

## SOME MIDDLE CARBONIFEROUS RUGOSA FROM THE SOUTHERN URALS

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## НЕКОТОРЫЕ РУГОЗЫ ИЗ СРЕДНЕКАМЕННОУГОЛЬНЫХ ОТЛОЖЕНИЙ ЮЖНОГО УРАЛА

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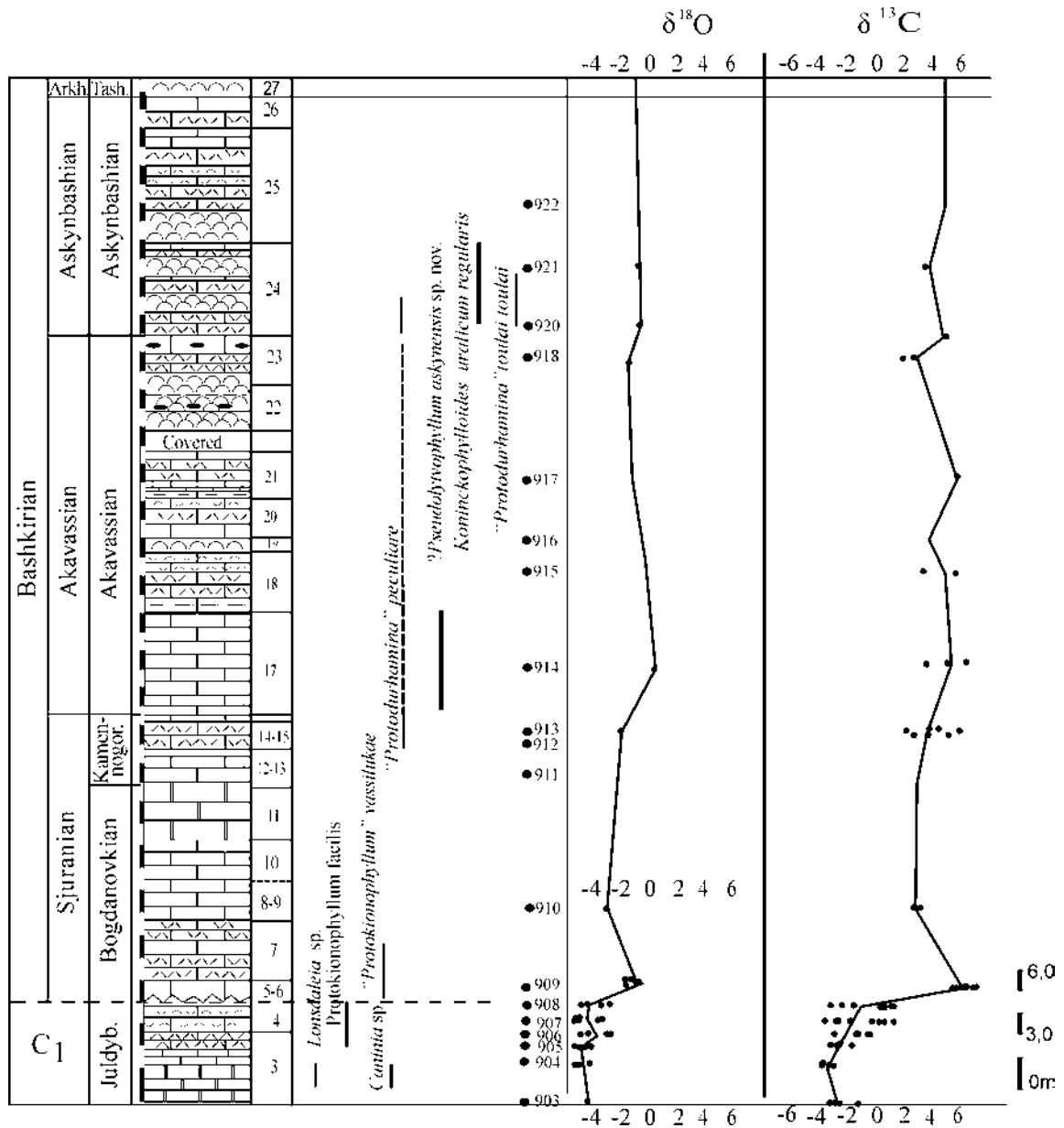
Создание Международной стратиграфической шкалы и обновление Общей шкалы каменноугольной системы потребовало обоснования границ подразделений в различных фациях, в том числе и анализа распределения различных видов ругоз вблизи измененной границы башкирского яруса [Постановление МСК ..., 1997]. Изменение таксономического состава ругоз, характеризующееся вымиранием около 90 процентов раннекаменноугольных таксонов, связано со среднекаменноугольным оледенением [Vassiljuk, Polyakova, 1996; Kossovaya, 1996]. Существенные изменения климата подтверждаются позитивным трендом дельта  $\delta^{18}\text{O}$  and  $\delta^{13}\text{C}$ , полученным при анализе экземпляров брахиопод из разреза Аскын [Brand, Bruckschen, 2002; Grossman et al., 2002]. Раннебашкирский комплекс характеризуется преобладанием ветвистых форм. Ранее имевшиеся данные по разрезу Аскын дополнены видом *Koninckophylloides uralicum regularis* Gorsky и впервые описанным в данной статье видом *?Pseudolytvophyllum askynensis* sp. nov. Комплекс, характерный для подольских отложений разреза Дальний Тюлькас (Горная Башкирия), включает преимущественно одиночные «каниноморфные» формы. Мелкие кораллы без диссепиментов характерны для конденсированной части разреза — верхней пачки ташлинской свиты мячковского горизонта. Последний комплекс имеет определенное сходство с фауной формации Picos de Europe (Кантабрийские Горы) и Мидконтинента.

