

Bryozoans from the Jurginskaya Formation (Famennian, Upper Devonian) of the Tom-Kolyvansk area (Western Siberia, Russia)

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Abstract

Nine bryozoan species are described from the Jurginskaya Formation (Famennian, Late Devonian) from Western Siberia, Russia, namely: *Leptotrypella pojarkovi* Orlovski, 1961, *Rhombopora subtilis* Nekhoroshev, 1977, *Klaucena lalolamina* Yang, Hu, Xia, 1988, *Eofistulotrypa famennensis* sp. n., *Atactotoechus cellatus* sp. n., *Nikiforopora jurgensis* sp. n., *Eridotrypella tyzhnovi* sp. n., *Mediapor a elegans* sp. n., and *Klaucena gracilis* sp. n. The studied assemblage shows palaeogeographical affinity with Kazakhstan, Kirgizia, Transcaucasia, China, and the United States of America.

Keywords: Bryozoa, Late Devonian, Western Siberia, Russia

Introduction

The sedimentary Jurginskaya Formation spreads on the eastern periphery of the Tom-Kolyvansk area (south of Western Siberia, Russia). The age of the formation is Middle-Late Famennian, based on stratigraphy, lithology and fossils (Kraevskaya, 1960; Babin et al., 1999; Gutak & Tolokonnikova, 2010). The first bryozoan fauna was discovered in the 1940s, but without a detailed description (Kraevskaya, 1960). Bryozoans outnumber the other fossils (brachiopods, crinoids, cephalopods, bivalves). The bryozoan assemblage consists of cystoporates (*Eofistulotrypa famennensis* sp. n.), trepostomes (the already known species *Leptotrypella pojarkovi* Orlovski, 1961, and three new species: *Atactotoechus cellatus* sp. n., *Nikiforopora jurgensis* sp. n., *Eridotrypella tyzhnovi* sp. n.), as well as rhabdomesines (two already known species *Rhombopora subtilis* Nekhoroshev, 1977, and

Klaucena lalolamina Yang, Hu, Xia, 1988; and two new species: *Mediapor a elegans* sp. n., and *Klaucena gracilis* sp. n.).

Methods and material

The material for the present study was collected during the summer of 2008 in the type section of the Jurginskaya Formation on the right bank of the Tom River near the town of Jurga in the Kemerovo region (Fig. 1). The bryozoans were found at three localities, mainly in shales, rarely in calcareous sandstones and siliceous limestones. They were investigated in thin section using a binocular microscope. A total of 103 thin sections were studied.

The morphological terminology is adopted from Astrova (1978) and Boardman et al. (1983). The taxonomic descriptions of the bryozoan fauna are based on measurements of the

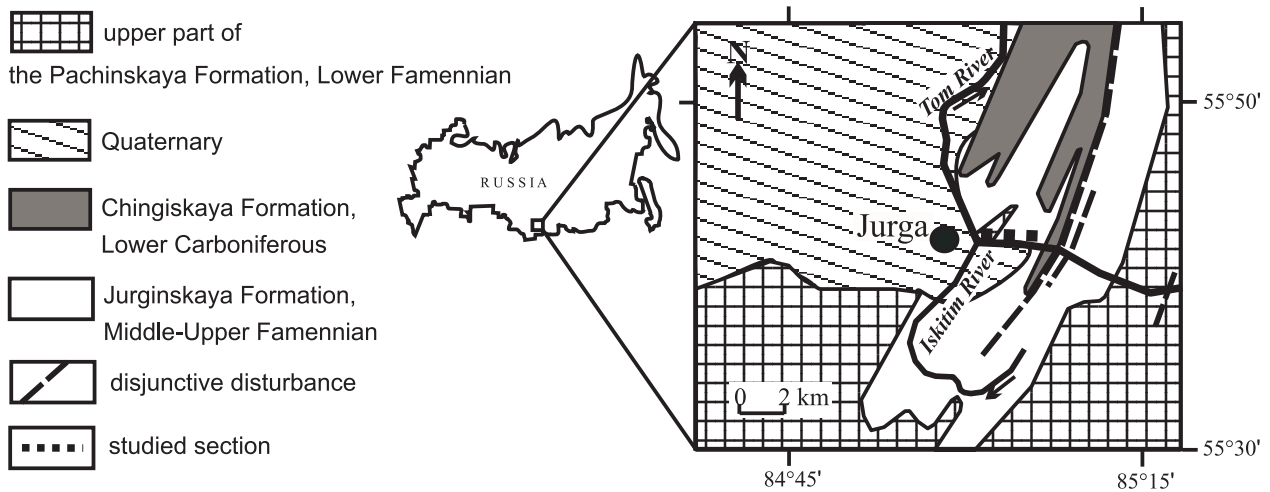


Fig. 1. Scheme of spreading of deposits of the Jurginskaya Formation (compiled on unpublished data of Tyzhnov, 1943).

morphological characteristics. The inner diameter was measured for hollow characteristics such as apertures and autozooeical chambers. The spacing of the morphological characteristics at the colony surface was measured from the centre to the next centre of the apertures. Additional quantitative characteristics studied are the number of exilazoecia and the acanthostyles surrounding each autozooeical aperture. The spacing of the horizontal structures such as diaphragms was quantified by counting their number in 1 mm of the length of the host autozooeicum. Numerical statistical values (mean, standard deviation, variation coefficient, and minimum/maximum values) were calculated following Köhler et al. (1996).

The described material is stored at the Kuzbass State Pedagogical Academy (Novokuznetsk, Russia; collection number 4).

Systematic palaeontology

Phylum Bryozoa Ehrenberg, 1831
 Class Stenolaemata Borg, 1926
 Order Cystoporata Astrova, 1964
 Suborder Fistuliporina Astrova, 1964
 Family Fistuliporidae Ulrich, 1882

Genus *Eofistulotrypa* Morozova, 1959

Type species: *Eofistulotrypa manifesta* Morozova, 1959, Frasnian (Late Devonian), Kuzbass (Russia).

Diagnosis: colonies ramose. Autozooeica with diaphragms. Apertures circular-oval, possessing well-developed lunaria. Vesicles in exozone only.

Occurrence: China, Russia, Mongolia; Middle-Late Devonian.

Discussion: *Eofistulotrypa* Morozova, 1959 differs from *Fistulotrypa* Bassler, 1929 in the absence of vesicular tissue in the endozone.

Eofistulotrypa famennensis sp. nov. (Figs. 2 A-C; Table 1)

Etymology: referring to the Famennian in which this species was found.

Holotype: 4/18.1; paratype: 4/18.2.

Type locality: Tom River, Kemerovo region, Russia.

Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Diagnosis: colonies ramose with self-incrustation. Apertures circular, large; lunaria weakly developed. Vesicles 2–3 rows, developed in exozones only.

