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., *Mediapora 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* Orlovskii, 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: *Mediapora 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
morphological characteristics. The inner diameter was measured for hollow characteristics such as apertures and autozooecial 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 exilazooecia and the acanthostyles surrounding each autozooecial 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 autozooecium. 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. Autozooecia 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 endozooce.

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. Autozooecial walls 0.012 mm thick in endozones, 0.025 mm thick in exozones. Autozooecial diaphragms straight or inclined, numbering 1–2 on 1 mm of autozooecial length in endozones and 3–5 on 1 mm in exozones. Au-
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Table 1. Descriptive statistics for *Eofistulotrypa famennensis* sp. nov.

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

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

tozooecial 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 autozooecia, polygonal in tangential section.

**Discussion:** *Eofistulotrypa famennensis* sp. nov. is similar to *Eofistulipora primacylindilla* Xia, 1997 from the Famennian of Xinjiang, 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. Autozooecia with polygonal to circular-polygonal apertures. Diaphragms abundant, straight or inclined. Cystiphragms single or several in cluster. Exilazooecia rare. Acanthostyles absent or present in small numbers in maculae. Autozooecial 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 autozooecial 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>
<thead>
<tr>
<th><em>Atactotoechus cellatus</em> sp. nov.</th>
<th>N</th>
<th>X</th>
<th>SD</th>
<th>CV</th>
<th>MIN</th>
<th>MAX</th>
</tr>
</thead>
<tbody>
<tr>
<td>branch width [mm]</td>
<td>6</td>
<td>10.33</td>
<td>0.605</td>
<td>5.85</td>
<td>9.500</td>
<td>11.00</td>
</tr>
<tr>
<td>endozone width [mm]</td>
<td>10</td>
<td>3.75</td>
<td>0.205</td>
<td>5.45</td>
<td>3.500</td>
<td>4.00</td>
</tr>
<tr>
<td>exozone width [mm]</td>
<td>10</td>
<td>3.25</td>
<td>0.227</td>
<td>6.99</td>
<td>3.000</td>
<td>3.50</td>
</tr>
<tr>
<td>aperture width [mm]</td>
<td>20</td>
<td>0.19</td>
<td>0.042</td>
<td>21.55</td>
<td>0.120</td>
<td>0.27</td>
</tr>
<tr>
<td>exilazooecia width [mm]</td>
<td>10</td>
<td>0.07</td>
<td>0.018</td>
<td>25.44</td>
<td>0.050</td>
<td>0.10</td>
</tr>
<tr>
<td>acanthostyle diameter [mm]</td>
<td>10</td>
<td>0.04</td>
<td>0.013</td>
<td>35.13</td>
<td>0.025</td>
<td>0.05</td>
</tr>
</tbody>
</table>
Bryozoans from the Jurginskaya Formation (Famennian, Upper Devonian) of the Tom-Kolyvansk area...

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). Autozoecial walls twisted, 0.075 mm thick in exozones. Autozoecial diaphragms rare in endozones, abundant in exozones, straight or inclined. Autozoecial diaphragms 4–5 per 1 mm. Cystiphragms rare. Autozoecial apertures circular-polygonal. In any direction 7–8 apertures in 2 mm. Exilazooecia rare, short, polygonal in cross-section. Sometimes 4–5 exilazooecia surrounding autozoecial 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 Vinasssa de Regny, 1921
Type species: Chaetetes barrandei Nicholson, 1874, Middle Devonian, Canada.

<table>
<thead>
<tr>
<th>Table 3. Descriptive statistics for Leptotrypella pojkarkovi Orlovski, 1961. (for abbreviations, see Table 1).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Leptotrypella pojkarkovi</strong> Orlovski, 1961</td>
</tr>
<tr>
<td>---------------------------------------------------------------</td>
</tr>
<tr>
<td>branch width [mm]</td>
</tr>
<tr>
<td>endozone width [mm]</td>
</tr>
<tr>
<td>aperture width [mm]</td>
</tr>
<tr>
<td>aperture spacing [mm]</td>
</tr>
<tr>
<td>exilazooecia width [mm]</td>
</tr>
<tr>
<td>number of exilazooecia between apertures</td>
</tr>
<tr>
<td>exozonal wall thickness [mm]</td>
</tr>
</tbody>
</table>

Fig. 2. Bryozoans 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 pojkarkovi* 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 Stenoporididae Waagen & Wentzel, 1886

Genus *Nikiforopora* Dunaeva, 1964
Type species: *Batostomella concentrica* Nikiforova, 1927, Early Carboniferous, Ukraine. Diagnosis: branched colonies with narrow exozone. Autozooecia with oval apertures. Exilazooecia rare. Acanthostyles large, 2–3 surrounding each aperture. Autozoecial diaphragms in the exozozone located close to the colony surface. 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 autozooecia 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.

