Paleozoic Bryozoa from Severnaya Zemlya (Russian Arctic)

Lyudmila V. NEKHOROSHEVA
Department of Stratigraphy,
All-Russia Research Institute of Geology and Mineral Resources
of the World Ocean (VNIIOkeangeologia),
Angliisky ave., 1, St. Petersburg 190121 (Russia)
VNIIO@g-ocean.spb.su

406

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ABSTRACT
Paleozoic Bryozoa are reported from Severnaya Zemlya for the first time. Bryozoans of the orders Cystoporata Astrova, 1964 and Trepostomata Ulrich, 1882 are represented by four species, one of which is new: *Halloporina severozemelica* n. sp. from the Middle Ordovician. Representatives of the genus *Fistulipora* McCoy, 1849 from the Lower Devonian (Rusanov Formation) are similiar to the species *F. nordica* L. Nekhorosheva, 1961 from Taribigai Beds (Emsian) of Taimyr. *Fistulotrypa* sp. A from Rusanov Formation is the oldest species of the genus. The Permian species *Dyscritella* cf. *lucida* Morozova, 1986 has strong affinities with *D. lucida* from the Kapp Starostin Formation of Svalbard.

KEY WORDS
Bryozoa,
Ordovician,
Devonian,
Permian,
Russian Arctic,
Severnaya Zemlya.

RÉSUMÉ
Les bryozoaires du Paléozoïque de Severnaya Zemlya (Arctique russe).
Des bryozoaires paléozoïques de Severnaya Zemlya sont signalés pour la première fois. Ils appartiennent aux ordres Cystoporata Astrova, 1964 et Trepostomata Ulrich, 1882 et sont représentés par quatre espèces dont l'une, de l'Ordovicien moyen, est nouvelle, *Halloporina severozemelica* n. sp. Des espèces appartenant au genre *Fistulipora* McCoy, 1849 du Dévonien inférieur de la Formation Rusanov sont proches de l'espèce *F. nordica* L. Nekhorosheva, 1961 des niveaux de Taribigai de l'Emsien du Taimyr. La plus ancienne espèce de *Fistulotrypa* sp. A provient de la Formation Rusanov. Dans le Permien l'espèce *Dyscritella* cf. *lucida* Morozova, 1986 présente de fortes affinités avec *D. lucida* de la Formation Kapp Starostin du Spitsberg.

MOTS CLÉS
Bryozoaire,
Ordovicien,
Dévonien,
Permien,
Arctique russe,
Severnaya Zemlya.

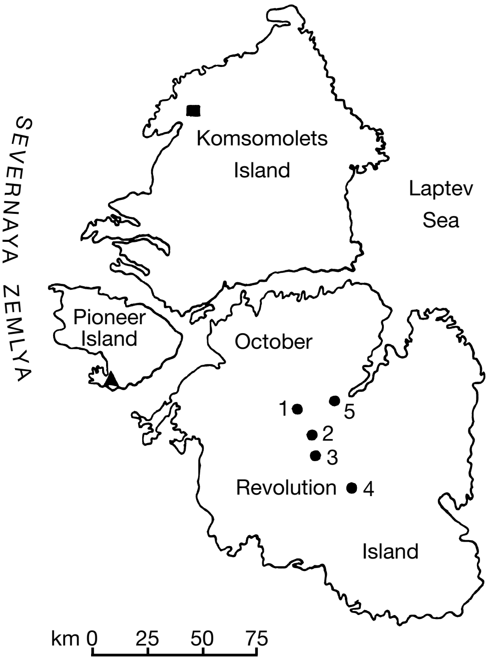

FIG. 1. — Sketch of Severnaya Zemlya Archipelago, indicating sampling localities, which are coded as ●, Ordovician; **1**, Matusevich River, loc. 34; **2**, Ushakov River, loc. 46; **3**, Strojnaya River, loc. 49; **4**, Ozernaya River, loc. 1149; **5**, Lednikovaya River, loc. 1032. Central October Revolution Island; ▲, Devonian, South-western coast of Pioneer Island, Govorlivaya River, loc. 2369, and loc. 2492. South-West coast of Pioneer Island; ■, Permian Slabyj Stream, loc. 20369. North-West of Komsomolets Island.