Description: colonies are ramose with secondary overgrowth. Branches 10–18 mm in diameter, secondary overgrowths 5–7 mm thick. Endozones 4–5 mm wide, exozones 3–6 mm wide. Autozooeical walls 0.012 mm thick in endozones, 0.025 mm thick in exozones. Autozooeical diaphragms straight or inclined, numbering 1–2 on 1 mm of autozooeical length in endozones and 3–5 on 1 mm in exozones. Au-

Table 1. Descriptive statistics for *Eofistulotrypa famennensis* sp. nov.

| <i>Eofistulotrypa famennensis</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|---|----|------|-------|-------|-------|------|
| aperture width [mm] | 20 | 0.30 | 0.029 | 9.70 | 0.270 | 0.37 |
| aperture spacing from centre to centre [mm] | 15 | 0.45 | 0.065 | 14.47 | 0.350 | 0.57 |
| lunaria length [mm] | 10 | 0.03 | 0.012 | 37.10 | 0.025 | 0.05 |
| lunaria width [mm] | 10 | 0.09 | 0.018 | 20.60 | 0.075 | 0.12 |
| vesicles per 1 mm] | 10 | 2.35 | 0.337 | 14.36 | 2.000 | 3.00 |
| diameter of vesicles [mm] | 10 | 0.17 | 0.036 | 20.30 | 0.120 | 0.25 |

Abbreviations: N = number of measurements, X = mean, SD = standard deviation, CV = coefficient of variation, MIN = minimal value, MAX = maximal value.

toozoecial apertures circular. Lunaria weakly developed, 0.025 mm thick in the middle part. Vesicles large, abundant, arranged in 2–3 rows, rarely in 5 rows between autozoecia, polygonal in tangential section.

Discussion: *Eofistulotrypa famennensis* sp. nov. is similar to *Eofistulipora primacylindilla* Xia, 1997 from the Famennian of Xinijang, China (*crepida* Conodont Zone), but differs in colony form (ramose with secondary overgrowth versus ramose with central zooecia in *Eofistulipora primacylindilla*). The apertures are circular and the width of 0.27–0.37 mm in *Eofistulotrypa famennensis* is different in *Eofistulipora primacylindilla*, which shows an oval shape of 0.14–0.2 mm in width and 0.23–0.28 mm in length.

Order Trepostomata Ulrich, 1882

Suborder Amplexoporina Astrova, 1965

Family Atactotoechidae Duncan, 1939

Genus: *Atactotoechus* Duncan, 1939

Type species: *Atactotoechus typicus* Duncan, 1939, Traverse Group (Middle Devonian), United States of America.

Diagnosis: colonies encrusting, massive or branched. Autozoecia with polygonal to cir-

cular-polygonal apertures. Diaphragms abundant, straight or inclined. Cystiphragms single or several in cluster. Exilazooecia rare. Acanthostyles absent or present in small numbers in maculae. Autozoecial walls thin in the endozone; irregularly thickened, finely laminated in the exozone (modified after Astrova, 1978).

Occurrence: worldwide; Early Silurian to Late Devonian.

Discussion: *Atactotoechus* Duncan, 1939 differs from *Orbignyella* Ulrich & Bassler, 1904 in having thickened autozoecial walls and absence of acanthostyles.

Atactotoechus cellatus sp. nov. (Figs. 2 D–F; Table 2)

Etymology: the specific name '*cellatus*' refers to the view of surface colony in tangential section (derived from Latin '*cella*' = cell).

Holotype: 4/19.1; paratypes: 4/19.2–4/19.5.

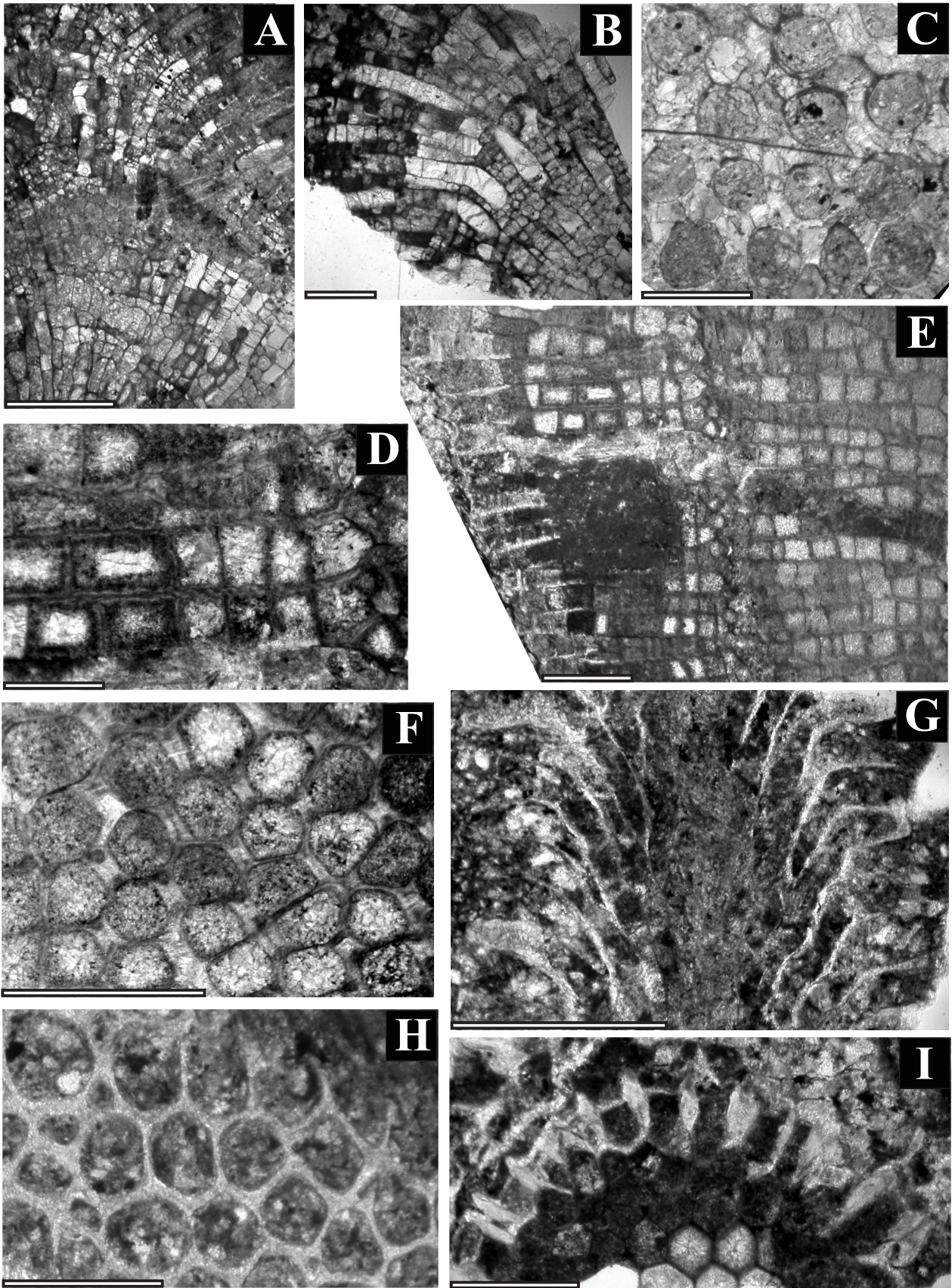
Type locality: Tom River, Kemerovo region, Russia.

Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Diagnosis: colonies branched and encrusting. Apertures circular-polygonal; exilazooecia

Table 2. Descriptive statistics for *Atactotoechus cellatus* sp. nov. (for abbreviations, see Table 1).

| <i>Atactotoechus cellatus</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|--|----|-------|-------|-------|-------|-------|
| branch width [mm] | 6 | 10.33 | 0.605 | 5.85 | 9.500 | 11.00 |
| endozone width [mm] | 10 | 3.75 | 0.205 | 5.45 | 3.500 | 4.00 |
| exozone width [mm] | 10 | 3.25 | 0.227 | 6.99 | 3.000 | 3.50 |
| aperture width [mm] | 20 | 0.19 | 0.042 | 21.55 | 0.120 | 0.27 |
| exilazooecia width [mm] | 10 | 0.07 | 0.018 | 25.44 | 0.050 | 0.10 |
| acanthostyle diameter [mm] | 10 | 0.04 | 0.013 | 35.13 | 0.025 | 0.05 |



rare and short or 4–5 in cluster around each aperture; acanthostyles absent or 3–5 around aperture.

Description: colonies branched and encrusting. Encrusting colonies 4–6 mm thick (usually it has two layers of incrustation: first 1–2 mm thick and second 3–4 mm thick). Autozoocial walls twisted, 0.075 mm thick in exozones. Autozoocial diaphragms rare in endozones, abundant in exozones, straight or inclined. Autozoocial diaphragms 4–5 per 1 mm. Cystiphragms rare. Autozoocial apertures circular-polygonal. In any direction 7–8 apertures in 2 mm. Exilazooecia rare, short, polygonal in cross-section. Sometimes 4–5 exilazooecia surrounding autozoocial aperture. Acanthostyles short, locally abundant, 3–5 surrounding each aperture, in some place absent.

Discussion: *Atactotoechus cellatus* sp. nov. is similar to *Atactotoechus solus* Troitzkaya, 1968 from the Famennian of central Kazakhstan. The new species differs in colony form, which is massive in *A. solus*, the wall thickness in exozone of *A. cellatus* has 0.075 mm vs. 0.02 mm in *A. solus*, size and number of acanthostyles (3–5 acanthostyles of 0.025–0.05 mm in diameter vs. 1–2 acanthostyles of 0.02 mm in diameter in *A. solus*).

Genus *Leptotrypella* Vinassa de Regny, 1921

Type species: *Chaetetes barrandei* Nicholson, 1874, Middle Devonian, Canada.

Diagnosis: colonies branched. Autozoocia with polygonal to circular-polygonal apertures. Autozoocial diaphragms lacking in endozone; rare to common in exozone. Exilazooecia rare. Acanthostyles long, common to abundant. Autozoocial walls granular, thin in the endozone; laminated, irregularly thickened in exozones (modified after Astrova, 1978).

Occurrence: worldwide; Middle Silurian to Early Carboniferous.

Discussion: *Leptotrypella* Vinassa de Regny, 1921 differs from *Leptotrypa* Ulrich, 1883 in having a branched colony, and from *Anomalot-oechus* Duncan, 1939 in having a branched colony and absence of diaphragms in endozones.

Leptotrypella pojarkovi Orlovski, 1961 (Figs. 2 G–H; Table 3)

1961 *Leptotrypella pojarkovi* sp. nov., Orlovski, pp. 67–68, pl. 8, fig. 5.

Material: 4/20a, 4/20b.

Description: colonies branched. Exozones 0.87–1 mm wide. Autozoocial walls of 0.025 mm thick in endozones. Autozoocial diaphragms straight or inclined, 1–2 in number. Autozoocial apertures circular-polygonal, sometimes oval. Exilazooecia polygonal, arranged single or in groups of 3–4. Acanthostyles located at junctions of zoocial apertures.

Occurrence: Kirgizia, Republic of Nakhichevan (Azerbaijan): the Early-Middle Famennian (Late Devonian); Kemerovo region, Russia:

Table 3. Descriptive statistics for *Leptotrypella pojarkovi* Orlovski, 1961. (for abbreviations, see Table 1).

| <i>Leptotrypella pojarkovi</i> Orlovski, 1961 | N | X | SD | CV | MIN | MAX |
|---|----|------|-------|-------|-------|-------|
| branch width [mm] | 5 | 2.55 | 0.180 | 7.40 | 2.370 | 2.870 |
| endozone width [mm] | 5 | 0.87 | 0.078 | 8.93 | 0.800 | 1.000 |
| aperture width [mm] | 15 | 0.19 | 0.036 | 18.91 | 0.150 | 0.270 |
| aperture spacing [mm] | 10 | 0.05 | 0.018 | 35.10 | 0.025 | 0.075 |
| exilazooecia width [mm] | 15 | 0.08 | 0.023 | 27.88 | 0.050 | 0.012 |
| number of exilazooecia between apertures | 10 | 2.00 | 0.940 | 47.10 | 1.000 | 4.000 |
| exozonal wall thickness [mm] | 10 | 0.06 | 0.020 | 30.49 | 0.050 | 0.010 |

Fig. 2. Bryozoa from the families Fistulliporidae, Atactotoechidae and Stenoporidae.

A–C – *Eofistulotrypa famennensis* sp. nov. **A:** 4/18.2, longitudinal section, scale bar = 2 mm; **B:** 4/18.2, longitudinal section, scale bar = 1 mm; **C:** 4/18.1, tangential section, scale bar = 0.5 mm; **D–F** – *Atactotoechus cellatus* sp. nov. **D:** 4/19.1, longitudinal section, showing wall structure, scale bar = 1 mm; **E:** 4/19.1, longitudinal section, scale bar = 2 mm; **F:** 4/19.1, tangential section, scale bar = 1 mm; **G–H** – *Leptotrypella pojarkovi* Orlovski, 1961. **G:** 4/20a, longitudinal section, scale bar = 1 mm; **H:** 4/20a, tangential section, scale bar = 0.5 mm; **I** – *Nikiforopora jurgensis* sp. nov.: 4/21.1, transverse section, scale bar = 0.5 mm.