Creation of the International Stratigraphic Scale and changes in the General Stratigraphic scale for Russia have demanded tracing of the recently ratified boundaries in various facies which sometimes lack index species. The ratification of the Pennsylvanian boundary has resulted in the change of the Bashkirian boundary in the Russian General Stratigraphic Scale [Resolution ..., 1997] and thus there is a need for more accurate data on the distribution of species.

About 90 percent of the Lower-Carboniferous rugose genera became extinct at about the Mid-Carboniferous boundary [Vassiljuk, Polyakova, 1996; Kossovaya, 1996]. This event correlates with the Mid-Carboniferous global glaciation marked in the region by a positive shift of delta  $^{18}\text{O}$  and a positive shift of delta  $^{13}\text{C}$  according to data from the Southern Urals [Brand, Bruckschen, 2002; Grossman et al., 2002]. Isotopic data also show the onset of the mid-Carboniferous glaciation in the Askyn section [Brand, Bruckschen, 2002; Grossman et al., 2002]. Also the appearance of a new Bashkirian assemblage of rugose corals, including fasciculate colonies described earlier as *Fisherina* Stuckenbergh, *Profisherina* Cotton, *Heintzella* Fedorowski, *Lytvophyllum* Soshkina, *Protodurhamina* Kozyreva and others, is well known in contemporaneous deposits of the Urals, Northern Timan, Russian Platform (Voronezh Antecline) and Novaya Zemlya [Kossovaya, 2002]. Some of these generic names are synonyms, but detailed analyses await future re-study of the holotypes.

Rugose corals are widely distributed especially in the shallow-water deposits of the Urals (Fig. 1), but some occur in the deep-water facies (Fig. 2). In spite of fairly numerous monographic descriptions [Gorsky et al., 1975; Degtyrev, 1975; Grosky, 1978; Kossovaya, 2007] information on the exact position of the corals in particular sections is insufficient. Changes in specific and generic concepts, which are now based mostly on the features of the holotype or topotype specimens, demand an accurate revision of specific and generic diagnoses. A few well exposed sections already have been measured in detail and have been recollected.

**Askyn section.** The Askyn section is situated on the southern slope of Asatau Mountain on the right bank of the Askyn River near the abandoned Solontsy Village. For a long time it was considered one of the most complete stratigraphic sections of the Bashkirian stage. The interval underlying the boundary is represented by secondary dolostone and oolitic grainstone with Chaetetidae colonies (Bed 3) and packstone with horizontally oriented brachiopod shells. The mid-Carboniferous boundary in this section is marked by a regional unconformity which is well shown via the cut shells in the *Striatifera* shell limestone (Bed 4). The overlying bed 5 is represented by shoal oolitic grainstone. The boundary is placed below the first appearance of *Plectostaffella bogdanovkensis* (fusulinids) [Kulagina et al., 2001]. The remainder of the section is composed of shallow-water algal and foraminiferal grainstone and packstone, with rather rare colonies or small bioherms of tabulates. According to I.I. Gorsky [1978] the Askyn section contains “*Zaphrentis*” ex gr. *delanouei* M. Edw. et H., *Lophophyllum (Arachnolasma) singulare* Gorsky, *Lytvophyllum antiquum* Gorsky, *Campophyllum contortulum* Gorsky (C<sub>2</sub>m), *Lithostrotion ineptum* Gorsky, and *Orionastraea* (?) sp. indet. Two typical assemblages in the Askyn section were distinguished by Degtyarev [Degtyarev, 1975]: a Bashkirian assemblage with



