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Cystoporida (Bryozoa) from the Emsian Stage (Lower Devonian) of the Salair Ridge and Gorny and Rudny Altai

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Abstract—Eight bryozoan species of the order Cystoporida are described from the Emsian Stage of the Lower Devonian in the western Altai-Sayan Folded Area. Five of them are new species: *Fistulipora salairiensis* sp. nov., *Fistuliramus fasciculus* sp. nov., *Fistuliphragma sibirica* sp. nov., *F. moniliformis* sp. nov., and *Fistulocladia cincinnata* sp. nov. The others belong to the genera *Ganiella, Physallidopora,* and *Fistuliporidra*. Most of the cystoporid species studied from the Emsian Stage in the Altai-Sayan Folded Area are widespread laterally. Six cystoporid species have a narrow stratigraphic range and are, therefore, characteristic species of the bryozoan biostratigraphic zones of this region. The species of *Physallidopora cantabrica* Ernst et Buttler and *Fistuliporidra hibera* Ernst et Buttler, for the first time encountered in the Emsian of Gorny and Rudny Altai, were previously described from coeval deposits in northwestern Spain.

Keywords: Bryozoa, Cystoporida, Devonian, Emsian, Altai-Sayan Folded Area

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INTRODUCTION

According to the current stratigraphical scheme for the Devonian (Yolkin et al., 2005), the Emsian Stage of the Lower Devonian of the Salair Ridge and Gorny and Rudny Altai contain two cystoporid species: *Ganiella frequens* Jaroshinskaja, 1968 and *G. parva* Jaroshinskaja, 1968 (Astrova and Jaroshinskaja, 1968; Jaroshinskaja, 1983). During further investigations in the sections of the Emsian Stage of these regions, the author has found representatives of six more genera of the 21 genera widespread in Lower Devonian deposits (Gorjunova, 1996; Ernst and Buttler, 2012): *Fistulipora salairiensis* sp. nov., *Fistuliramus fasciculus* sp. nov., *Fistuliphragma sibirica* sp. nov., *Fistuliphragma moniliformis* sp. nov., *Physallidopora cantabrica* Ernst et Buttler, 2012, *Fistuliporidra hibera* Ernst et Buttler, 2012, and *Fistulocladia cincinnata* sp. nov.

These species are included in the faunal assemblages of the biostratigraphic zones based on bryozoans established in the Emsian Stage of the Altai-Sayan Folded Area (ASFA). The lower Emsian Stage—the range of the *Kuzbassus admirandus–Eridotrypa neocallosa* Zone, the stratotype of which is represented by the lower–middle Salairka Beds (Mesentseva, 2012)—has yielded two cystoporid species (Fig. 1). In the Salair Ridge *Fistuliphragma sibirica* sp. nov. cooccurs in the same section (B-819; Yolkin et al., 2005) with *Kuzbassus admirandus* Mesent. and *Eridotrypa neocallosa* Mesent. and with characteristic species of the zone (*Neotrematopora multi* Mesent., *Cyphotrypa minor* Mesent., *Chondraulus salairiensis* Mesent., and *Eostenopora notabilisica* Mesent.). In addition, this species has been found in bed 14 of this section, which belongs to the upper Salairka Beds.

Ganiella parva was encountered together with the index species and characteristic species of this zone in the middle Salairka Beds of the stratotype section of the Salairka Horizon (B-793; Yolkin et al., 2005). This species was first mentioned as a member of the Salairka assemblage from the Salair Ridge by A.M. Jaroshinskaja (1983). However no data on the records of the species from any particular section are known; hence the need to re-describe it.

In Gorny Altai the *Kuzbassus admirandus–Eridotrypa neocallosa* biostratigraphic Zone has not been discovered. In the sections along Ganin Klyuch and Kuvash creeks, this zone apparently correlates with the notably coarse clastic sediments of the lower Salairka Horizon that contain no bryozoans. They immediately underlie the *Eridotrypa beloviensis–Lioclema lucida* bryozoan Zone, which in these sections is characterized by the presence of index species.

In the range of the *Eridotrypa beloviensis–Lioclema lucida* Zone (the stratotype of the zone is represented by the Upper Salairka–Lower Shanda Beds) there are five cystoporid species (Fig. 1). In Gorny Altai *Ganiella parva, G. frequens*, and *Fistuliporidra hibera* were uncovered by the section along the right side of Ganin Klyuch Creek (near the abandoned small town of Kireevskii) in the upper part of the Salairka Horizon

(Yolkin et al., 2005). Here they co-occur with the index species *Eridotrypa beloviensis* Mesent. and *Lioclema lucida* Mesent. and characteristic species *L. multiacanthoporum* Astrova. In the right bank of Kuvash Creek, the lower part of the Shanda Horizon yielded *Fistuliphragma moniliformis* sp. nov. together with the index species *Lioclema lucida* and characteristic species *Lioclema pseudogloria* Mesent., *Eridotrypa nekhoroshevi* Jarosh., *Spinofenestella glarea* (Jarosh.), and *Eosemicoscinium amurensiforme* (Jarosh.).

As noted above, *Fistuliphragma sibirica* sp. nov. occurs in the Salair Ridge in the lower *Eridotrypa beloviensis*–*Lioclema lucida* Zone. In the upper part of this zone, *Fistuliphragma moniliformis* sp. nov. was discovered together with the index species *Eridotrypa beloviensis* and *Lioclema lucida* and characteristic species *Leptotrypella gurievensis* Astrova and *Lioclema pseudogloria* (section B-819; Yolkin et al., 2005).

The cystoporids of the *Lioclema akarachica*–*Reteporina ubensis* bryozoan Zone (stratotype of the zone is represented by middle Shanda Beds) are represented by five species (Fig. 1). The species *Fistuliramus fasciculus* sp. nov. was only discovered on the Salair Ridge in the vicinity of the town of Gur'evsk together with the index species *Lioclema akarachica* J. Udodov and with *Fistulipora salairiensis* sp. nov. and *Fistuliphragma moniliformis* sp. nov. (section B-8225; Yolkin et al., 2005). The records of the species *Physallidopora cantabrica* and *Fistulocladia cincinnata* sp. nov. are restricted to Rudny Altai. They were discovered in the vicinity of the town of Zmeinogorsk (section B-903; Yolkin et al., 2005) together with the index species *Lioclema akarachica* and *Reteporina ubensis* Nekhoroshev, with the characteristic species of the zone (*Spinofenestella nekhoroshevi* (Krasnopeeva), *Alternifenestella capillate* (Krasn.), *Eosemicoscinium ubense* (Nekh.), *Reteporina ubensis* Nekh.), and with *Fistulipora salairiensis* sp. nov. and *Fistuliphragma moniliformis* sp. nov.

Fistulipora salairiensis and *Fistuliphragma moniliformis* occur within three regions. The basic data on the location of these new species within the Salair Ridge and Rudny Altai have been already provided above. I can only add that both species were also found in section 2.IIb in the vicinity of the town of Gur'evsk (Yolkin et al., 2005) together with the index species and characteristic species of the zone (*Lioclema akarachica, Reteporina ubensis, Spinofenestella nekhoroshevi, Alternifenestella capillate, Eosemicoscinium ubense, Polyporella gurievskensis* Mesent., *Septopora salairiensis* Mesent., etc.). The species *Fistulipora salairiensis* sp. nov. was encountered in the sections located along the left side of the Charysh River in Gorny Altai (Mesentseva and Udodov, 2007) together with the index species of the zone—*Lioclema akarachica*. *Fistuliphragma moniliformis* sp. nov. was discovered in the right side of the L-shaped bend of the Ganin Klyuch Creek valley.