INTRODUCTION

Paleozoic Bryozoa have never been described from Severnaya Zemlya Archipelago. The first Paleozoic Bryozoa from Severnaya Zemlya were collected during 1973-1980 as a result of the Norilsk Expedition of PGO "Sevmorgeologia" and other topical studies. Bryozoans have been collected from Ordovician, Devonian and Permian on October Revolution, Pioneer and Komsomolets islands respectively (Fig. 1). All the illustrated and described specimens are housed in the collection numbered 13009 of the Central Scientific Research Geological Exploration Museum named after Academician F. N. Chernyshev (CNIGR Museum) in St. Petersburg, Russia.

GEOLOGICAL SETTING OF THE BRYOZOAN FAUNA

ORDOVICIAN BRYOZOANS

The Ordovician bryozoans from October Revolution Island are the oldest Paleozoic Bryozoa known from Severnaya Zemlya (Markovsky & Makar'ev 1982). These bryozoans occurred in calcareous beds from the lower and mainly middle Ozernaya Formation (Middle Ordovician) in several localities of the island. Only trepostomes, among them *Halloporina* Bassler, 1913 and *Nicholsonella* Ulrich, 1883, were recorded from the Ozernaya Formation. *Nicholsonella* represented by a small specimen, determined as *Nicholsonella* sp., is reported from only one locality (4, Fig. 1). The genus *Halloporina* shows a wider distribution being known from five localities (1-5, Fig. 1). The range of both genera is restricted to Ordovician (Goryunova 1996). *Nicholsonella* has the widest geographical distribution. This genus has been described from many places of the world, where it is defined from Lower Ordovician (Arenigian) to Upper Ordovician. However, *Nicholsonella* is very common only in the Middle Ordovician, being described from New York and Vermont, USA (Ross 1964), Alabama, USA (McKinney 1971), Siberia, Russia (Astrova 1965), Taimyr, Russian Arctic (Nekhorosheva 1965) and from Polar Urals, Russia (Nekhorosheva 1991). In author's opinion, *Nicholsonella* is typical for shallow water benthic assemblages from many Middle Ordovician sections of the Arctic Russia region, where it was repeatedly reported together with Rhodophyta. These observations indicate that *Nicholsonella* is confined to shallow parts of the photic zone. According to Ross (1964) the genus *Nicholsonella* is typical among Chazian bryozoan fauna of New York and Vermont, USA. There this genus was found in shelf deposits together with other bryozoans, algae and crinoids. Therefore *Nicholsonella* from Chazian USA and from Ozernaya Formation of Severnaya Zemlya probably were ecologycally adapted to similar shallow neritic environments.

The genus *Halloporina* occurs mainly in the Middle Ordovician. Originally this genus was described from the Middle Ordovician of North America (Ulrich & Bassler 1904) and recently it has been recorded in the Middle Ordovician of Estonia (Gorjunova 1992). Although scarce, the genus *Halloporina* is also known from the Llandeilo Limestone in Wales, UK (Buttler 1997). A new species of *Halloporina* is herein described from the Ozernaya Formation of October Revolution Island. This species shows affinity with *H. parva* (Ulrich & Bassler, 1904) described from the Middle Ordovician of North America and was reported from the Middle Ordovician of Estonia as well. Therefore the concept of the faunal exchange between several Middle Ordovician basins seems quite realistic. The idea of paleogeographical relations in north polar region between North Europe and North America is already expressed by Bassler (1911) regarding baltic area Ordovician bryozoans. Ordovician bryozoans from Severnaya Zemlya get the additional data for paleogeographical relations in north polar area between North Europe, North America and North Asia.