Podonino horizon, the Middle-Late Famennian (Late Devonian).

Discussion: *Leptotrypella pojarkovi* Orlovski, 1961 is similar to *Leptotrypella parva* Duncan, 1939 from the Traverse Group of North America, but differs from it in a lower number of diaphragms (1–2 vs. 4–6 in *L. parva*).

Family Stenoporidae Waagen & Wentzel, 1886

Genus *Nikiforopora* Dunaeva, 1964

Type species: *Batostomella concentrica* Nikiforova, 1927, Early Carboniferous, Ukraine.

Diagnosis: branched colonies with narrow exozone. Autozooezia with oval apertures. Hemiphragms rare; restricted to exozones. Exilazooezia rare. Acanthostyles large, rare. Tubules abundant in different parts of the skeleton. Autozooezial walls thin in endozone; strongly and regularly thickened in exozone.

Occurrence: Eurasia; Late Devonian to Middle Carboniferous.

Discussion: *Nikiforopora* Dunaeva, 1964 differs from *Tabulipora* Young, 1883 in having rare diaphragms and regularly thickened walls, from *Rhombotrypella* Nikiforova, 1933 in having an irregular polygonal section of autozooezia in endozones.

Nikiforopora jurgensis sp. nov. (Figs. 2 I, 3 A–C; Table 4)

Etymology: the specific name refers to the Jurginskaya Formation in which the material was found.

Holotype: 4/21.1; paratypes: 4/21.2–4/21.6.

Type locality: Tom River, Kemerovo region, Russia.

Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Diagnosis: colonies branched. Autozooezia with oval apertures. Exilazooezia short and rare. Acanthostyles large, 2–3 surrounding each aperture. Autozooezial diaphragms in the exozone located close to the colony surface.

Description: colonies branched. Exozones 0.65 mm wide. Autozooezial diaphragms complete, rare in endozones. Autozooezial hemiphragms occur in exozones, 1–2 in each autozooezium, located close to the colony surface. Autozooezial walls of 0.012 mm thick in endozones, 0.075–0.1 mm thick in exozones. Autozooezia with oval apertures. Exilazooezia short, circular in cross-section, 1–3 surrounding each aperture. Acanthostyles of 0.025–0.05 mm in diameter, 2–3 surrounding each autozooezial aperture. Tubules abundant, 0.014 mm in diameter.

Discussion: *Nikiforopora jurgensis* sp. nov. differs from *Nikiforopora rotaji* (Trizna, 1958) from the Visean of the Kuzbass in its smaller number of hemiphragms in autozooezia (2–4 vs. 6 in *N. rotaji*), size of acanthostyles (0.025–0.05 mm vs. 0.1–0.15 mm in *N. rotaji*).

Family Eridotrypella Morozova, 1960

Genus *Eridotrypella* Duncan, 1939

Type species: *Batostomella obliqua* Ulrich, 1890, Hamilton Group (Middle Devonian), United States of America.

Diagnosis: colonies branched. Autozooezia with irregular-circular apertures. Autozooezial diaphragms in endozones lacking or very rare; variable in number in exozones. Exilazooe-

Table 4. Descriptive statistics for *Nikiforopora jurgensis* sp. nov. (for abbreviations, see Table 1).

| <i>Nikiforopora jurgensis</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|--|----|------|-------|-------|-------|-------|
| branch width [mm] | 5 | 2.62 | 0.151 | 5.76 | 2.370 | 2.750 |
| endozone width [mm] | 10 | 1.16 | 0.131 | 11.35 | 1.000 | 1.370 |
| aperture width [mm] | 15 | 0.14 | 0.017 | 12.56 | 0.120 | 0.170 |
| aperture spacing [mm] | 10 | 0.07 | 0.020 | 26.89 | 0.050 | 0.120 |
| exilazooezia width [mm] | 10 | 0.07 | 0.010 | 15.05 | 0.050 | 0.075 |
| number of exilazooezia between apertures | 10 | 1.50 | 0.700 | 47.10 | 1.000 | 3.000 |
| acanthostyle diameter [mm] | 10 | 0.04 | 0.010 | 28.40 | 0.025 | 0.050 |

cia very rare. Acanthostyles small. Tubules in autozoecial walls common, sometimes completely surrounding acanthostyles. Autozoecial walls thin in endozones, irregularly thickened in exozones.

Occurrence: Eurasia, North America; Late Silurian to Early Carboniferous.

Discussion: *Eridotrypella* Duncan, 1939 differs from *Eostenopora* Duncan, 1939 in having only a branched colony, well defined exozones and small acanthostyles.

Eridotrypella tyzhnovi sp. nov. (Figs. 3 D-F; Table 5)

Etymology: the species was named in honour of A.V. Tyzhnov, who studied the Jurga section in detail.

Holotype: 4/22.1; paratype: 4/22.2.

Type locality: Tom River, Kemerovo region, Russia.

Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Diagnosis: colonies branched with narrow exozone. Autozoecia with circular apertures. Exilazoecia rare. Acanthostyles rare and large. Autozoecial walls containing abundant tubules in medium part, thick in exozone.

Description: colonies branched. Branches of 2.37–2.9 mm in diameter. Endozones 1.37 mm wide, exozones 0.5–0.75 mm wide. Autozoecial walls of 0.012 mm thick in endozones, 0.12–0.15 mm thick in exozones. Abundant tubules developed in the middle part of autozoecial walls. Autozoecial diaphragms complete and straight, 1–2 in exozonal parts of autozoecia. Autozoecial apertures circular or oval, measuring 0.1–0.2×0.2–0.25 mm, arranged in step-down places. Exilazoecia rare and short, having a circular form in transversal section, 0.075–0.1 mm in diameter. Acanthostyles locally 1–2 in number surrounding autozoecial apertures, in some place absent.

Discussion: *Eridotrypella tyzhnovi* sp. nov. differs from *Eridotrypella stellata* Tolokonnikova, 2007 from the Upper Famennian of the Kuzbass in smaller number of diaphragms (1–2 vs. 4 in *E. stellata*), thickness of the autozoecial walls in exozone (0.12–0.15 mm vs. 0.028–0.042 mm in *E. stellata*), larger and more rare acanthostyles (1–2 vs. 5–6 acanthostyles per aperture in *E. stellata*; acanthostyles diameter 0.025–0.050 mm vs. 0.014–0.028 mm in *E. stellata*).

Order Cryptostomata Vine, 1884

Suborder Rhabdomesina Astrova

& Morozova, 1956

Family Rhomboporidae Simpson, 1895

Genus *Rhombopora* Meek, 1872

Type species: *Rhombopora lepidodendroides* Meek, 1872, Late Carboniferous, United States of America.