It is worth noting that out of the eight cystoporid species described below *Physallidopora cantabrica* and *Fistuliporidra hibera* are recorded within Rudny and Gorny Altai, respectively. Previously, they were recorded from the Emsian sediments of northwestern Spain (Ernst and Buttler, 2012).

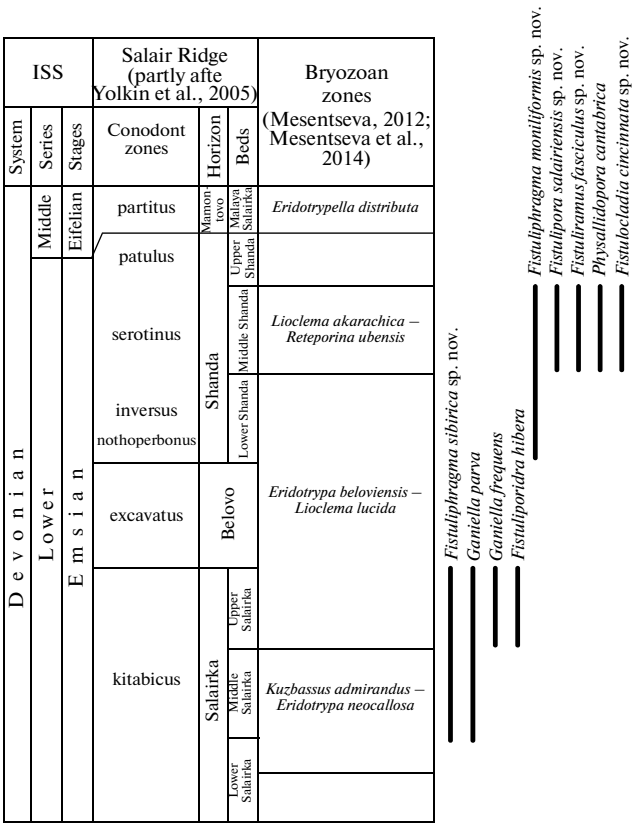


Fig. 1. Distribution of cystoporids in the Emsian Stage of the Altai–Sayan Folded Area.

MATERIAL

The bryozoan collection studied in this paper was collected by the author with assistance from Yu.V. Udodov and is stored in the Siberian State Industrial University (SibGIU, coll. no. 14).

SYSTEMATIC PALEONTOLOGY

Order Cystoporida

Family Ceramoporidae Ulrich, 1882

Genus *Ganiella* Jaroshinskaja, 1968

***Ganiella parva* Jaroshinskaja, 1968**

Ganiella parva: Astrova et Jaroshinskaja, 1968, p. 52, pl. I, fig. 2.

H o l o t y p e. Siberian Research Institute of Geology, Geophysics, and Mineral Resources (SNIIGGIMS), no. 952/T6a-1; Gorny Altai, right bank of Ganin Klyuch Creek near the abandoned small town of Kireevskii; Lower Devonian.

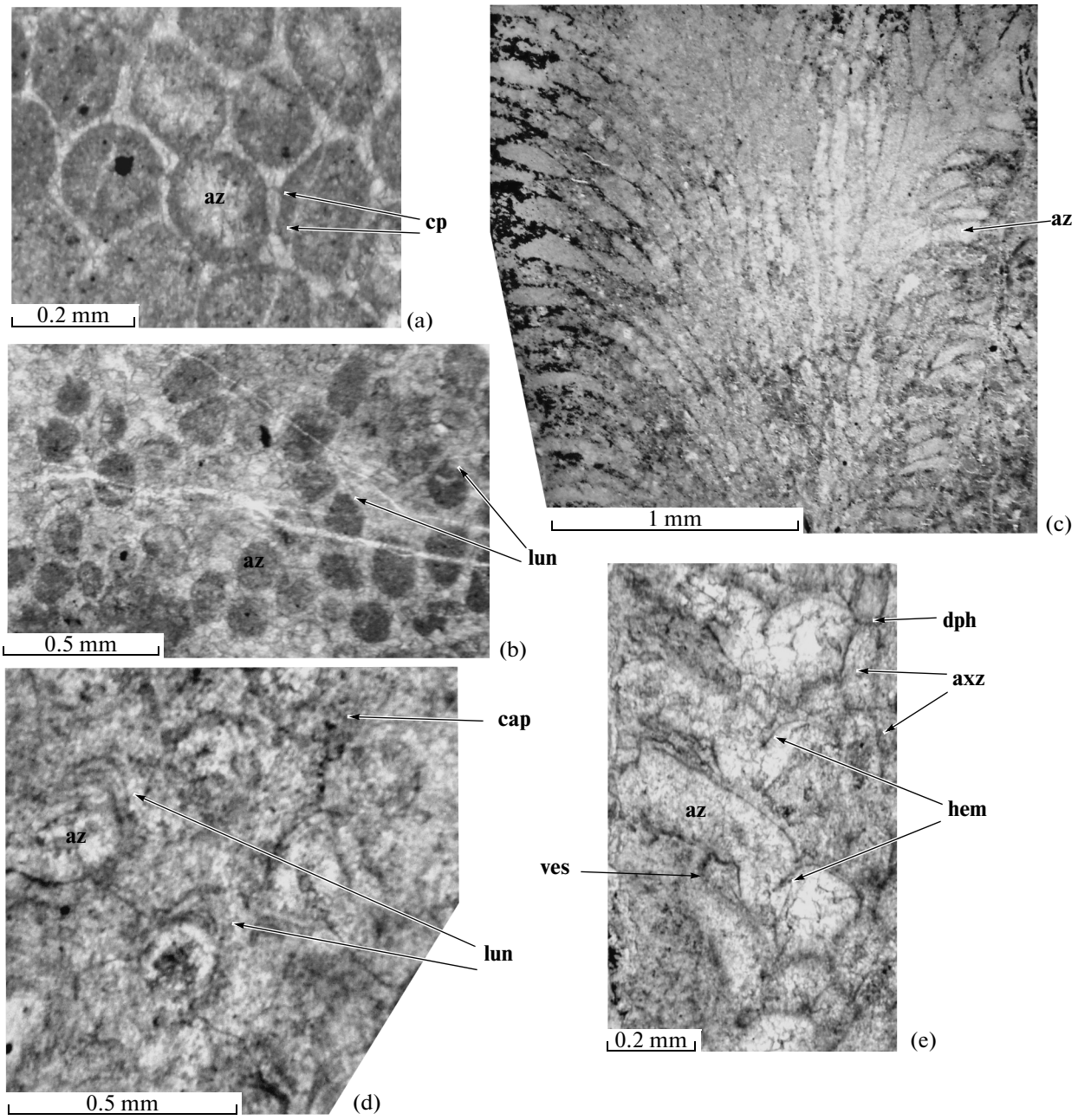


Fig. 2. Morphology of the genera *Ganiella* and *Fistulocladia*: (a–c) *Ganiella parva* Jarosh., specimen SibGIU, no. 14/1: (a) tangential section in the region of a monticule; (b) tangential section, some apertures of autozooecia are closed by calcification; (c) longitudinal section of a portion of the colony branching; (d, e) *Fistulocladia cincinnata* sp. nov., holotype SibGIU, no. 14/68: (d) tangential section; (e) longitudinal section of dendroid colony, exozone. Designations for Figs. 2–4: (az) autozooecia, (ac) acanthostyles, (hem) hemiphragms, (dph) diaphragms, (cap) capillaries, (lun) lunaria, (cp) communication pores, (mon) monticules, (axz) axial zooecia, (ves) vesicular tissue.