Devonian bryozoans

The Devonian Bryozoa were collected by E. N. Lenkin and E. I. Kachanov (Klubov *et al.* 1980) on Pioneer Island (Fig. 1) during two expeditions to Severnaya Zemlya in 1974 and 1976. On Pioneer Island bryozoans are embedded in limestones of the Rusanov Formation (Emsian), where they are represented by massive (e.g., *Fistulipora* McCoy, 1849) and ramose (e.g., *Fistuliramus* Astrova, 1960 and *Fistulotrypa* Bassler, 1929) fistuliporids. In the Rusanov Formation, among *Fistulipora*, were identified *Fistulipora* sp. and *Fistulipora* aff. *nordica* L. Nekhorosheva, 1961. The latter is similar to *F. nordica* described from the Taribigai Beds of the Lower Devonian of Taimyr (Nekhorosheva 1968). Specimens of *Fistuliramus* from the Rusanov Formation are fragmentary and show too few characters to be identified to species level. Since Late Silurian the genus *Fistuliramus* was very common in the Paleozoic. This genus has its maximum species diversity in Middle Devonian. In the Lower Devonian of the Arctic Russia *Fistuliramus* is known only from Taimyr and Severnaya Zemlya. The genus *Fistulotrypa* is represented by *Fistulotrypa* sp. A, the oldest of the genus. It was the first finding of the genus in Arctic Russia. Earlier *Fistulotrypa* was recognized only in the Lower Permian of Timor (Bassler 1929), and from the Middle/Upper Devonian (Givetian-base Frasnian) of Mongolia (Kopajevich 1984). All fistuliporids from the Rusanov Formation occur together with tabulate corals (*Favosites goldfussi* d'Orbigny, 1850) and brachiopods (*Howellella yacutica* Alekseeva, 1967 *s.l.*). These two species are typical of the Taribigai Beds of Taimyr (Menner *et al.* 1982) correlated with the Emsian (Cherkesova 1994). Based on faunal similarity the Rusanov Formation of Severnaya Zemlya could be coeval to the Taribigai Beds of Taimyr.

Permian bryozoans

The Permian trepostome bryozoans were collected in 1978 by A. F. Khapilin and V. A. Markovsky from a single locality of the Zhuravlev strata in north western Komsomolets Island (Fig. 1). The age of this sequence is determinated by foraminifers, brachiopods, bivalves, and palynological assemblages as Early/Late Permian (Ageev *et al.* 1981). Bryozoans were found only in the lower part of the Zhuravlev strata where they are represented by monotonous ramose colonies of *Dyscritella* Girty, 1911. Because of a strong surface recrystallization these bryozoans could be defined only as *D.* cf. *lucida* Morozova, 1986, which are similar to the holotype of *D. lucida* described from the lower Kapp Starostin Formation of Svalbard (Morozova & Kruchinina 1986). According to recent publications describing Permian bryozoans of Svalbard (Nakrem 1994a, b) the age of the Kapp Starostin Formation is Kungurian-Kazanian. Therefore the Zhuravlev strata on Komsomolets Island of Severnaya Zemlya can be considered as similar in age to Kapp Starostin Formation. In the lower Zhuravlev strata *D.* cf. *lucida* was found together with Kungurian palynological assemblage (Dibner 1982), and it is suggested that the lower

Zhuravlev strata of Komsomolets Island cannot be older than Kungurian, and not younger than early Roadian.

CHARACTER MEASUREMENTS

In the descriptions of encrusting Cystoporata and ramose Cystoporata and Trepostomata following measurements (in mm) have been taken:

ACD	acanthostyles diameter;
BD	branch diameter in ramose colonies;
D1	number of diaphragms per 1 mm in zooecial tubes;
ENWA	endozonal zooecial wall thickness;
EW	exozone width;
EXD	diameter of exilazooecia;
EXWA	exozonal zooecial wall thickness;
MS	distance between adjacent monticula (macula) measured from centre to centre;
VD	vesicles diameter;
Z2	number of zooecial apertures per 2 mm in any direction;
ZD	zooecial apertures diameter;
ZL	length of ovate zooecial aperture;
ZL2	number of ovate zooecial apertures per 2 mm measured longitudinally colony surface;
ZT	zoarium thickness in encrusting colonies;
ZW	width of ovate zooecial aperture.