**Fig. 1. Distribution of rugose corals in the Bashkirian deposits of the Askyn Section** ([Giedbook, 1995; Ogar' 1995 mns], the authors collection treated in this paper are in bold line). The position of isotope samples by P. Bruckschen pers. Com. (1998). The isotope data is from U. Brand, P.Bruckschen [2002], E.L. Grossman et al. [2002])

*Koninckophylloides juresanense* Gorsky, *Koninckophyllum vesiculosa* Gorsky, and *K. riphacum* Gorsky, and a Moscovian assemblage containing *Bothrophyllum simplex* Gorsky, *Hapsiphyllum* cf. *usvense* Gorsky, *Lithostrotion peculiare* Gorsky, *Fischerina stuckenbergi* Dobrolybova, *F. aff. stuckenbergi* Dobrolybova, and *Corwenia* aff. *toulai* Gorsky. V. Ogar [1995], who also revised the taxonomy of the corals in the Askyn section, showed that the “horizons” he recognized also contain different faunal assemblages. All these data were used in the Guidebook [1995] where detailed bed by bed distribution of corals was documented for the first time for the Askyn section. Data on corals from different sections demonstrates that the lower boundary coincides with the change from the typical Early Carboniferous corals to assemblages with various fasciculate colonial corals [Kossovaya, 1996]. According to our analyses the fasciculate corals with variable and rather complex axial structures are mostly typical of the lower part of the Bashkirian stage within the scope of the Syranian – Askynbashian substages. The first colonial corals appear in the bed 11 [Guidebook ..., 1995] (Fig. 1). The underlying deposits contain solitary *Caninia* sp. and rare isolated fragments of *Protokionophyllum facilis* Vassiljuk. Abundant colonies of fasciculate corals represented by *?Pseudolytvyphyllum askynensis* sp. nov. (Plate 1, fig. 1–7), that earlier was included in *Lytvophyllum antiquum* Gorsky [Gorsky, 1978; Kossovaya, 2002], and *Koninckophylloides uralicum regularis* Gorsky (Plate 1, figs. 10–11) are present in bed 17. The first species needs substantial revision as was pointed out by several authors [Gorsky, 1978; Ogar, 1985 manuscript; Kossovaya, 2002; Fedorowski et al., 2007]. *Koninckophylloides uralicum regularis* Gorsky originally described from the Bashkirian deposits of the Min’ar River [Gorsky, 1978, plate XIX, fig. 1] was found in the bed 24. This bed was assigned to C<sub>2</sub><sup>c</sup> considered as upper middle Carboniferous in age. Our specimens were found in the Askynbashian Substage of the Bashkirian Stage (Fig. 1; Plate 1, fig. 10–11).