D e s c r i p t i o n (Figs. 2a, 2c). The colonies are dendroid, 4.2–9.0 mm in diameter, not differentiated into endozone and exozone. The autozooecia gradually diverge from the axial part of the colony toward the surface. The monticles are no less than 3.0 mm in diameter and consist of megazooecia. The apertures of autozooecia are circular to ovate and randomly arranged; the apertures of megazooecia located in monticles are predominantly rounded polygonal in shape. The lunaria are poorly defined. The apertures of autozooecia are 0.11–0.20 mm in diameter, in monticles the apertures are 0.22–0.27 mm in diameter; there are 10–11 apertures per 2 mm, and in monticles there are 8–9 apertures per 2 mm. The walls of

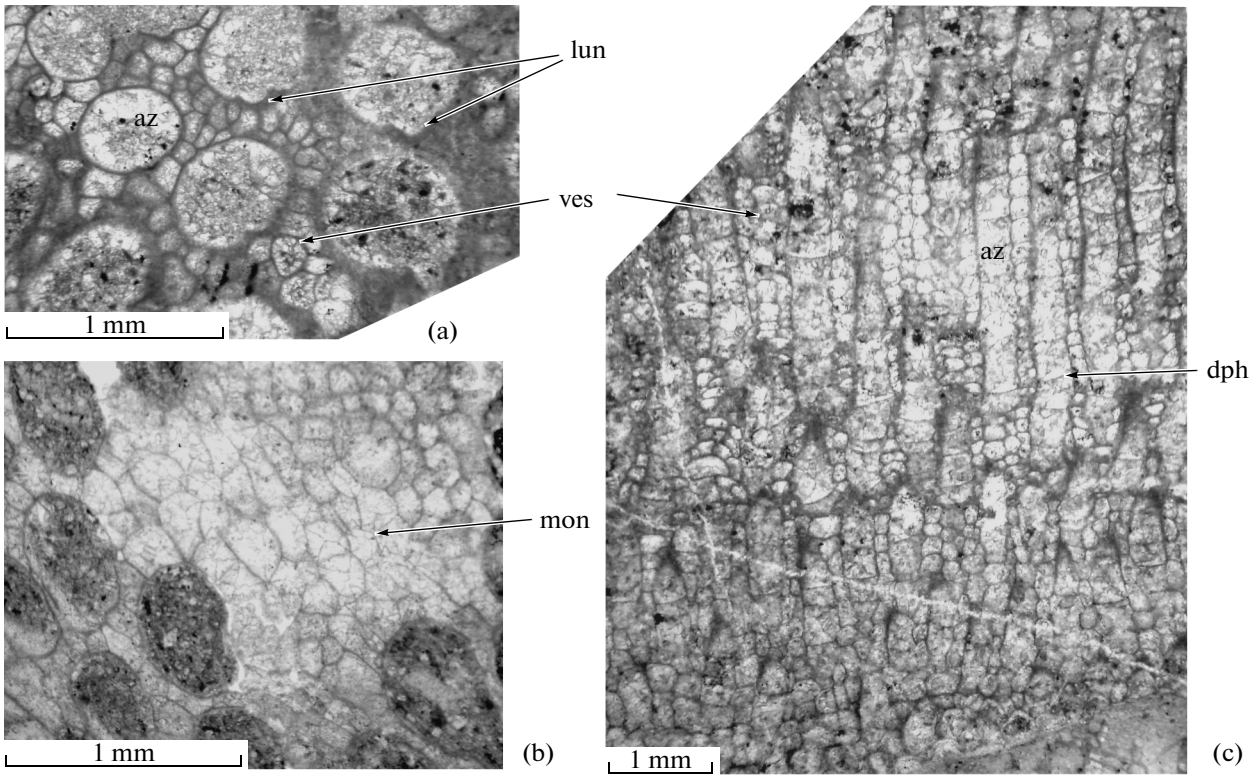


Fig. 3. Morphology of *Fistulipora salairiensis* sp. nov.: (a) paratype SibGIU, no. 14/6, tangential section; (b) paratype SibGIU, no. 14/14, monticule, tangential section; (c) paratype SibGIU, no. 14/19, portion of a massive colony, longitudinal section. See Fig. 2 for designations.

autozooecia are slightly undulating, structureless, pierced by communication pores; near the colony surface the walls thicken up to 0.03–0.06 mm. Diaphragms have not been found. Exilazooecia, neozooecia, and vesicular tissue are absent.

Comparison. *G. parva* differs from *G. frequens* Jaroshinskaja, 1968 from the Lower Devonian of Gorny Altai (Astrova and Jaroshinskaja, 1968) in the greater diameter of branches (4.5–9.0 mm instead of 3.2–3.5 mm), large monticules, number of autozooecia per 2 mm (8–11 instead of 8–9), and in the absence of diaphragms.

Occurrence. Lower Devonian, Emsian Stage, Salairka Horizon, Middle Salairka Beds, Salair Ridge; upper Salairka Beds, Gorny Altai.

Material. Four specimens (16 thin sections): SibGIU, nos. 14/1, 2, Gorny Altai, right bank of Ganin Klyuch Creek, vicinity of the abandoned small town of Kireevskii, outcrop E-56; SibGIU, no. 14/3, left bank of Aktashka Creek, a tributary of the Sema River, section Aktashkinskii-2, bed 27; SibGIU, no. 14/4, Salair Ridge, vicinity of the town of Gur'evsk, section B-793, bed 11.

Family Fistuliporidae Ulrich, 1882

Genus *Fistulipora* McCoy, 1849

***Fistulipora salairiensis* Mesentseva, sp. nov.**

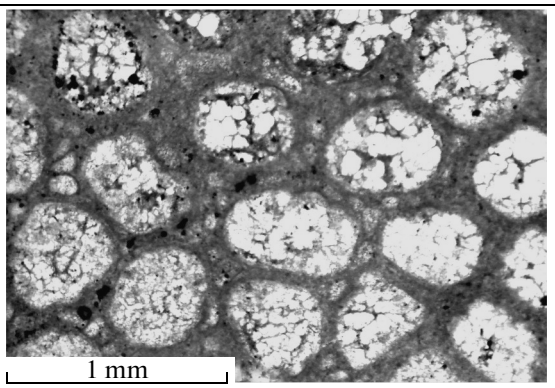
Plate 10, fig. 1

Etymology. From the Salair Ridge.

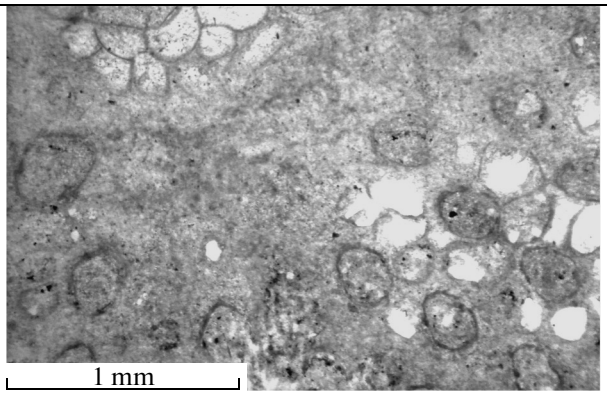
Holotype. SibGIU, no. 14/5; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Description (Fig. 3). The colonies are laminated, unilaminate or multilaminate (consisting of 2–7 layers), occasionally alternating with layers of sediment. The multilaminate colonies measure 10 × 15–15 × 25 mm; the layers varies in thickness from 0.50 to 6.50 mm. The differentiation into zones is indistinguishable. The monticles are infrequent, consist of vesicular tissue, 1.3–2.0 mm in diameter. The autozooecia are in an upright position or, more rarely, they are first in an oblique position (at an angle of 30°–50°) near the colony base and then take an upright position. The apertures of autozooecia are circular to ovate or, more rarely, rounded polygonal, arranged in longitudinal rows; there are 2–4.5 apertures per 2 mm along a row. The maximum diameter of apertures varies from 0.33 to 0.46 mm in autozooecia and from 0.50 to 0.63 mm in monticles. The lunaria are located near