Statistic for most characters in each described species are presented in measurements:

AVG	arithmetic mean;
CV	coefficient of variance;
MIN, MAX	minimum and maximum values observed;
n	number of observations (= number of measurements);
STDS	sample standard deviation.

SYSTEMATICS

Order CYSTOPORATA Astrova, 1964
Suborder FISTULIPORINA Astrova, 1964
Family FISTULIPORIDAE Ulrich, 1882

Genus *Fistulipora* McCoy, 1849

TYPE SPECIES. — *Fistulipora minor* McCoy, 1849 by subsequent destignation (Milne-Edwards & Haime 1850: lix) from the Lower Carboniferous of the British Isles.

Fistulipora sp.
(Fig. 2A, B; Table 1)

MATERIAL EXAMINED. — Two fragmented colonies, CNIGR Museum, 1/13009, 2/13009.

OCCURRENCE. — Lower Devonian, Emsian, Rusanov Formation; Pioneer Island, Govorlivaya River, loc. 2369.

DESCRIPTION

The description is based on two small fragments of *Fistulipora*. These specimens have tubular or encrusting zoarium with smooth surface and maculae on it. Maximum colony width is 1.80-2.30 mm; minimum width is about 1.10-1.30 mm. Zooecial apertures are rounded or rounded to ovate, average 0.21-0.25 mm in diameter. There are about four to five zooecial apertures per 2 mm in any direction. Thin-walled zooecial tubes contain thin diaphragms in 0.08-0.21 mm apart. Vesicular tissue formed by blister-like vesicles 0.06-0.15 mm in diameter. One or two rows of the vesicles are arranged between zooecial tubes. Vesicles are densely packed within maculae, where zooecia are lacking.

COMPARISON

The specific affinities of the investigated specimens of *Fistulipora* sp. cannot be determined. Based on the mentioned measurement features, the current specimens have, however, characters in common with *F. nordica* L. Nekhorosheva, 1961 (Nekhorosheva 1968: 51, pl. II, figs 1-3) described from Emsian: Taribigai beds of Taimyr.

Genus *Fistulotrypa* Bassler, 1929

TYPE SPECIES. — *Fistulotrypa ramosa* Bassler, 1929 by original designation from the Lower Permian of Timor.

Fistulotrypa sp. A
(Fig. 2C-E; Table 2)

MATERIAL EXAMINED. — One colony, CNIGR Museum, 3/13009.

OCCURENCE. — Lower Devonian, Emsian, Rusanov Formation; Pioneer Island, loc. 2492.