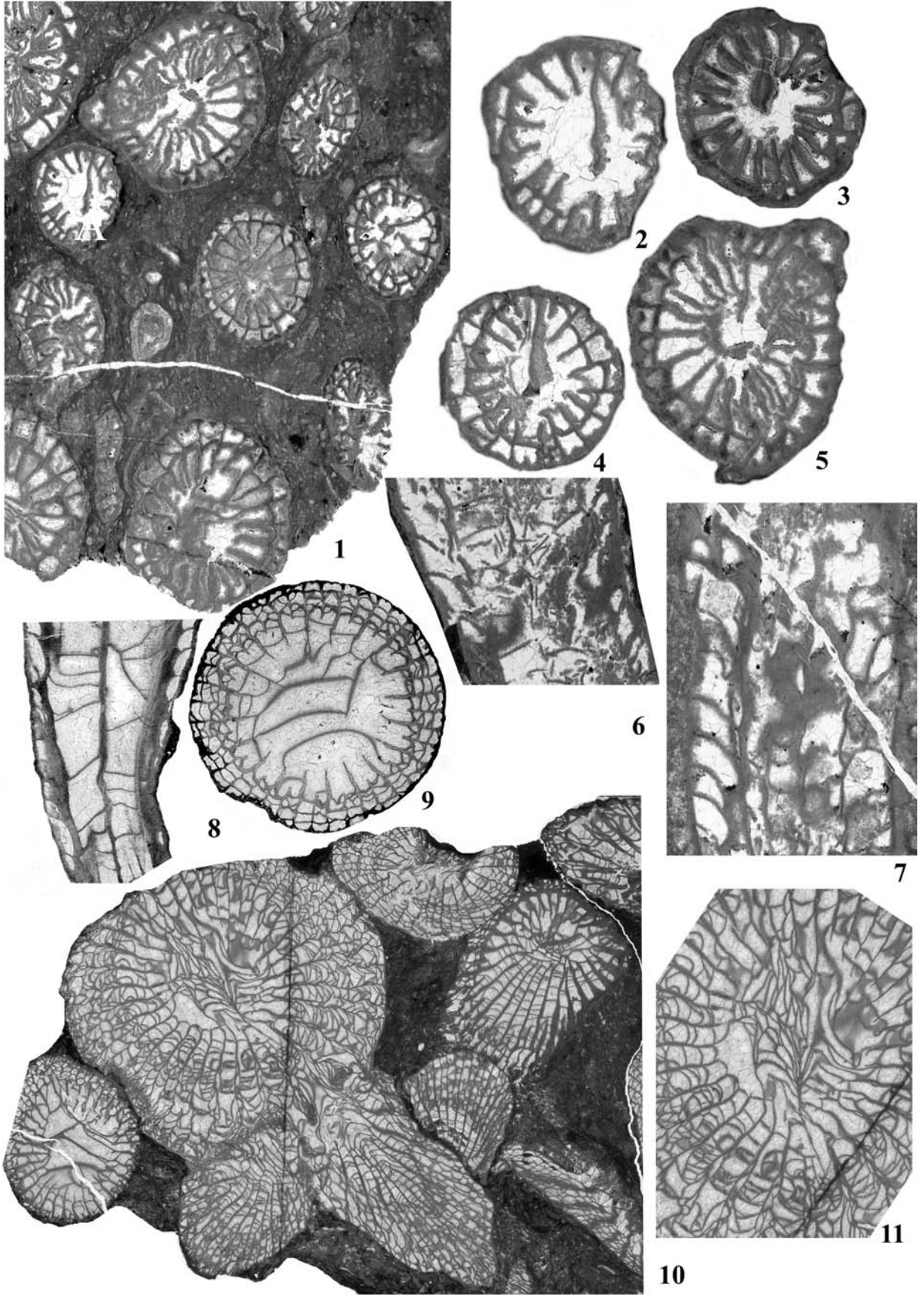
**Short remarks on taxonomy.** The genus *Lytvophyllum* Dobrolyubova, 1941 was based on the material collected at two different outcrops: from Artinskian deposits of the Lytva River and from conglomerates of Sim Factory. A description based on the re-study of the lectotype was published recently [Fedorowski et al., 2007]. The specimens from the Sim Factory were proclaimed by the same authors as belonging to *Lytvophyllum* sp. nov. undescribed. The new thin sections of the original topotype specimen, specimen 925/146, Paleontological Museum (Moscow) are considerably different from those of the lectotype of *Lytvophyllum* from Lytva River. Gorsky [1978] proposed assignment of the specimens from Sim Factory to his new species *Lytvophyllum antiquum* which also occurs in the Askyn section. New longitudinal sections of the topotypes from Sim Factory (Specimen 925/146 Pin RAN) show that the specimens have a biform tabularium and they lack lonsdaleoid dissepiments (Plate 1, fig. 8, 9). So, the specimens from Sim do not belong to *Lytvophyllum* according to the emended diagnosis of J. Fedorowski et al. [2007]. In addition, *Lytvophyllum antiquum* Gorsky [1978] is represented by a holotype which does not show the typical features of the lectotype from Lytva River so it also can not be assigned to *Lytvophyllum* as was pointed out by J. Fedorowski et al. [2007].