Plate 10



1a



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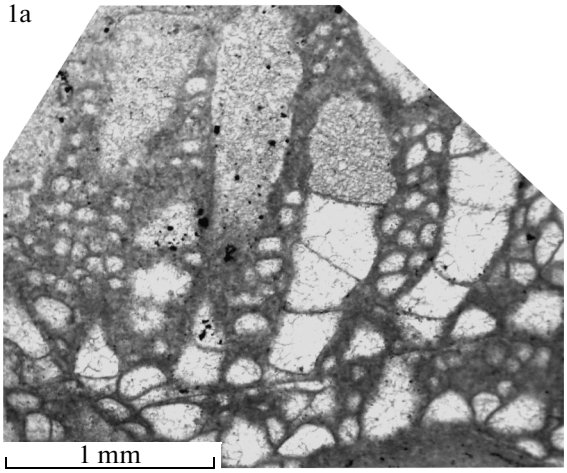

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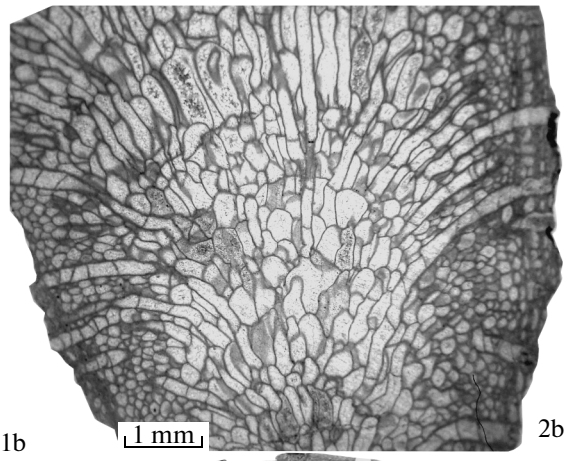

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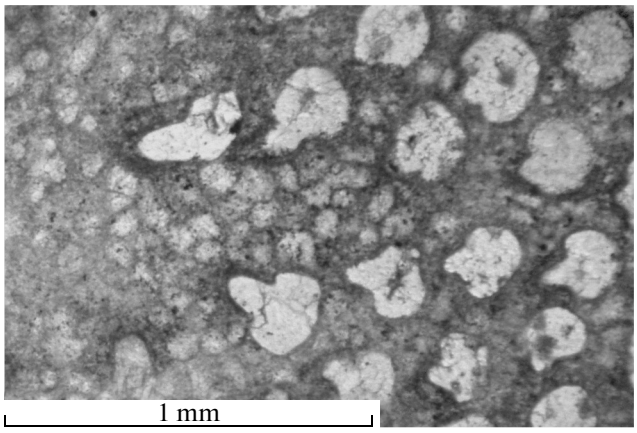

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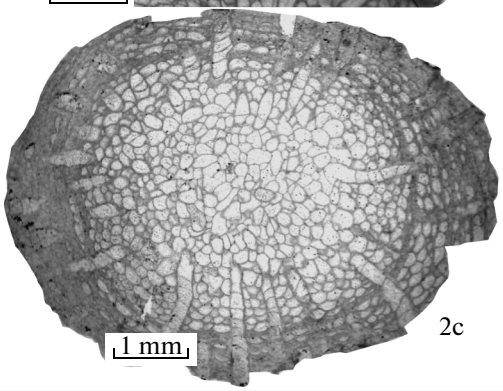

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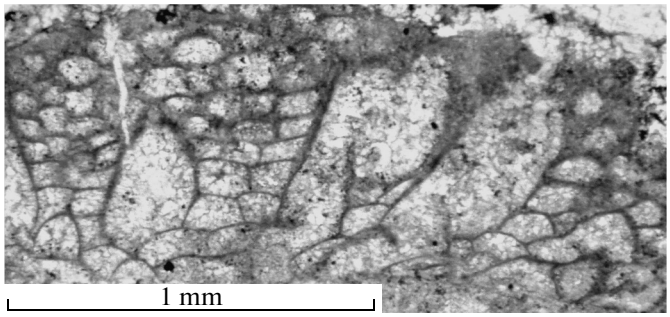
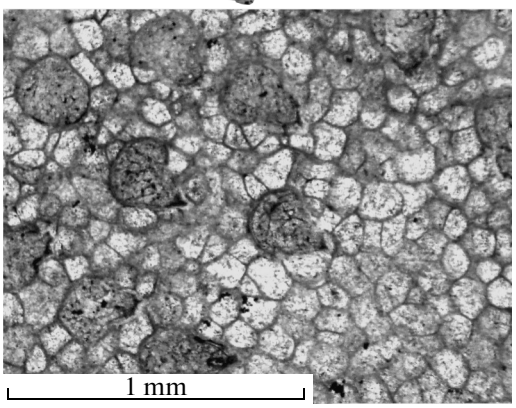


3b



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the wide side of the aperture in the form of slightly projecting edges of the wall; within and near the monticles the lunaria are well defined, crescentic, occasionally triangular, with the tips slightly jutting out into the aperture. The lunaria are 0.04–0.14 mm long, 0.14–0.20 mm wide, and 0.02–0.04 mm thick. The walls of autozooecia thicken away from the colony base up to 0.015–0.028 mm. The diaphragms are thin, flat or concave, occasionally oblique, unevenly distributed: there are usually 1–4 diaphragms per 1 mm; near the colony surface and in thin colonies they are sporadic or absent. The distance between diaphragms varies from 0.08–0.30 to 0.65 mm or, more frequently, from 0.20 to 0.50 mm. In tangential section the vesicles are rounded polygonal in shape, 0.07–0.14 mm in diameter, and 0.11–0.29 mm in diameter in monticles. Near the surface, occasionally as far as the middle of the colony, the vesicular tissue is hidden under granular calcareous material. In the colony the vesicles are distributed unevenly: usually they isolate autozooecia by one or two (incomplete) rows or, more rarely, autozooecia touch each other. In the vicinity of monticles the vesicles increase sharply in number: around an aperture there are from 9 to 19 vesicles forming two complete rows or, more rarely, 3–4 incomplete rows. There are 4.5–9.5 scale-shaped or rounded polygonal vesicles per 1 mm along the length of an autozooecium, and at the colony base there are large (0.25–0.50 mm long) vesicles, frequently forming accumulations.

Comparison. *F. salairiensis* sp. nov. differs from *F. compacta* Astrova, 1964 from the Lower Devonian of Podolia (Astrova, 1964) in the greater diameter of autozooecial apertures (0.33–0.63 mm instead of 0.16–0.33 mm), fewer apertures per 2 mm (2–4.5 instead of 6–8), more numerous diaphragms, and in the uneven distribution of diaphragms (from sporadic to 1–4 per 1 mm instead of sporadic). The new species differs from *F. indigena* Morozova (Morozova, 1961) from the Givetian Stage of the Kuznetsk Basin in the greater diameter of autozooecial apertures (0.33–0.63 mm instead of 0.20–0.45 mm), uneven distribution of diaphragms, greater number of vesicles (4.5–9.5 vesicles per 1 mm of the length of an autozooecium instead of 3–4), and in the presence of accumulations of large vesicles at the colony base.