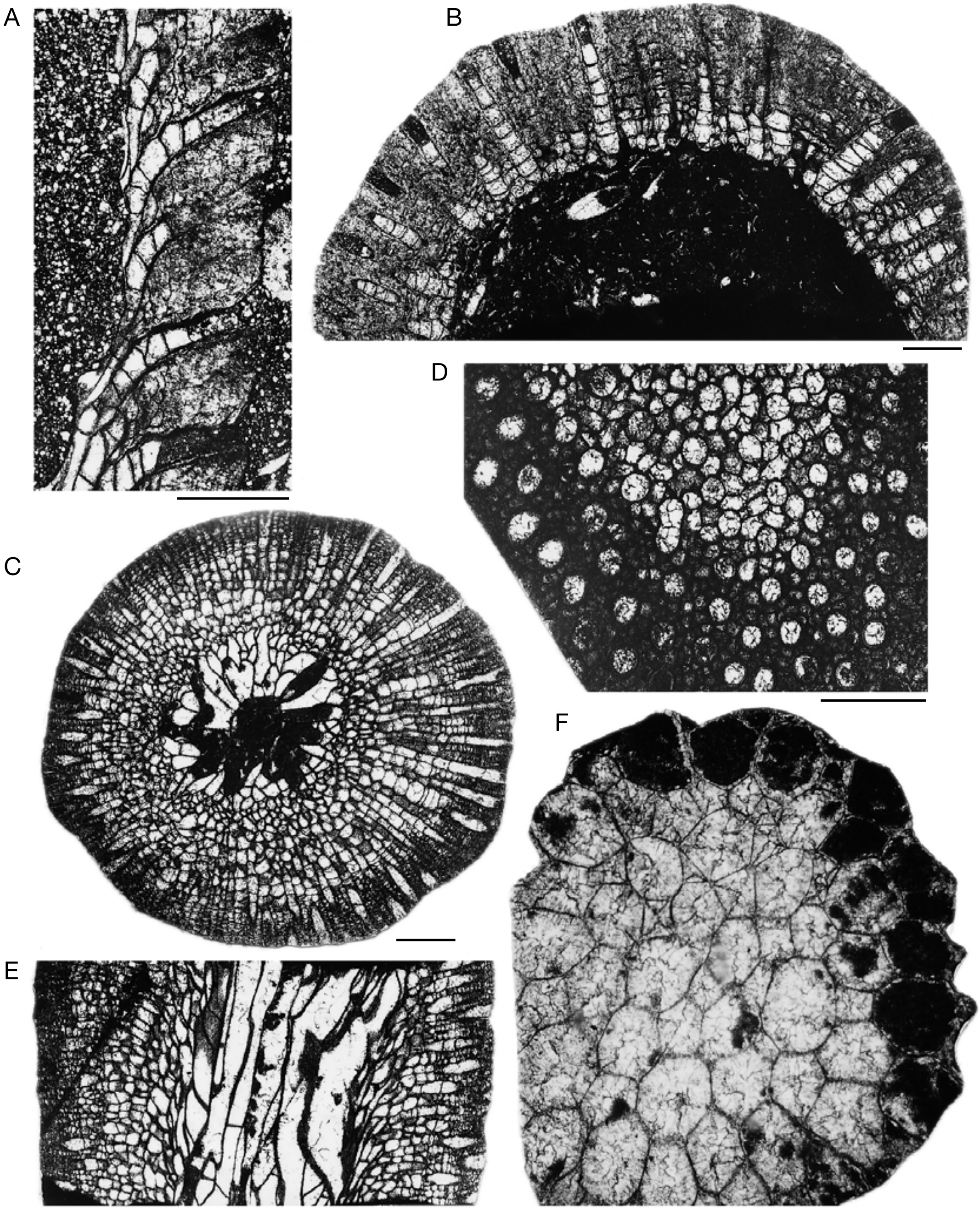

FIG. 2. — **A**, **B**, *Fistulipora* sp.; **A**, longitudinal section, CNIGR Museum, 1a/13009; **B**, transverse section, CNIGR Museum, 2a/13009, Rusanov Formation, Emsian; Pioneer Island, Govorlivaya River, loc. 2369; **C**-**E**, *Fistulotrypa* sp. A; **C**, transverse section, CNIGR Museum, 3a/13009; **D**, tangential section, CNIGR Museum, 3b/13009; **E**, longitudinal section, showing endozone without vesicular tissue, CNIGR Museum, 3c/13009, Rusanov Formation, Emsian; Pioneer Island, loc. 2492; **F**, *Halloporina severozemelica* n. sp., transverse section, CNIGR Museum, 5a/13009, Ozernaya Formation, Middle Ordovician; October Revolution Island, Strojnaya River, loc. 49. Scale bars: A-E, 1 mm; F, 0.5 mm.

TABLE 1. — Measurements (in mm) of *Fistulipora* sp. Abbreviations: **AVG**, arithmetic mean; **CV**, coefficient of variance; **D1**, number of diaphragms per 1 mm in zooecial tubes; **MIN**, **MAX**, minimum and maximum values observed; **n**, number of observations (= number of measurements); **STDS**, sample standard deviation; **VD**, vesicles diameter; **ZT**, zoarium thickness in encrusting colonies; **ZD**, zooecial apertures diameter; **Z2**, number of zooecial apertures per 2 mm in any direction.