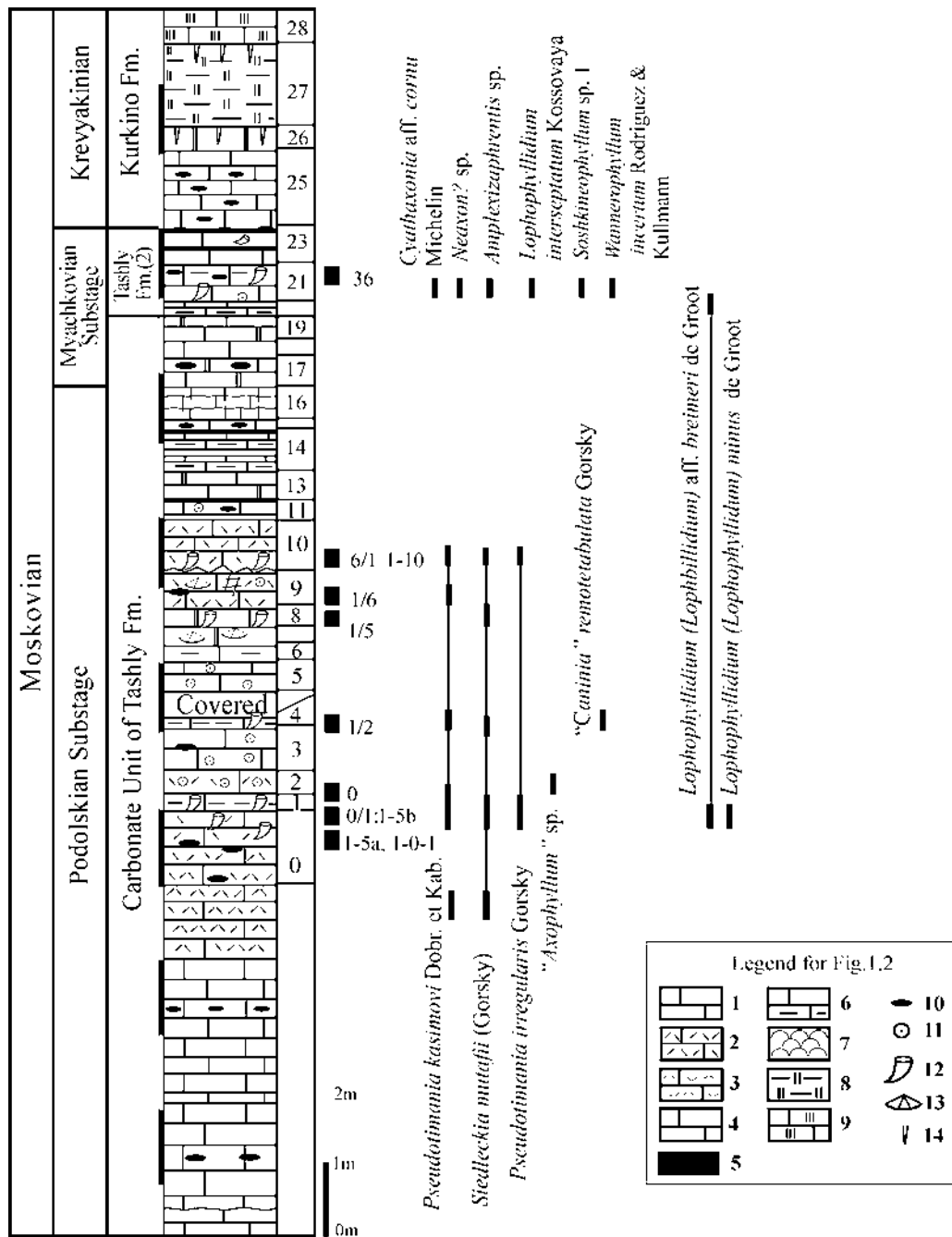
Our data show that specimens collected in the Askyn section in the bed 17 are identical to some of Gorsky’s specimens [Gorsky, 1978, Plate XXI, Fig. 6, 9] included by him in *Lytvophyllum antiquum* Gorsky, but are different from the holotype of this species. Therefore we propose the new species *?Pseudolytvyphyllum askynensis* Kossovaya sp. nov. to embrace these specimens. We assign this species questionably to *Pseudolytvyphyllum* X. Yu et H.D. Wang [Yu et al., 1983] and not to *Lytvophyllum* because it has weakly developed lonsdaleoid dissepiments, a simple columella and short minor septa.

The Moscovian deposits considered here from bed 31 and above contain *Alekseeviella* sp., and *Bothrophyllum* sp. So, above this boundary the colonial coral fauna is replaced by more tolerant solitary ones.

**Dalnyi Tyulkas section.** Two assemblages are distinguished in Dalnyi Tyulkas section located in the vicinity of the town Krasnousolsk in Usolka River Valley. The lower assemblage occurs in the lower carbonate unit of the Tashly Formation [Stepanov, 1941]. This unit consists of light-gray and white dolomitized crinoid packstone with numerous chert nodules. Beds are separated by wavy surfaces with accumulations of yellow fusulinid packstone nearby. The lower assemblage consists of large solitary corals in shallow-water limestone in the Podolskian interval. The age is based on conodont and fusulinid data [Alekseev et al., 2002].