Diagnosis: colonies ramose. Tube-like autozoecia meet the colony surface at low angles. Diaphragms can occur. Hemisepta absent. Autozoecial apertures oval. Metazoecia rare to absent. One or two acanthostyles at the distal end of each aperture. Exozonal walls with abundant paurostyles arranged in a regular pattern around the apertures.

Occurrence: Eurasia, North America, Australia; Devonian-Permian.

Discussion: The genus *Rhombopora* Meek, 1872 differs from the genus *Klaucena* Trizna, 1958 in the shape of the autozoecia and in the absence of large acanthostyles, as well as in having rare metazoecia.

Rhombopora subtilis Nekhoroshev, 1977 (Figs. 3 G-H; Table 6)

1977 *Rhombopora subtilis* sp. nov., Nekhoroshev, pp. 139–140, pl. 32, figs. 4–7.

Material: single specimen 4/23.

Description: colony thin ramose, 0.8 mm in diameter. Endozones of 0.2 mm wide, exozones

Table 5. Descriptive statistics for *Eridotrypella tyzhnovi* sp. nov. (for abbreviations, see Table 1).

| <i>Eridotrypella tyzhnovi</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|--|----|------|-------|-------|-------|------|
| aperture width [mm] | 15 | 0.15 | 0.034 | 23.28 | 0.100 | 0.20 |
| aperture spacing [mm] | 10 | 0.09 | 0.015 | 15.20 | 0.075 | 0.12 |
| acanthostyle diameter [mm] | 10 | 0.04 | 0.012 | 32.27 | 0.025 | 0.05 |

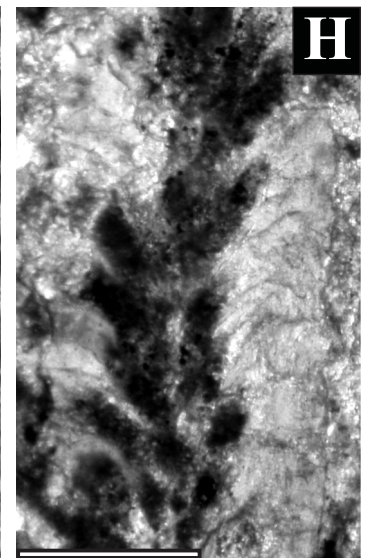
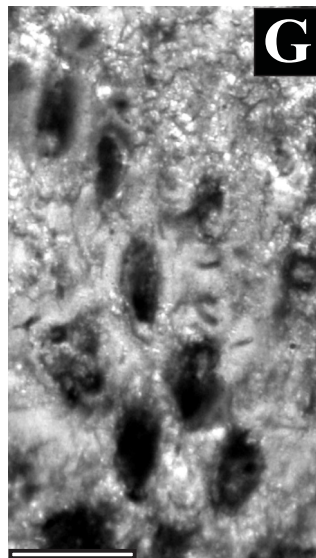
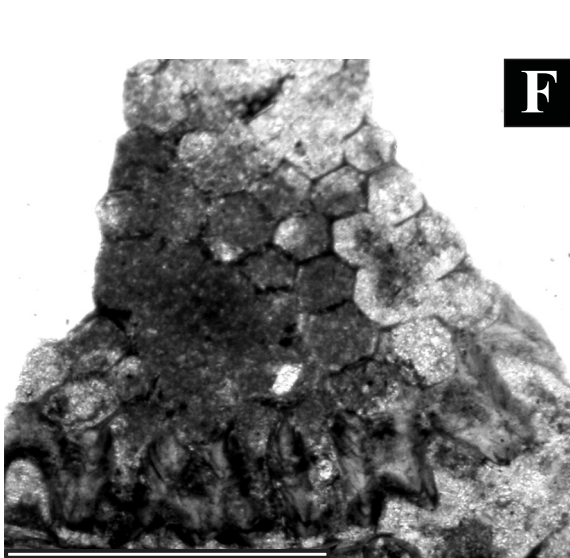
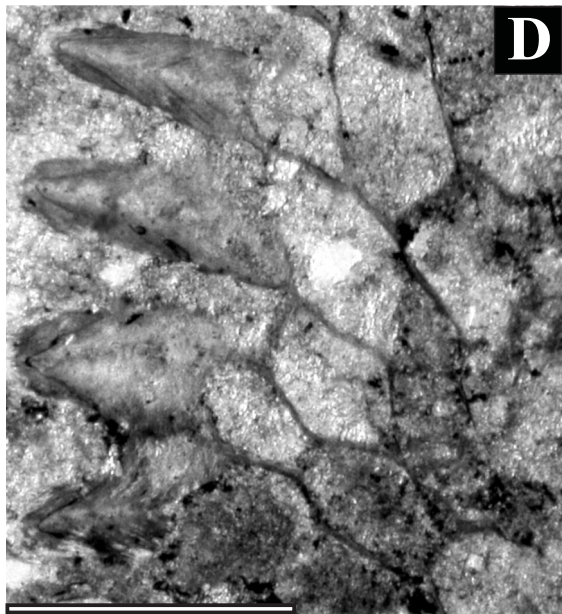
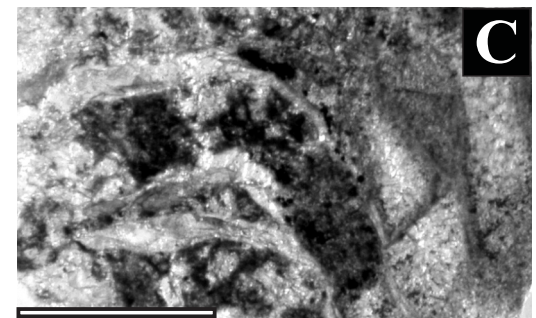
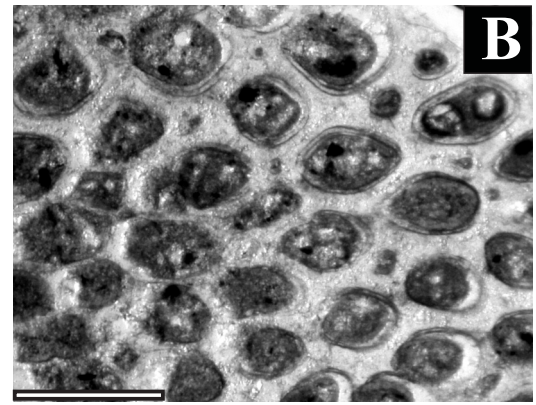
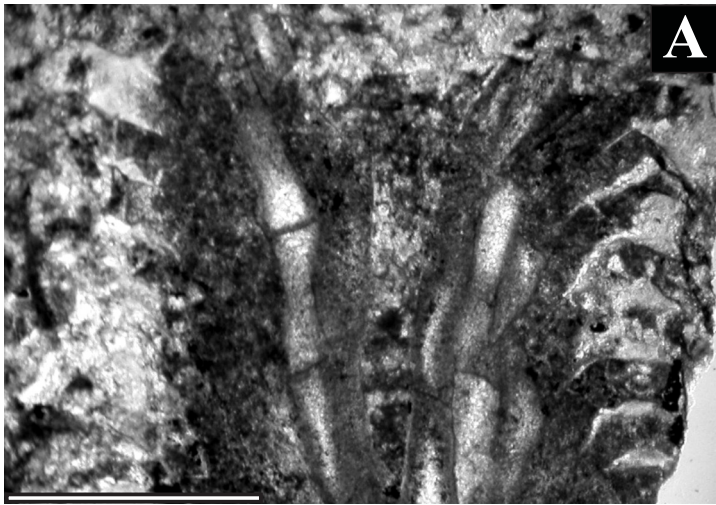