Occurrence. Lower Devonian, Emsian Stage, Shanda Horizon, Middle Shanda Beds, Salair Ridge, Gorny and Rudny Altai.

Material. In addition to the holotype, 21 specimens (94 thin sections): SibGIU, nos. 14/6-13, Salair Ridge, vicinity of the town of Gur'evsk, section 2.IIb, beds 3–5, section B-8225, beds 17, 20, 21; SibGIU, nos. 14/14-18, Gorny Altai, left bank of the Charysh River, vicinity of the small town of Mendursakon, section Mendursakon I-4, beds 1, 2, 10, section Mendursakon I-5, bed 4; SibGIU, nos. 14/19-26, Rudny Altai, vicinity of the town of Zmeinogorsk, Mel'nichnye Sopki, section B-903, bed 10, section Ya-906, bed 13.

Genus *Fistuliramus* Astrova, 1960

Fistuliramus fasciculus Mesentseva, sp. nov.

Plate 10, fig. 2

Etymology. From the Latin *fasciculus* (bunch).

Holotype. SibGIU, no. 14/27; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Description (Fig. 4a). The colonies are dendroid, attached by an encrusting base; the branches are 5.5–8.5 mm in diameter, the encrusting layer is 2.0–5.5 mm thick. The branching part of the colony differentiates into the exozone and endozone; the exozone is 1.5–2.0 mm wide, the endozone is 2.5–4.5 mm in diameter. The monticles, composed of vesicular tissue, are restricted to the exozone. The apertures of autozooecia are circular to ovate, occasionally oval, 0.20–0.24 mm long and 0.18–0.21 mm wide; in the vicinity of monticles the apertures are 0.24–0.36 mm long and 0.21–0.25 mm wide, oriented so that the lunaria are directed toward the monticles, and form short rows; 4.5–5.5 apertures per 2 mm in a row. The lunaria are very small: 0.04–0.08 mm long, 0.11 mm wide, and 0.01–0.03 mm thick. In the autozooecia the diaphragms are flat, oblique, slightly concave; in the exozone, there are in addition intersecting diaphragms. In the endozone there are 1–3 diaphragms per 1 mm of the length of an autozooecium, spaced 0.28–0.88 mm apart, and in the exozone there are 3–5 diaphragms spaced 0.08–0.33 mm apart. The vesicles are 0.15–0.28 mm in diameter and isolate the apertures of autozooecia by one or, in the vicinity of monticles, by two rows. At the very surface the vesicular tissue is overgrown by calcareous material. In the exozone the vesicles are uniform and small, and at the colony surface they become scale-shaped. The endozone is characterized by large irregularly shaped vesicles. In the exo-

Explanation of Plate 10

Fig. 1. *Fistulipora salairiensis* sp. nov., holotype SibGIU, no. 14/5: (1a) tangential section, (1b) longitudinal section; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Fig. 2. *Fistuliramus fasciculus* sp. nov., holotype SibGIU, no. 14/27: (2a) tangential section, (2b) longitudinal section, (2c) cross section; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Fig. 3. *Fistuliphragma sibirica* sp. nov., holotype SibGIU, no. 14/32: (3a) tangential section, (3b) longitudinal section; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Salairka Horizon.

Fig. 4. *Fistuliphragma moniliformis* sp. nov., holotype SibGIU, no. 14/40, tangential section; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

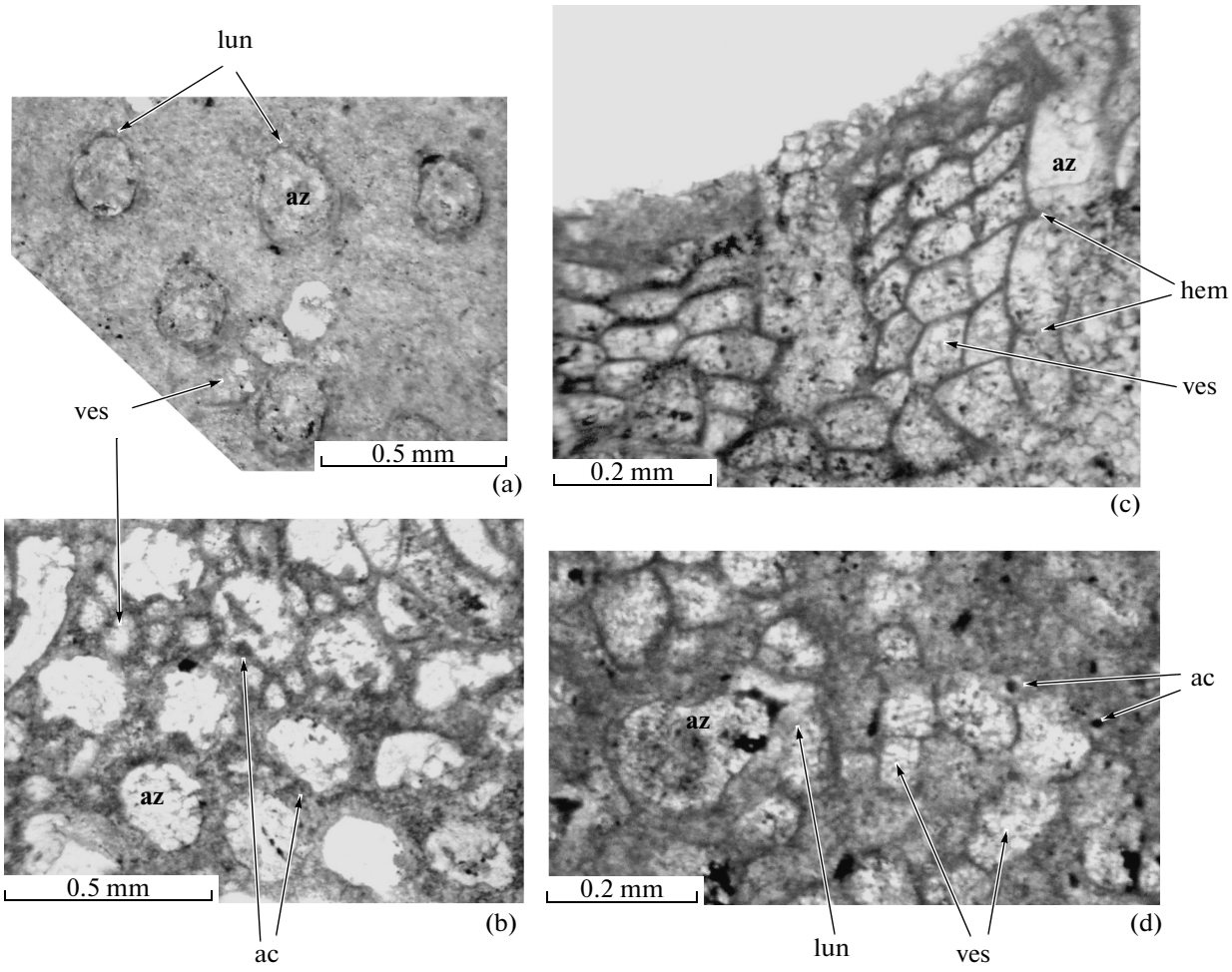


Fig. 4. Morphology of the genera *Fistuliramus* and *Fistuliphragma*: (a) *Fistuliramus fasciculus* sp. nov., holotype SibGIU, no. 14/27, tangential section; (b, c) *Fistuliphragma sibirica* sp. nov., (b) holotype SibGIU, no. 14/32, tangential section; (c) paratype SibGIU, no. 14/33, longitudinal section; (d) *Fistuliphragma moniliformis* sp. nov., holotype SibGIU, no. 14/40, tangential section. See Fig. 2 for designations.

zone there are 6–8 vesicles per 1 mm of the length of an autozooecium (vesicles are 0.08–0.20 mm long), and in the endozone there are 2–3.5 vesicles (0.30–1.00 mm long).