<table>
<thead>
<tr>
<th>Table 4. Descriptive statistics for <em>Nikiforopora jurgensis</em> sp. nov. (for abbreviations, see Table 1).</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nikiforopora jurgensis</strong> sp. nov.</td>
</tr>
<tr>
<td>branch width [mm]</td>
</tr>
<tr>
<td>endozone width [mm]</td>
</tr>
<tr>
<td>aperture width [mm]</td>
</tr>
<tr>
<td>aperture spacing [mm]</td>
</tr>
<tr>
<td>exilazooecia width [mm]</td>
</tr>
<tr>
<td>number of exilazooecia between apertures</td>
</tr>
<tr>
<td>acanthostyle diameter [mm]</td>
</tr>
</tbody>
</table>

Family Eridotrypellidae Morozova, 1960

Genus *Eridotrypella* Duncan, 1939
Type species: *Batostomella obliqua* Ulrich, 1890, Hamilton Group (Middle Devonian), United States of America. Diagnosis: colonies branched. Autozooecia with irregular-circular apertures. Autozoecial diaphragms in endozones lacking or very rare; variable in number in exozones. Exilazooec-
Bryozoans from the Jurginskaya Formation (Famennian, Upper Devonian) of the Tom-Kolyvansk area...

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

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

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

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 autozooecial walls in exozones (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 autozooecia meet the colony surface at low angles. Diaphragms can occur. Hemisepta absent. Autozooecial apertures oval. Metazooecia 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 autozooecia and in the absence of large acanthostyles, as well as in having rare metazooecia.

Rhombopora subtilis Nekhoroshev, 1977 (Figs. 3 G–H; Table 6)
1977 Rhombopora subtilis sp. nov., Nekhoroshev, pp. 139–140, pl. 32, figs. 4–7.
Description: colony thin ramose, 0.8 mm in diameter. Endozones of 0.2 mm wide, exozones...
Bryozoans from the Jurginskaya Formation (Famennian, Upper Devonian) of the Tom-Kolyvansk area... of 0.3 mm wide. Autozooecial walls of 0.025 mm in thickness the endozone, 0.075–0.1 mm thickness in exozone. Hemisepta absent. Autozooecial 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).

Diagnosis: colonies branched with incomplete mesotheca. Few diaphragms and hemisepta. Autozooecial apertures irregular-oval or oval-rhombic. Abundant macroacanthostyles and paurostyles. Autozooecial 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 autozooecia 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 6. Descriptive statistics for Rhombopora subtilis Nekhoroshev, 1977 (for abbreviations, see Table 1).

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

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

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

Fig. 3. Bryozoans from the families Stenoporidae, Eridotrypellidae and Rhomboporidae. A–C – Nikiforopora jurgenisis 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.


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 apertures oval, arranged in regular diagonal rows. 3–5 Macroacanthostyles surround each autozoecial aperture, 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: *Mediapora injaensis* Trizna, 1958, Early Carboniferous, Kuzbass, Russia.


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 metazoecia.

*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).

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

**Fig. 4.** Bryozoans 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.
Type locality: Tom River, Kemerovo region, Russia.
Type horizon: Jurginskaya Formation, Podoninno horizon, Middle-Late Famennian (Late Devonian).
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 Mesoplica 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 western 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
development of the genera Klaucena and Mediapora, which include 10 and 3 species, respectively. Their distribution comprised Kuzbass, China, Kazakhstan, and Mongolia. The finding of a representative of Nikijoropora extends the stratigraphic range of this genus. This genus has previously been reported from the Mississippian of Russia, Uzbekistan, Mongolia, and Ukraine (Dunaeva, 1964; Astrova, 1978; Morozova et al., 2003).

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