Table 6. Descriptive statistics for *Rhombopora subtilis* Nekhoroshev, 1977 (for abbreviations, see Table 1).

| <i>Rhombopora subtilis</i> Nekhoroshev, 1977 | N | X | SD | CV | MIN | MAX |
|--|---|------|-------|-------|-------|-------|
| aperture width [mm] | 7 | 0.06 | 0.013 | 22.00 | 0.050 | 0.075 |
| aperture spacing along branch [mm] | 5 | 0.17 | 0.020 | 12.19 | 0.150 | 0.200 |
| acanthostyle diameter [mm] | 5 | 0.04 | 0.013 | 34.23 | 0.025 | 0.050 |
| aperture spacing across branch [mm] | 5 | 0.13 | 0.013 | 10.01 | 0.120 | 0.150 |

of 0.3 mm wide. Autozoecial walls of 0.025 mm in the thickness the endozones, 0.075–0.1 mm thickness in exozones. Hemisepta absent. Autozoecial apertures elongate-oval, measuring on average 0.06×0.12 mm. One acanthostyle on the distal end of aperture, 0.025–0.05 mm in diameter. Paurostyles 0.010 mm in diameter arranged around each aperture.

Occurrence: Kazakhstan: *Sulcifer* horizon, Middle Famennian (Late Devonian); Transcaucasia: Early Famennian; Kemerovo region, Russia: Podonino horizon, Middle-Late Famennian (Late Devonian).

Discussion: *Rhombopora subtilis* Nekhoroshev, 1977 from the Middle Famennian of Kazakhstan is similar to *Rhombopora lepidodendroides* Meek, 1872 from the Late Carboniferous, United States of America, but differs in having smaller colonies (0.8 mm vs. 1.2–1.5 mm in diameter in *R. lepidodendroides*).

Genus *Klaucena* Trizna, 1958

Type species: *Klaucena immortalis* Trizna, 1958, Early Carboniferous, Kuzbass, Russia.

Diagnosis: colonies branched with incomplete mesotheca. Few diaphragms and hemisepta. Autozoecial apertures irregular-oval or oval-rhombic. Abundant macroacanthostyles and paurostyles. Autozoecial walls thin in endozone; regularly thickened in exozone.

Occurrence: Russia, China; Early Carboniferous and Early Permian.

Discussion: the genus *Klaucena* Trizna, 1958 differs from the genus *Rhombopora* Meek, 1872 in the shape of the autozoecia and in the presence of macroacanthostyles and hemisepta.

Klaucena gracilis sp. nov. (Figs. 4 A–C; Table 7)

Etymology: The specific name '*gracilis*' refers to the habit of the colony (derived from Latin '*gracilis*' = slender).

Holotype: 4/24.1; paratypes: 4/24.2–4/24.4.

Type locality: Tom River, Kemerovo region, Russia.

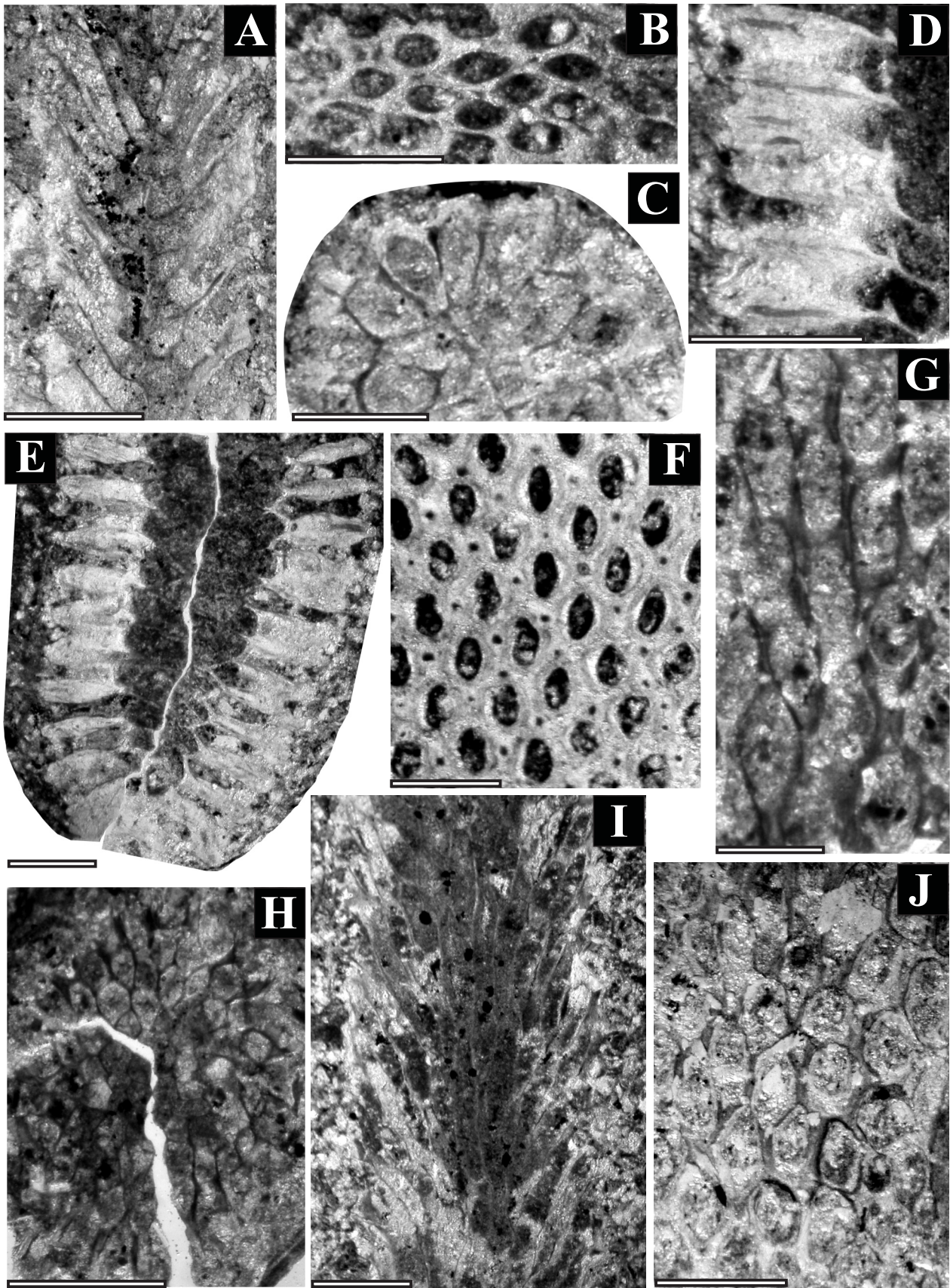
Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Table 7. Descriptive statistics for *Klaucena gracilis* sp. nov. (for abbreviations, see Table 1).