C o m p a r i s o n. *F. fasciculus* sp. nov. differs from *F. changi* from the Givetian Stage of northeastern China (Yang, 1956) in the wide exozone, presence of very conspicuous monticles, fewer autozooecial apertures per 2 mm (4.5–5.5 instead of 6), and in the fewer vesicles (1–2 rows instead of 2–4).

R e m a r k s. The remains of the colonies of *F. fasciculus* sp. nov. (Mesentseva, 2012) were originally assigned to *F. changi* (Yang, 1956). Subsequent records revealed significant differences from *F. changi*.

O c c u r r e n c e. Lower Devonian, Emsian Stage, Shanda Horizon, Middle Shanda Beds, Salair Ridge.

M a t e r i a l. In addition to the holotype, 4 specimens (19 thin sections): SibGIU, nos. 14/28-31, Salair Ridge, vicinity of the town of Gur'evsk, section B-8225, bed 17 and outcrop M-01-21.

Genus *Fistuliphragma* Bassler, 1934

Fistuliphragma sibirica Mesentseva, sp. nov.

Plate 10, fig. 3

E t y m o l o g y. From Siberia.

H o l o t y p e. SibGIU, no. 14/32; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Salairka Horizon.

D e s c r i p t i o n (Figs. 4b, 4c). The colonies are encrusting, unilaminate (occasionally tubular); the layer is 0.28–1.36 mm thick. Most of the colony is occupied by the exozone 0.22–1.22 mm wide. The autozooecia diverge from the epitheca either vertically or at an angle of 20°–35° and then take an upright position. The monticles, composed of vesicular tissue, are 0.56–0.70 mm in diameter. The autozooecia, ori-

ented so that the lunaria are directed toward the center of monticles, form radial rows. The apertures of autozooecia are circular, 0.15–0.21 mm in diameter, and up to 0.24 mm in the vicinity of monticles; there are 6.5–7 apertures per 2 mm along a row, and 5–5.5 apertures in the vicinity of monticles. The lunaria are crescentic, and they are horseshoe-shaped in the vicinity of monticles. The lunaria are 0.03–0.11 mm long, 0.07–0.13 mm wide, and 0.01–0.04 mm thick. The walls of autozooecia are 0.005–0.010 mm thick in the endozone and 0.02–0.04 mm thick in the exozone. The hemiphragms are flat or curved, 0.03–0.07 mm long, and alternate at a distance of 0.28–0.42 mm from each other. In thin colonies hemiphragms are sporadic, restricted to the base. In the well-developed colonies they are quite common in the endozone and exozone, varying in number depending on the colony thickness. Diaphragms are absent. The vesicles are uniform, 0.04–0.13 mm in diameter, at the colony surface they are overgrown by a thin layer of calcareous material. The apertures of autozooecia are usually isolated by vesicles, forming a single row, but in the vicinity of monticles the number of rows increases up to 2–4. The vesicles are 0.10–0.24 mm long in the endozone and 0.06–0.10 mm long in the exozone. The acanthostyles are 0.02–0.03 mm in diameter and are located around the apertures of autozooecia (1 or, more rarely, 2–3) and between vesicles.

Comparison. *F. sibirica* sp. nov. differs from *F. gracilis* Ernst, 2008 from the Lower and Middle Devonian of northwestern Spain (Ernst and Buttler, 2012) and the Middle Devonian of Germany (Ernst, 2008) in the presence of monticles, crescentic shape of lunaria, and in the development of numerous acanthostyles around the apertures of autozooecia and between vesicles.

Occurrence. Lower Devonian, Emsian Stage, Salairka Horizon, middle and upper Salairka Beds, Salair Ridge.

Material. In addition to the holotype, 7 specimens (26 thin sections): SibGIU, nos. 14/33-39, Salair Ridge, vicinity of the town of Gur'evsk, section B-819, beds 11–14.

***Fistuliphragma moniliformis* Mesentseva, sp. nov.**

Plate 10, fig. 4; Plate 11, fig. 1

Etymology. From the Latin *moniliformis* (moniliform).

Holotype. SibGIU, no. 14/40; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

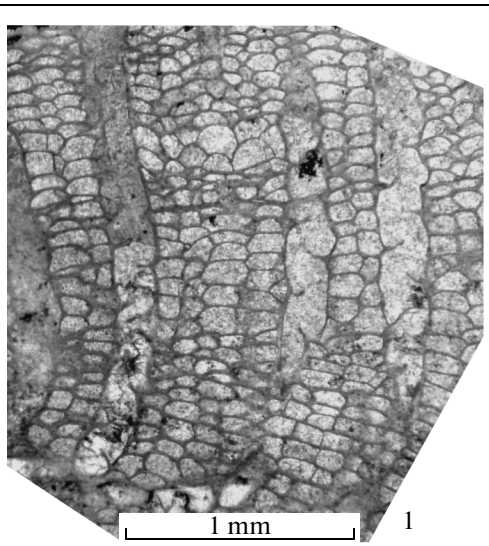
Description (Fig. 4d). The colonies are encrusting (occasionally tubular), laminated, unilaminate and multilaminate; the layer varies in thickness from 0.75 to 4.5 mm. The monticles are composed of vesicular tissue, spaced 5.00–6.00 mm apart; about 1.00 mm in diameter. The differentiation into the endozone and exozone is almost indistinguishable. The autozooecia bud off from a thin epitheca and are arranged vertically or remain for a short distance in contact with the substrate and subsequently take an upright position. In the vicinity of monticles the apertures of autozooecia form fairly regular radial rows and are oriented so that the lunaria are directed to the center of monticles. The apertures of autozooecia are circular or circular to ovate in shape. The maximum diameter of apertures is 0.18–0.22 mm; there are 4.5–5.5 along a row and 2.5–3.5 apertures per 2 mm in the vicinity of monticles. The lunaria are triangular or, more rarely, horseshoe-shaped, 0.07–0.13 mm long, 0.13–0.15 mm wide, and 0.03–0.07 mm thick. In the exozone the walls of autozooecia thicken up to 0.010–0.025 mm. The hemiphragms are flat, curved, 0.06–0.10 mm long, located in the endozone and exozone, alternating at a distance of 0.21–0.42 mm from each other. In the encrusting colonies hemiphragms are sporadic. Diaphragms are absent. The autozooecia are isolated by two or, in the vicinity of monticles, by 3–4 rows of vesicles of polygonal shape, 0.04–0.15 mm in diameter. In longitudinal section the vesicles vary in length from 0.06 to 0.14 mm (10–12 vesicles per 1 mm of the length of an autozooecium). In some places the length of vesicles is reduced to 0.02–0.06 mm (13–15 vesicles per 1 mm of the length of an autozooecium). In the attachment areas of the colony there are occasionally accumulations of vesicular tissue, in which the length of vesicles attains 0.14–0.50 mm. Some interspaces between the vesicles contain rare acanthostyles 0.03–0.04 mm in diameter.

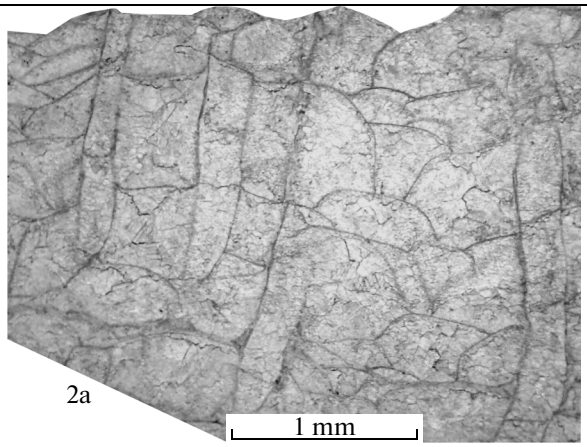
Variability. There are colonies with thickened walls of vesicles, and the length of vesicles varies both within and between colonies.