	AVG	STDS	CV	MIN	MAX	n
ZT	1.50	0.37	24.48	1.10	2.30	15
ZD	0.23	0.017	7.29	0.21	0.25	10
Z2	4.50	0.45	10.00	4.00	5.00	6
D1	5.90	0.97	16.44	5.00	8.00	10
VD	0.11	0.028	25.45	0.06	0.15	20

DESCRIPTION

Ramose species of *Fistulotrypa* with smooth branches surface and rounded maculae. Exozone and endozone are quite distinct. Vesicular tissue only in exozone; apertures rounded without lunaria. Ramose zoarium with branches about 6-7 mm in diameter and with quite distinct exozone of 2.1-2.4 mm wide. On the smooth surface of the branches there are maculae, which are formed by the accumulations of vesicles. Distance between maculae centres is about 4-5 mm. Zooecial apertures rounded without lunaria, usually 0.17-0.19 mm in diameter. The maculae are surrounded by zooecial apertures, which diameter is about 0.21-0.25 mm. There are about six to seven zooecial apertures per 2 mm in any direction. Zooecial walls are uniformly thin (about 0.02 mm) in exozone and endozone. In endozone thin-walled zooecial tubes with singular thin diaphragms form subparallel bunch. Within exozone zooecial tubes contain thin diaphragms 0.21-0.31 mm apart each other. Vesicular tissue is developed only in exozone. Vesicles about 0.09-0.17 mm in diameter are densely packed on maculae. The smallest vesicles are developed in subsurface part of zoarium, which width is about 0.6-0.9 mm. Between maculae there are one or two rows of vesicles surrounding each zooecium.

COMPARISON

This species is partly similar to *F. proavus* Kopajevich, 1984 which was described from Givetian-base of Frasnian: Ulanobin Beds of Mongolia (Kopajevich 1984). *Fistulotrypa* sp. A differs from *F. proavus* in having thicker branches (6-7 mm *versus* 2,5-3 mm in *F. proavus*) and rounded zooecial apertures (*F. proavus* has ovate apertures), which are smaller than in *F. proavus* (0.17-0.19 mm to 0.21-0.25 mm *versus* 0.22-0.31 × 0.11-0.21 mm in *F. proavus*).

TABLE 2. — Measurements (in mm) of *Fistulotrypa* sp. A. Abbreviations: **AVG**, arithmetic mean; **BD**, branch diameter in ramose colonies; **CV**, coefficient of variance; **D1**, number of diaphragms per 1 mm in zooecial tubes; **EW**, exozone width; **MIN**, **MAX**, minimum and maximum values observed; **MS**, distance between adjacent monticula (macula) measured from centre to centre; **n**, number of observations (= number of measurements); **STDS**, sample standard deviation; **VD**, vesicles diameter; **ZD**, zooecial apertures diameter; **Z2**, number of zooecial apertures per 2 mm in any direction.

	AVG	STDS	CV	MIN	MAX	n
BD	6.50	0.50	7.69	6.00	7.00	5
EW	2.25	0.13	5.78	2.10	2.40	8
MS	4.55	0.42	9.23	4.00	5.00	4
ZD	0.21	0.022	10.48	0.17	0.25	20
Z2	6.40	0.41	6.41	6.00	7.00	10
D1	0.13	0.029	22.31	3.00	4.00	8
VD	3.50	0.44	12.57	0.09	0.17	20

Order TREPOSTOMATA Ulrich, 1882
Suborder AMPLEXOPODOIDEA Astrova, 1965
Family AMPLEXOPORIDAE Ulrich *in* Miller, 1889

Genus *Halloporina* Bassler, 1913

TYPE SPECIES. — *Calloporina crenulata* Ulrich, 1893 by original designation from the Middle Ordovician, Trentonian of Minnesota, USA.

Halloporina severozemelica n. sp.
(Figs 2F; 3A, B; Table 3)

HOLOTYPE. — CNIGR Museum, 4/13009, thin sections.

PARATYPES. — CNIGR Museum, 5-6/13009, thin sections.

TYPE LOCALITY. — Strojnaya River, October Revolution Island, Severnaya Zemlya.

TYPE LEVEL. — Ozernaya Formation, Middle Ordovician.

ETYMOLOGY. — After Severnaya Zemlya.