Corals of the lower unit were collected from 3 levels and are most abundant at the top of second bench of the quarry and the base of the third bench. In the latter they were found also in thin lenses close to bedding surfaces. Rugose corals are abundant and include: *Pseudotimania* sp., *P. kasimovi* Dobrolyubova et Kabackovich, *Pseudotimania irregularis* Gorsky, *Siedleckia mutafii* (Gorsky), ‘*Caninia*’ *remotetabulata* Gorsky, and others (Fig. 2). Rare representatives of the ‘Cyathaxonia fauna’ were also found: *Lophophyllidium* (*Lophbillidium*)





**Fig. 2. Distribution of rugose corals in the Podolskian–Myachkovian deposits of the Dalnyi Tyulkas Section (Usolka River). Stratigraphy is based on fusulinid and conodont data from [Stepanov, 1941; Chuvashov et al., 1983, 1990; Alekseev et al., 2002]**

Legend: 1 – limestone; 2 – bioclastic limestone; 3 – shell limestone; 4 – oolitic limestone; 5 – clay; 6 – clayey limestone; 7 – limestone with colonial corals (tabulate and rugose ones) 8 – marl; 9 – cherty limestone; 10 – cherty nodules; 11 – crinoids; 12 – corals; 13 – brachiopods; 14 – trace fossils

**Plate 1. 1–7. ?*Pseudolytrophylllum askynensis* Kossovaya sp. nov.** 1 – (×3), transverse section of the part of colony. 2, 3, 4, 5 (×7) – transversal section of the isolated corallites from the same colony; 6, 7 (×9) – longitudinal sections of the same colony. Specimen 17/1, Askyn section, bed 17, Akavassian Substage. **8–9. “*Lytrophylllum tchernowi* Dobrolyubova”, 1941;** Specimen 925/146 Paleontological museum, PIN RAS, originals from outcrop near Sim Factory. Fig. 7 (×5) – longitudinal section with well visible biform tabularium; Fig. 8 (×5) – transversal section mature stage without lonsdaleoid dissepiments. Middle Carboniferous. **10–11. *Koninckophylloides uralicum regularis* Gorsky, 1978;** Specimen 24/1. 10 (×2) – transversal section of the part of the colony. 11 (×3) – transversal section of the axial part of the corallite with well development of axial structure with irregular axial plate. Askyn section, bed 24, Akavassian Substage, the base

aff *breimeri* De Groot, 1963 and *L. (Lophophyllidium) minus* De Groot, 1963 [De Groot, 1963, emend by Fedorowski, 2004]. Outside the Uralian Basin, a similar “caninomorph” coral fauna is known from the northern Timan region, Moscow Basin, Novaya Zemlya, and Spitsbergen. The lower boundary of the Myachkovian is not easily recognized.

The upper assemblage occurs in the condensed part of the section in the uppermost part of the Tashly Formation. This part of the section, called unit 2 of the Tashly Fm., includes clays, mudstones, and tuffs. A late Myachkovian age of this unit is suggested by the occurrence of *Neognathodus roundyi* and *Gondolella magna* [Alekseev et al., 2002]. The ‘*Cyathaxonia* fauna’ in these rocks is characterized by *Lophophyllidium interseptatum* Kossovaya [Kossovaya, 2007], *Lophophyllidium* sp. (“cyathaxonimorph” type), *Wannerophyllum? incertum* Rodriguez and Kullmann, *Cyathaxonia* aff. *cornu* Michelin, *Neaxon? multitabulatus* Rodriguez and Kullmann, and *Soshkineophyllum* sp. 1. The taxonomic replacement by the upper assemblage coincides with an abrupt change in lithology from carbonates to strata with considerable amounts of terrigenous, tuff, and siliceous material triggered by deepening of the basin.

The above assemblage shows a considerable similarity in species and genera with that in contemporaneous deposits of the upper part of the Picos de Europa Fm. (Spain) [Rodriguez, Kullmann, 1999]. The collection from the Dalnyi Tyulkas section comprises 22 species of Laccophyllidae Grabau, 1928, Lophophyllidiidae Moore and Jeffords, 1945, Polycoeliidae Fromentel, 1861, and Wannerophyllidae Fedorowski, 1986 (Plate 2).