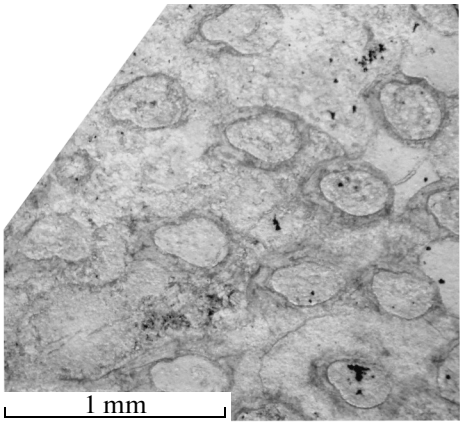
Comparison. The new species differs from *F. sibirica* sp. nov. in the thicker colonies (0.75–4.5 mm instead of 0.28–1.36 mm), number of autozooecial apertures per 2 mm (2.5–5.5 instead of 5–7 apertures), triangular shape and greater measurements of lunaria (0.07–0.13 mm long, 0.13–0.15 mm wide, 0.03–0.07 mm thick instead of 0.03–011 mm long, 0.07–0.13 mm wide, 0.01–0.04 mm thick), and in the rare acanthostyles occurring between the vesicles. The species *F. moniliformis* sp. nov. differs from *F. eifeliensis* Ernst, 2008 from the Middle Devonian of Germany (Ernst, 2008) in the smaller size of monticles (about 1.00 mm in diameter instead of 2.0–2.8 mm), triangular shape of lunaria, absence of diaphragms, more numerous rows of vesicles, and in the location of acanthostyles in the interspaces between vesicles.

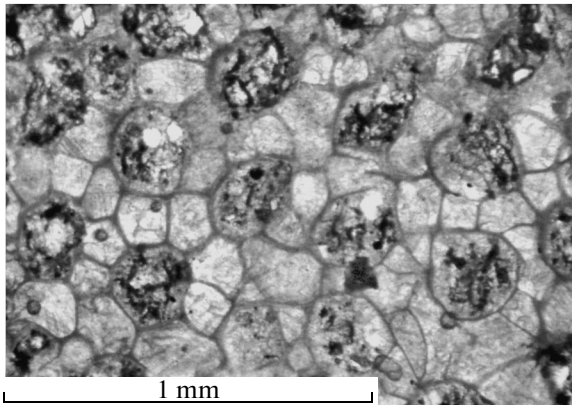
Occurrence. Lower Devonian, Emsian Stage, Shanda Horizon, Lower Shanda Beds, Salair Ridge,

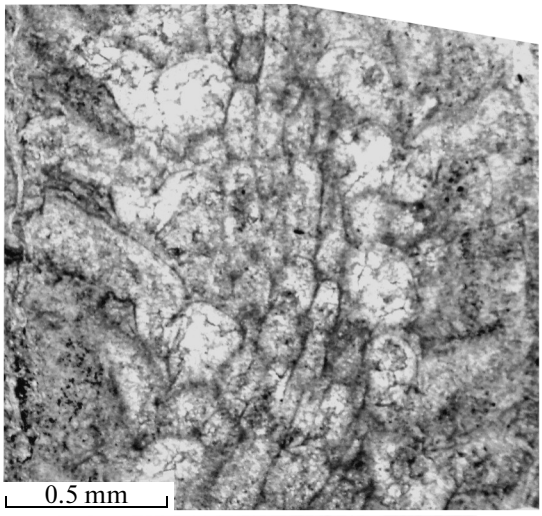
Plate 11

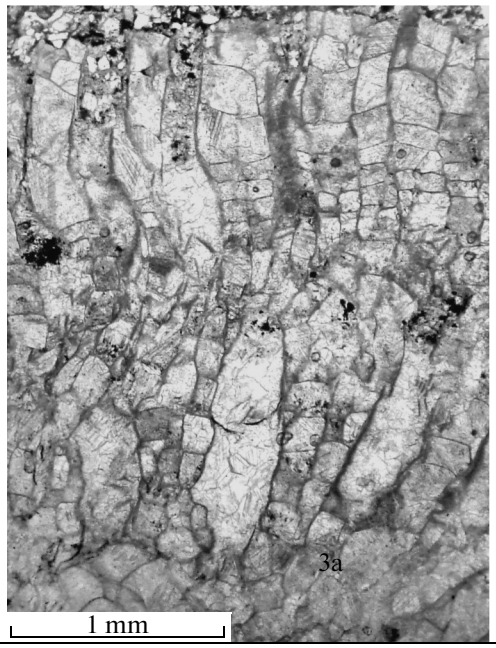


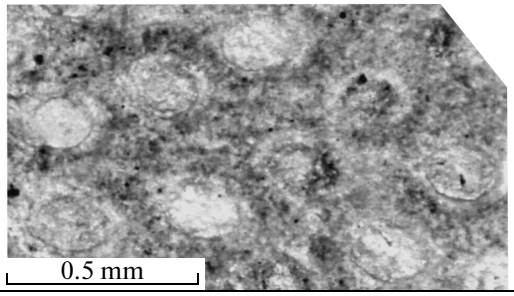












Gorny Altai; Middle Shanda Beds, Salair Ridge and Gorny and Rudny Altai.

Material. In addition to the holotype, 24 specimens (91 thin sections): SibGIU, nos. 41–61, Salair Ridge, vicinity of the town of Gur'evsk, section B-819, beds 20, 23, 25; section B-8225, beds 17, 19–21; section 2.IIb, bed 2; section B-8315, bed 3; SibGIU, nos. 62, 63, Gorny Altai, right side of the L-shaped bend of the Ganin Klyuch Creek valley, outcrop M-99-5; right bank of Kuvash Creek, vicinity of the small town of Baragash, section Kuvash 1, bed 19; SibGIU, no. 64, Rudny Altai, vicinity of the town of Zmeinogorsk, Mel'nichnye Sopki, section Ya-906, bed 13.

Genus *Physallidopora* Ernst et Buttler, 2012

Physallidopora cantabrica Ernst et Buttler, 2012

Plate 11, fig. 2

Physallidopora cantabrica: Ernst et Buttler, 2012, p. 268, text-figs. 4F, 5A-F, 6A-F, pl. 4.

Holotype. GZG.IN.0.010.527c,d; northwestern Spain, Cantabrian Mountains; Lower Devonian, lower part of the upper Emsian.

Description. The colonies are laminated, multilaminate, up to 4.00 mm thick, with layers 0.75–2.1 mm thick. The autozooecia are tubular, bud off from a thin epitheca, sharply diverging to the surface. Differentiation into the exozone and endozone is absent. The apertures of autozooecia are ovate or, occasionally, circular with a peristome, which may be up to 0.03–0.08 mm thick. The maximum diameter of autozooecial apertures is 0.17–0.22 mm; there are 3.5–4.5 apertures per 2 mm. The lunaria are horseshoe-shaped, triangular, 0.07–0.10 mm long, 0.13–0.17 mm wide, and 0.06–0.15 mm thick. The walls of autozooecia vary in thickness from 0.01 to 0.03 mm, at the colony base they occasionally thicken up to 0.04 mm. The diaphragms of autozooecia are slightly concave, flat, oblique, distributed throughout the colony, and spaced 0.45–0.78 mm apart. The colony surface is overgrown by calcareous material, under which vesicles 0.28–0.46 mm in diameter and polygonal in cross section may be disclosed. Around the apertures of autozooecia there are from 3 to 6 vesicles. In longitudinal section there are 2–3 vesicles per 1 mm of the length of an autozooecium; they are boxlike, hemispherical, or angular in shape, 0.22–0.49 mm long; at the colony surface there are 6 vesicles per 1 mm and they are 0.07–0.14 mm long.