REFERRED MATERIAL. — 14 fragmented colonies from five localities on October Revolution Island, Ozernaya Formation, Middle Ordovician.

MATERIAL EXAMINED. — 14 fragmented colonies: CNIGR Museum, 4-6/13009 and 12-22/13009.

OCCURENCE. — Middle Ordovician, Ozernaya Formation. The species is found on October Revolution Island in five localities (1-5, Fig. 1).

DIAGNOSIS. — Zoarium ramose, smooth branches thin about 1.5-3.0 mm in diameter; exozone thin; zooecial apertures polygonal or subpolygonal; exilazooecia angular without diaphragms vary in abundance.

DESCRIPTION

Delicate, frequently bifurcating colonies with thin branches usually 1.5-1.8 mm, rarely 3 mm in diameter. Surface smooth with inconspicuous maculae. Zooecial apertures polygonal or subpolygonal, average 0.21-0.25 mm. There are about nine to 11 apertures per 2 mm in all directions, and eight apertures per 2 mm across maculae. Exilazooecia vary in abundance, very often on maculae up to four exilazooecia around a single zooecial aperture, in other places there are rare exilazooecia. All exilazooecia are angular, about 0.06-0.08 mm in diameter. Exozone narrow, commonly 0.21-0.25 mm wide. Zooecial walls in endozone are thin (about 0.01 mm) and crenulated. The thickness of zooecial walls in exozone averages 0.04-0.06 mm. Diaphragms are lacking in exilazooecia and in majority of zooecia. In few by the single zooecia there is one diaphragm at the endozone-exozone transition.

COMPARISON

H. severozemelica n. sp. is very similar to *H. parva* (Ulrich & Bassler, 1904) regarding many zoarial and zooecial dimensions, but is distinguished in having singular diaphragms in zooecia, especially in the branches more than 2 mm in diameter. The type species of *Halloporina*, *H. crenulata* (Ulrich, 1893), has thicker branches (7-8 mm *versus* 1.5-1.8 mm in *H. severozemelica* n. sp.), rounded monticules, numerous exilazooecia and ridge-shaped walls of zooecia in endozone.

TABLE 3. — Measurements (in mm) of *Halloporina severozemelica* n. sp. Abbreviations: **AVG**, arithmetic mean; **BD**, branch diameter in ramose colonies; **CV**, coefficient of variance; **EW**, exozone width; **EXD**, diameter of exilazooecia; **EXWA**, exozonal zooecial wall thickness; **MIN**, **MAX**, minimum and maximum values observed; **n**, number of observations (= number of measurements); **STDS**, sample standard deviation; **ZD**, zooecial apertures diameter; **Z2**, number of zooecial apertures per 2 mm in any direction.

	AVG	STDS	CV	MIN	MAX	n
BD	1.74	0.49	28.16	1.50	3.00	12
EW	0.23	0.020	8.70	0.21	0.25	6
ZD	0.22	0.017	7.73	0.21	0.25	9
Z2	10.00	0.72	7.20	9.00	11.00	10
EXD	0.07	0.009	13.43	0.06	0.08	10
EXWA	0.043	0.007	16.74	0.04	0.06	10

Family DYSCRITELLIDAE Astrova & Morozova, 1967

Genus *Dyscritella* Girty, 1911

TYPE SPECIES. — *Dyscritella robusta* Girty, 1911 by original designation from the Lower Carboniferous, Mississippian (Chester) of Arkansas, USA.

***Dyscritella* cf. *lucida* Morozova, 1986**
(Fig. 3C-F; Table 4)

cf. *Dyscritella lucida* Morozova *in* Morozova & Kruchinina 1986: 54, pl. XIV, fig. 6; pl. XV, fig. 2.

MATERIAL EXAMINED. — Description and measurements are based on eight fragmented colonies: CNIGR Museum, 7-10/13009, 23-27/13009, thin sections.

OCCURRENCE. — Lower-Upper Permian, Kungurian-Ufimian, Lower part of Zhuravlev strata; Komsomolets Island, Slabyj Stream, loc. 20369.