| <i>Klaucena gracilis</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|---|----|------|-------|-------|-------|-------|
| branch width [mm] | 5 | 0.80 | 0.075 | 9.39 | 0.720 | 0.900 |
| endozone width [mm] | 5 | 0.21 | 0.029 | 14.18 | 0.170 | 0.250 |
| aperture width [mm] | 10 | 0.06 | 0.012 | 21.00 | 0.050 | 0.075 |
| aperture length [mm] | 10 | 0.16 | 0.008 | 5.10 | 0.150 | 0.170 |
| aperture spacing across branch [mm] | 10 | 0.14 | 0.021 | 15.14 | 0.120 | 0.170 |
| aperture spacing along branch [mm] | 10 | 0.07 | 0.022 | 32.80 | 0.050 | 0.100 |
| macroacanthostyle diameter [mm] | 10 | 0.01 | 0.004 | 28.06 | 0.012 | 0.025 |
| number of macroacanthostyle between apertures | 10 | 4.30 | 0.674 | 15.69 | 4.000 | 6.000 |

Fig. 3. Bryozoa from the families Stenoporidae, Eridotrypellidae and Rhomboporidae.

A–C – *Nikiforopora jurgensis* sp. nov. **A:** 4/21.1, longitudinal section, scale bar = 1 mm; **B:** 4/21.2, tangential section, scale bar = 0.5 mm; **C:** 4/21.3, longitudinal section, showing exilazooecia, scale bar = 0.2 mm; **D–F** – *Eridotrypella tyzhnovi* sp. nov. **D:** 4/22.1, longitudinal section, scale bar = 0.5 mm; **E:** 4/22.1, tangential section, scale bar = 0.5 mm; **F:** 4/22.1, transverse section, scale bar = 1 mm; **G–H** – *Rhombopora subtilis* Nekhoroshev, 1977. **G:** 4/23, tangential section, scale bar = 0.2 mm; **H:** 4/23, longitudinal section, scale bar = 0.5 mm.



Diagnosis: colonies branched. Diaphragms and hemisepta not observed. Autozoecia with oval-rhombic apertures. Macroacanthostyles and paurostyles arranged around each autozoecial aperture in various numbers.

Description: colonies branched dichotomous. Mesotheca incomplete, slightly wavy, 0.025 mm in thickness. Exozones 0.25–0.3 mm wide. Autozoecial walls of 0.012 mm thick in endozones, and 0.025–0.05 mm thick in exozones. Autozoecial apertures oval-rhombic, arranged in regular diagonal rows. Macroacanthostyles surrounding each autozoecial aperture. Paurostyles rare, 0.01 mm in diameter, arranged in groups.

Discussion: *Klaucena gracilis* sp. nov. differs from *Klaucena aculeus* Trizna, 1958 from the Tournaisian (Early Carboniferous) of the Kuzbass in the size of the autozoecial apertures (0.05–0.075×0.15–0.17 mm vs. 0.20×0.17 mm in *Klaucena aculeus*), and in smaller macroacanthostyles (0.012–0.025 mm vs. 0.04–0.08 mm in *Klaucena aculeus*).

Klaucena lalolamina Yang, Hu, Xia, 1988 (Figs. 4 D–F; Table 8)

1988 *Klaucena lalolamina* sp. n., Yang, Hu, Xia, pp. 175–176, pl. 33, figs. 4–7.

Material: 4/25.1–4/25.2.

Description: colonies flattened and branched, 1.75 mm thick; width of a fragment 2.5 mm. Exozones 0.75 mm wide. Autozoecial walls 0.025 mm thick in endozones, and 0.1 mm thick in exozones. Diaphragms not observed. Long inferior hemisepta present. Autozoecial aper-

tures oval, arranged in regular diagonal rows. 3–5 Macroacanthostyles surround each autozoecial apertures, 0.05–0.075 mm in diameter. Paurostyles abundant, 0.01 mm in diameter, located in groups or irregularly between autozoecial apertures and macroacanthostyles.

Occurrence: China: Mengkungao Formation, Early Carboniferous; Russia: Podonino horizon, the Middle-Late Famennian (Late Devonian).

Discussion: *Klaucena lalolamina* Yang, Hu, Xia, 1988 differs from other species of the genus in having a flattened and ramose colony.

Family Nikiforovellidae Gorjunova, 1975

Genus *Mediapora* Trizna, 1958

Type species: *Mediaporainjaensis* Trizna, 1958, Early Carboniferous, Kuzbass, Russia.

Diagnosis: colonies branched. Diaphragms rare. Hemisepta absent. Autozoecia with elongated oval apertures. Acanthostyles located at junctions of autozoecial apertures. Rare metazooecia present.

Occurrence: Russia, Kazakhstan, Mongolia; Middle Devonian to Early Carboniferous.

Discussion: *Mediapora* Trizna, 1958 differs from *Nikiforovella* Nekhoroshev, 1948 in having few diaphragms, its absence of a well-marked median axis and its presence of few metazooecia.

Mediapora elegans sp. nov. (Figs. 4 G–J; Table 9)

Etymology: The specific name '*elegans*' refers to the small size and general delicate appearance of the new species (derived from Latin '*elegantis*' = elegant).

Table 8. Descriptive statistics for *Klaucena lalolamina* Yang, Hu, Xia, 1988 (for abbreviations, see Table 1).

| <i>Klaucena lalolamina</i> Yang, Hu, Xia, 1988 | N | X | SD | CV | MIN | MAX |
|--|----|------|-------|-------|-------|-------|
| aperture width [mm] | 20 | 0.09 | 0.020 | 20.93 | 0.050 | 0.120 |
| aperture spacing along branch [mm] | 15 | 0.19 | 0.024 | 12.61 | 0.150 | 0.220 |
| aperture spacing across branch [mm] | 15 | 0.20 | 0.033 | 16.27 | 0.150 | 0.250 |
| macroacanthostyle diameter [mm] | 10 | 0.06 | 0.017 | 29.13 | 0.025 | 0.075 |
| number of macroacanthostyle between apertures | 15 | 4.06 | 0.593 | 14.59 | 3.000 | 5.000 |

Fig. 4. Bryozoa from the families Rhomboporidae and Nikiforovellidae.

