinolobus Genozone; collections by V.P. Orlov, 1962.

Figs. 12 and 13. *Lusitanoceras* sp.: (12) spec. TsNIGR Muzei, no. 18/13311: (12a) ventral view, (12b) lateral view, ×1; (13) spec. TsNIGR Muzei, no. 16/13311: (13a) lateral view, (13b) ventral view, ×2; Western Taimyr, Uboinaya River, Sample 1009; Viséan Stage, Zeledeevo unit, Beyrichoceras–Goniatites Genozone.

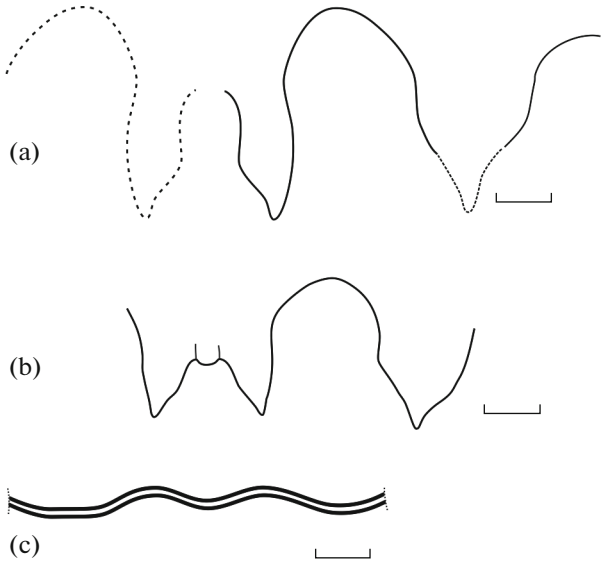

Fig. 8. Sutures and sculpture of *Kayutoceras pogrebitskyi* sp. nov: (a, b) sutures: (a) spec. TsNIGR Muzei no. 10/13311 at W = 21.7 mm, (b) holotype TsNIGR Muzei no. 12/13311 at W = 9.6 mm; (c) sculpture, spec. TsNIGR Muzei no. 11/13311 at W = 21.4 mm; Central Taimyr, Fad'yukuda River, Mokhovoi Creek; outcrop 620.

a poorly defined sinus in the center of ventral side (Fig. 8c).

S u t u r e (Figs. 8a, 8b). Ventral lobe is moderately wide (Wvl/Hvl = 0.94 on early whorls and 0.79 on mature ones), with relatively high (Hvl/Hms = 0.6) median saddle and cheliform branches. The lateral lobe is relatively narrow, asymmetrical. Umbilical and inner lines are not observed.

C o m p a r i s o n. This species differs from *K. triangulare* Ruzhencev et Ganelin, 1971 from the Bashkirian deposits of Central Siberia (Paren River basin) in the involute shell with narrower umbo (0.26 vs. 0.29–0.34) and narrower ventral lobe (0.94–0.79 vs. 1.0–0.96 at equal dimensions); as well as in the more abundant lyres (85–86 vs. 60–70 in Siberian species).

R e m a r k s. The family Orulganitidae includes 8 genera, many of which are monospecific (Bogoslovskaya et al., 1999). When identifying the specimens under consideration the determination of their generic affinity was of high priority. The characters of the species described indicate its belonging to the group that unites the genera *Yakutoceras*, *Kayutoceras*, and *Orulganites*. In contrast to representatives of the genus *Yakutoceras*, the studied specimens have involute shape and different suture (relatively wide ventral lobe with cheliform but not lanceolar branches, lower median saddle). The Central Taimyr forms can not be ascribed to the genus *Orulganites* due to sharp constrictions on inner whorls. The described Taimyr orulganitids belong to the genus *Kayutoceras*, since they corresponds precisely to the diagnosis given by Ruzhencev and Ganelin (1971).

M a t e r i a l. Five shells from sampling site 620 (collection by Yu. E. Pogrebitsky, 1963), Mokhovoi Creek, a left tributary of the Fad'yukuda River, Central Taimyr.

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