Besides the Dalnyi Tyulkas section, the latest Myachkovian “*Cyathaxonia* fauna” is known in a few outcrops in the Cis-Urals [Gorsky, 1978], usually accompanied by appearance of deep-water deposits. An increase of  $^{18}\text{O}$  and decrease of  $^{13}\text{C}$  was measured in the upper Myachkovian in Kamen’ Perevalochnyi by E.L. Grossmann et al. [2002]. These geochemical trends are interpreted as reflecting deepening of the Pre-Uralian foredeep accompanied by a slight decrease in temperature. The presence of the “*Cyathaxonia* fauna” in the latest Myachkovian is rather unusual (Fig. 2), but the occurrence of a similar fauna in the coeval deposits in the Cantabrian Mountains [Rodriguez, Kullmann, 1999; de Groot, 1963; Fedorowski, 2004] and Mid-Continent USA [Jeffords, 1947] indicates the widespread occurrence of this assemblage.

## Systematic description

? *Pseudolyttophyllum askynensis* Kossovaya sp. nov.

Plate 1, Figs. 1–7.

part *Lyttophyllum antiquum* Gorsky, 1978, page 153–157, Plate XXI, figs. 3, 4, 6, 7.

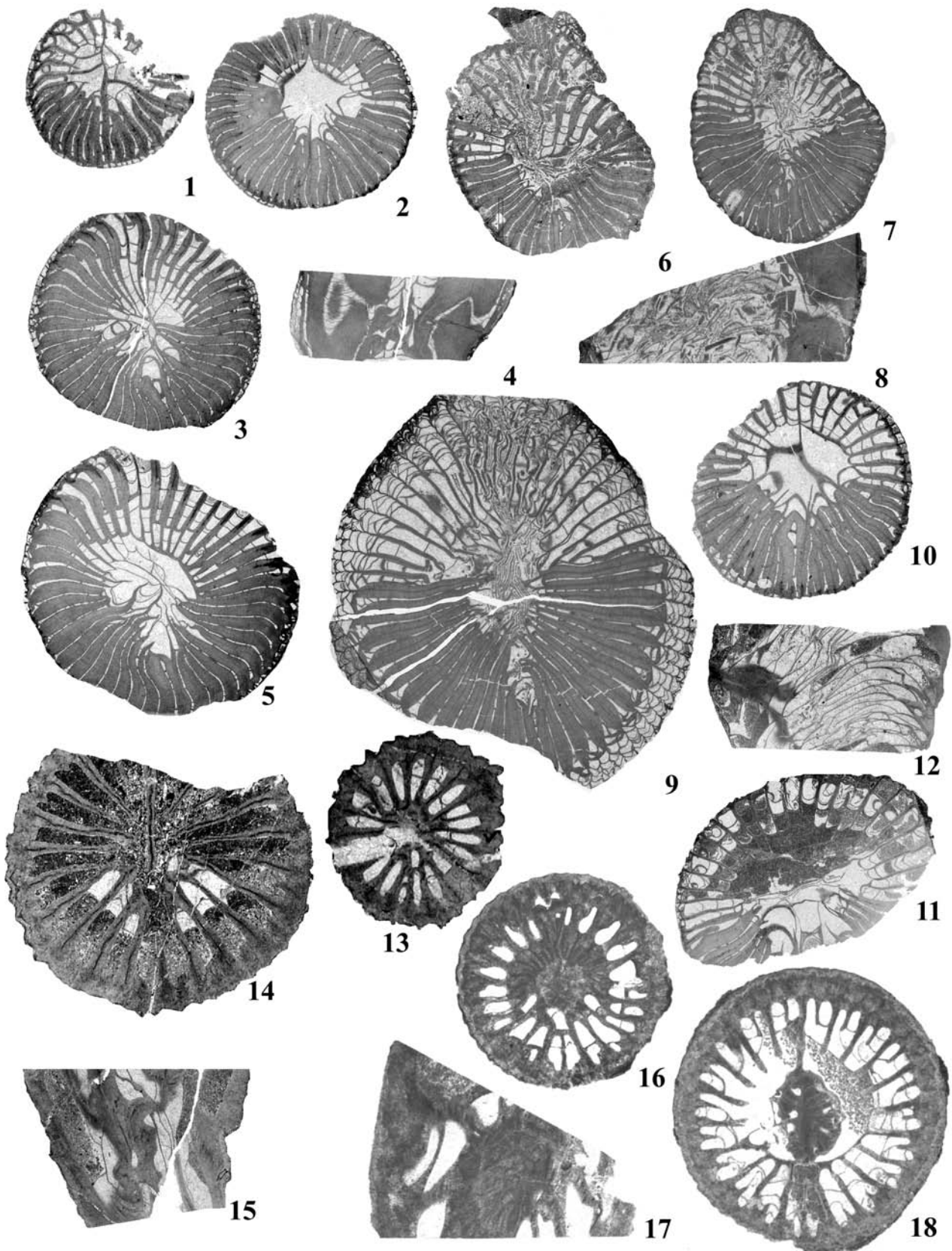
**Holotype.** Specimen 17-1 (fasciculate colony), CNIGR museum, section Askyn, Gornaya Bashkiria, Akavassian Substage, Bashkirian Stage.