A–C – *Klaucena gracilis* sp. nov. **A:** 4/24.1, longitudinal section, scale bar = 0.5 mm; **B:** 4/24.1, tangential section, scale bar = 0.5 mm; **C:** 4/24.2, transverse section, scale bar = 0.2 mm; **D–F** – *Klaucena lalolamina* Yang, Hu, Xia, 1988. **D:** 4/25.1, longitudinal section, scale bar = 0.5 mm; **E:** 4/25.1, transverse section, scale bar = 0.5 mm; **F:** 4/25.1, tangential section, scale bar = 0.5 mm; **G–J** – *Mediapora elegans* sp. nov. **G:** 4/26.1, tangential section, scale bar = 0.2 mm; **H:** 4/26.1, transverse section, scale bar = 0.5 mm; **I:** 4/26.2, longitudinal section, scale bar = 0.5 mm; **J:** 4/26.2, tangential section, scale bar = 0.2 mm.

Table 9. Descriptive statistics for *Mediapora elegans* sp. nov. (for abbreviations, see Table 1).

| <i>Mediapora elegans</i> sp. nov. | N | X | SD | CV | MIN | MAX |
|-----------------------------------|----|------|-------|-------|-------|-------|
| branch width [mm] | 5 | 1.64 | 0.314 | 19.13 | 1.200 | 2.000 |
| endozone width [mm] | 5 | 0.53 | 0.088 | 16.51 | 0.400 | 0.620 |
| aperture width [mm] | 10 | 0.12 | 0.022 | 18.45 | 0.100 | 0.170 |
| aperture length [mm] | 10 | 0.25 | 0.018 | 7.64 | 0.220 | 0.270 |
| metazooecia diameter [mm] | 5 | 0.05 | 0.017 | 35.35 | 0.025 | 0.075 |

Holotype: 4/26.1; paratypes: 4/26.2–4/26.3.

Type locality: Tom River, Kemerovo region, Russia.

Type horizon: Jurginskaya Formation, Podonino horizon, Middle-Late Famennian (Late Devonian).

Diagnosis: colonies thin branched. Few diaphragms. Autozooecia with long-oval apertures. Rare metazooecia. Acanthostyles numerous. Longitudinal ridges presents.

Description: colonies thin, branched. Exozones 0.4–0.7 mm wide. Autozooecial walls 0.012 mm thick in endozones, and 0.025 mm thick in exozones. Diaphragms few, straight, complete or incomplete. Autozooecial apertures elongated, oval, arranged in regular diagonal rows. 5 Acanthostyles surround the autozooecial apertures, 0.025 mm in diameter. Metazooecia rare, 0.025–0.075 mm in diameter.

Discussion: *Mediapora elegans* sp. n. differs from *Mediapora rhombicellata* Trizna, 1958 from the Tournaisian (Early Carboniferous) of the Kuzbass in its smaller size of acanthostyles (0.025 mm vs. 0.04–0.05 mm in *Mediapora rhombicellata*), and in the presence of metazooecia.

Discussion

The bryozoan fauna from the Jurginskaya Formation shows palaeobiogeographical affinities with Kazakhstan, Kirgizia, Transcaucasia, China, and the United States of America (Fig. 5). *Rhombopora subtilis* Nekhoroshev, 1977 and *Leptotrypella pojarkovi* Orlovski, 1961 are known from the *Mesoplicia meisteri* Brachiopod Zone of the Lower Famennian of Transcaucasia (Nakhichevan, Azerbaijan) (Lavrentjeva, 1985). The species is also known from the *Sulcifer* Horizon (Middle Famennian) of central Kazakhstan and from the Middle Famennian of the west-

ern offshoots of the Tian Shan (Chatkal-Narynskaya area), respectively (Orlovski, 1961; Nekhoroshev, 1977). *Klaucena lalolamina* Yang, Hu, Xia, 1988 is known from the lower part of the Mengkungao Formation (Tournaisian, Early Carboniferous) of China (Yang et al., 1988).

Most bryozoans from the Jurga section are new species of the genera *Eofistulipora*, *Atactotoechus*, *Nikiforopora*, *Eridotrypella*, *Klaucena*, and *Mediapora*. The genera *Atactotoechus* and *Eridotrypella* are more widely distributed in the Famennian. Six species of *Atactotoechus* are known from the Famennian of Kazakhstan, Kirgizia, China, and three species of *Eridotrypella* are known from the Famennian of the United States, Kazakhstan, and Kuzbass (Fritz, 1944; Yang, 1950; Orlovski, 1961; Troitzkaya, 1968, 1975; Tolokonnikova, 2007). The spatial distribution of three other genera was restricted in the Famennian: *Eofistulipora* is known from China, *Klaucena* from Kazakhstan and Transcaucasia, and *Mediapora* from Transcaucasia (Troitzkaya, 1975; Lavrentjeva, 1985; Xia, 1997). It is worthwhile to mention here that the Tournaisian was the time-span of a peak in the

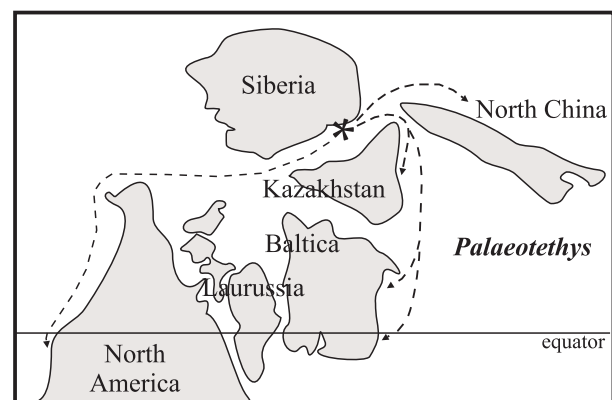


Fig. 5. Palaeobiogeography of genera from the Jurginskaya Formation in Famennian (plate tectonic reconstruction after Scotese, 2001). The asterisk indicates the Jurga section.

development of the genera *Klaucena* and *Medi-
apora*, which include 10 and 3 species, respec-
tively. Their distribution comprised Kuzbass,
China, Kazakhstan, and Mongolia. The finding
of a representative of *Nikiforopora* extends the
stratigraphic range of this genus. This genus
has previously been reported from the Missis-
sippian of Russia, Uzbekistan, Mongolia, and
Ukraine (Dunaeva, 1964; Astrova, 1978; Moro-
zova et al., 2003).

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