Comparison. This species differs from *P. wangi* (Yang, 1956) from the Givetian Stage of the Middle Devonian of China (Yang, 1956) in the fewer autozooecial apertures per 2 mm (3.5–4.5 instead of 6), lunaria not jutting out into the apertures of autozooecia, and in the more widely spaced diaphragms (0.45–0.78 mm instead of 0.17–0.48 mm).

Occurrence. Lower Devonian, Emsian Stage, lower upper Emsian, Spain; Shanda Horizon, Middle Shanda Beds, Rudny Altai.

Material. One specimen (6 thin sections): SibGIU, no. 14/65, Rudny Altai, vicinity of the town of Zmeinogorsk, Mel'nichnye Sopki, section B-903, bed 10.

Genus *Fistuliporidra* Simpson, 1897

Fistuliporidra hibera Ernst et Buttler, 2012

Plate 11, fig. 3

Fistuliporidra hibera: Ernst et Buttler, 2012, p. 276, text-fig. 9D-H, pl. 8.

Holotype. RGM 372.244; northwestern Spain, Cantabrian Mountains; Lower Devonian, Emsian Stage, ? Elsa Formation.

Description. The colonies are laminated, 1.0–3.6 mm thick. The autozooecia bud off from a thin epitheca and are arranged vertically. Differentiation into the endozone and exozone is absent. The monticles are infrequent, composed of vesicular tissue. The apertures of autozooecia are circular, rounded polygonal, ovate. The maximum diameter of apertures is 0.20–0.39 mm; there are 3.5–6.5 apertures per 2 mm. The lunaria are very small, triangular. The diaphragms are thin, flat, located at the colony base, 1–2 per autozooecium but not in every autozooecium. The walls of autozooecia are thin (no more than 0.01 mm) throughout the colony. The apertures of autozooecia are surrounded by 7–10 vesicles, arranged either in a single row or, in some places, in 2–3 incomplete rows. The vesicles are of polygonal shape, 0.08–0.17 mm in diameter, and up to 0.24–0.39 mm in the monticles. In some places the longi-

Explanation of Plate 11

Fig. 1. *Fistuliphragma moniliformis* sp. nov., holotype SibGIU, no. 14/40, longitudinal section; Salair Ridge, vicinity of the town of Gur'evsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Fig. 2. *Physallidopora cantabrica* Ernst et Buttler, 2012, specimen SibGIU, no. 14/65: (2a) longitudinal section, (2b) tangential section; Rudny Altai, vicinity of the town of Zmeinogorsk; Lower Devonian, Emsian Stage, Shanda Horizon.

Fig. 3. *Fistuliporidra hibera* Ernst et Buttler, 2012, specimen SibGIU, no. 14/66: (3a) tangential section, (3b) longitudinal section; Gorny Altai, right bank of Ganin Klyuch Creek (vicinity of the abandoned small town of Kireevskii); Lower Devonian, Emsian Stage, Salairka Horizon.

Fig. 4. *Fistulocladia cincinnata* sp. nov., holotype SibGIU, no. 14/68: (4a) longitudinal section, (4b) tangential section; Rudny Altai, vicinity of the town of Zmeinogorsk; Lower Devonian, Emsian Stage, Shanda Horizon.

tudinal sections of colonies show an alternation of layers of large and small vesicles. Accordingly, there are from 3.5 to 7.5 vesicles per 1 mm of the length of an autozooecium; the vesicles vary in length from 0.08 to 0.28 mm. The vesicles are boxlike, and they may be irregularly shaped and hemispherical at the colony base.

Variability. The species *Fistuliporidra hibera* is characterized by the variation in the patterns of colonies (from the laminated pattern in representatives of the Altai population to the massive hemispherical pattern in the Spanish population), in the diameter of the apertures of autozooecia (from 0.20–0.39 to 0.30–0.44 mm, respectively), and in the diameter of vesicles (from 0.08–0.39 to 0.18–0.41 mm, respectively).

Comparison. The new species differs from *F. triangulata* Ernst et Buttler, 2012 from the coeval deposits of northwestern Spain (Ernst and Buttler, 2012) in the fewer diaphragms in autozooecia and in the predominance of boxlike vesicles, which have polygonal outlines in tangential section.

Occurrence. Lower Devonian, Emsian Stage, ? Elsa Formation, northwestern Spain; Salairka Horizon, Upper Salairka Beds, Gorny Altai.

Material. Two specimens (13 thin sections): SibGIU, nos. 66 and 67, Gorny Altai, right bank of Ganin Klyuch Creek, vicinity of the abandoned small town of Kireevskii, outcrop Gk-3 and Gk-5.

Family Cheilotrypidae Moore et Dudley, 1944

Genus *Fistulocladia* Bassler, 1929

***Fistulocladia cincinnata* Mesentseva, sp. nov.**

Plate 11, fig. 4

Etymology. From the Latin *cincinnatus* (curled).

Holotype. SibGIU, no. 14/68; Rudny Altai, vicinity of the town of Zmeinogorsk, Mel'nichnye Sopki; Lower Devonian, Emsian Stage, Shanda Horizon.

Description (Figs. 2d, 2e). The colonies are dendroid, 1.4–1.7 mm in diameter. The exozone is 0.60–0.77 mm wide, the endozone is 0.25–0.38 mm in diameter. The endozone is formed by the bundle of axial zooecia. The axial zooecia contain closely spaced diaphragms, slightly constricting the zooecial cavities; the distance between diaphragms varies from 0.14 to 0.41 mm. At the beginning of the exozone the autozooecia bud out from axial zooecia at an angle of 50°–55° to the branch axis. The autozooecia are truncated tubular, with hemiphragms (0.07–0.10 mm long, 0.014–0.020 mm thick) at the beginning of the exozone; diaphragms are absent. The apertures of autozooecia are circular to oval, occasionally circular, and are arranged in diagonally intersecting rows. The apertures of autozooecia are 0.17–0.22 mm long, 0.13–0.14 mm wide, and 0.13–0.15 mm in diameter; there are 4–4.5 apertures per 2 mm along the branch axis and 5 apertures along a diagonal row. The lunaria are crescentic, 0.06–0.08 mm long, 0.13–0.14 mm wide, and 0.04–0.06 mm thick. The walls of autozooecia are thin at the beginning of the exozone, and at the colony surface they thicken up to 0.06 mm and are pierced by capillaries. The vesicles are infrequent, they are restricted to the exozone and usually overgrown by calcareous material.

Comparison. The new species differs from *F. antiqua* Kopajevich, 1984 from the Devonian of eastern Mongolia (Kopajevich, 1984) in the presence of hemiphragms in autozooecia, fewer autozooecial apertures per 2 mm (4–5 instead of 6–8), and in the development of crescentic lunaria and capillaries in walls.

Occurrence. Lower Devonian, Emsian Stage, Shanda Horizon, Middle Shanda Beds, Rudny Altai.

Material. In addition to the holotype, 3 specimens (8 thin sections): SibGIU, nos. 69–71, Rudny Altai, vicinity of the town of Zmeinogorsk, Mel'nichnye Sopki, section B-903, bed 10.

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