**Diagnosis.** Fasciculate colonies consist of cylindrical corallites. Colonies up to 15 cm in diameter. Diameter of corallites 5–6 mm. Major septa up to 2/3 of the radius. Extremely short minor septa restricted to the dissepimentarium. The simple columella originates from the inner part of the counter septum. One row of regular slightly convex or interseptal dissepiments. Flattened lonsdaleoid dissepiments are very rare in mature stage. Tabulae mainly horizontal.

**Comparison.** From *Lyttophyllum tshernowi* Dobr., re-described based on the lectotype specimen [Fedorowski et al., 2007], the present species differs in having rare lonsdaleoid dissepiments, a lack of a biform

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**Plate 2. 1–5.** *Pseudotimania kasimovi* Dobroljubova et Kabackovich, 1941. 1, 2 — sequential transverse sections of young stages ( $\times 3$ ), 3, 5 — sequential transverse sections of mature stage ( $\times 2$ ), 4 — longitudinal section ( $\times 2$ ), Specimen 1-0-1e, Dalnyi Tyulkas section, the top of the second step of the quarry, Tashly Fm, lower part, Podolskian. **6–9.** *Siedleckia mutafii* Gorsky, 1938, 6 ( $\times 3$ ), 7 ( $\times 2$ ), 9 ( $\times 2$ ), sequential transverse sections, 8 — longitudinal section ( $\times 2$ ), Specimen 1-0-1a, Dalnyi Tyulkas section, the top of the second step of the quarry, Tashly Fm., lower part, Podolskian. **10–12.** *Pseudotimania kasimovi* Dobroljubova et Kabackovich, 1948. 10 — transverse sections of young stage ( $\times 3$ ), 11 — transverse sections of mature stage ( $\times 2$ ), 12 — longitudinal section ( $\times 2$ ), Specimen 1-0-13, Dalnyi Tyulkas section, the top of the second step of the quarry, Tashly Fm., lower part, Podolskian. **13–15.** *Lophophyllidium (Lophophyllidium) minor* De Groot, 1963. 13 ( $\times 9$ ) — transverse section of the young stage; 14 ( $\times 6$ ) — longitudinal section; 15 ( $\times 8$ ) — transverse section of the mature stage, Specimen 01-2, Dalnyi Tyulkas section, the base of the third step of the quarry, Tashly Fm., lower part, Podolskian. **16–18.** *Lophophyllidium (Lophbillidium) interseptum* Kossovaya, 2007. 16, 17 — Specimen 21-1. 16 ( $\times 10$ ) — transversal section of the early stage; 17 ( $\times 10$ ) — longitudinal section 2; 18 — Specimen 21-1/2 ( $\times 7$ ), transversal section of the mature stage. Dalnyi Tyulkas section, Upper part of the third step, upper part of Tashly Fm., Myachkovian



tabularium, minor septa restricted to the dissepimentarium, and the character of tabulae. The connection of columella with the counter septum also differentiates this species from *L. tschernovi*. From topotype 925/146 Coll. PIN the new species differs in having flattened horizontal tabulae, short minor septa, presence of lonsdaleoid dissepiments, and lack of a biform tabularium (Plate 1, fig. 8–9). The specimens from author's collection are identical to the specimens 441, 452, 455, 467 coll. 5766 CNIGR museum [Gorsky, 1978, plate XXI, figs. 3, 4, 6, 7].

**Discussion.** The species described here can not be assigned to *Lytvophyllum* because of its very narrow dissepimentum, elongation of the counter septum, and lack of a biform tabularium. It is questionably assigned to *Pseudolytvophyllum* X. Yu et H.D. Wang because of the similarity of small dissepiments, which are rarely lonsdaleoid, and a simple columella joined with the counter? septum, and the small minor septa.

**Material.** 1 fasciculate colony from bed 17 of the Askyn River, four isolated specimens and part of a colony from collection 5766 CNIGR museum. Askyn section, Asatauan Substage.

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