REMARKS

Because of the strong recrystallisation the specific identification is denoted “cf.”.

DESCRIPTION

Ramose branching colonies 2.5-4.5 mm in diameter. Exozone 0.42-0.6 mm wide, clearly separated from endozone. Thickness of zooecial walls in exozone about 0.08-0.1 mm; in endozone about 0.015-0.02 mm. Zooecial apertures are rounded or ovate, average 0.25-0.27 × 0.13-0.17 mm, rarely 0.31 × 0.17 mm. There are

TABLE 4. — Measurements (in mm) of *Dyscritella* cf. *lucida* Morozova, 1986. Abbreviations: **ACD**, acanthostyles diameter; **AVG**, arithmetic mean; **BD**, branch diameter in ramose colonies; **CV**, coefficient of variance; **ENWA**, endozonal zooecial wall thickness; **EW**, exozone width; **EXD**, diameter of exilazooecia; **EXWA**, exozonal zooecial wall thickness; **MIN**, **MAX**, minimum and maximum values observed; **n**, number of observations (= number of measurements); **STDS**, sample standard deviation; **ZL**, length of ovate zooecial aperture; **ZL2**, number of ovate zooecial apertures per 2 mm measured longitudinally colony surface; **ZW**, width of ovate zooecial aperture.

	AVG	STDS	CV	MIN	MAX	n
BD	3.47	0.71	20.46	2.50	4.50	10
EW	0.51	0.085	16.67	0.42	0.60	10
ZL	0.26	0.009	3.38	0.25	0.27	10
ZW	0.16	0.014	8.75	0.13	0.17	10
ZL2	5.60	0.41	7.32	5.00	6.00	10
EXD	0.097	0.016	16.67	0.08	0.12	10
EXWA	0.092	0.010	10.87	0.08	0.10	10
ENWA	0.018	0.002	12.22	0.015	0.020	10
ACD	0.045	0.009	18.89	0.042	0.06	10

generally five to six apertures per 2 mm measured longitudinally, and seven apertures diagonally or across colony. Exilazooecia slightly angular or circular in outline, about 0.08-0.12 mm in diameter. Acanthostyles with diameter 0.04-0.06 mm generally 4-5, rarely 6-10 around each zooecium.

COMPARISON

The present form seems to be quite identical to *Dyscritella lucida*, which was reported from Kapp Starostin Formation at Bjernoya, Spitsbergen (Morozova & Kruchinina 1986). The difference between the present form and the type specimen of *D. lucida* from Bjernoyan lies only on the diaphragms in zooecia are lacking in the described form (*D. lucida* from Bjernoya has single diaphragms at the endozone/exozone boundary).

CONCLUSION

In summing up the results of the study Paleozoic bryozoans from Severnaya Zemlya (Russian Arctic) the following may be said. It is the first report dealing with Paleozoic bryozoans from Severnaya Zemlya. Only trepostomes bryozoans were collected in Ordovician and Permian strata on Severnaya Zemlya; Devonian bryozoans are represented by Fistuliporidae. *Halloporina severozemelica* n. sp. from Ozernaya Formation (Middle Ordovician) shows affinity with *H. parva* (Ulrich & Bassler, 1904) which is known from the Middle Ordovician of North America (Ulrich & Bassler 1904) and Estonia (Goryunova 1992). The similarity among the Middle Ordovician representatives of *Halloporina* from Severnaya Zemlya, North America and Estonia allows to suppose the paleogeographical relations in polar region between North Europe, North America and North Asia. As a whole these paleogeographical relations coincide with the reconstruction of Ordovician maps suggested by Scotese (1990). In this report *Halloporina* Bassler, 1913 is introduced into the family Amplexoporidae Ulrich *in* Miller, 1889 according to the systematics of order Trepostomata suggested by Astrova (1978). The position of this genus among Anisotrypidae Dunaeva & Morozova, 1967 recently suggested by Goryunova (1992) seems not clearly understood and remains to be discussed. In author's opinion *Nicholsonella* is common in Middle Ordovician shallow water benthic assemblages typical to many Middle Ordovician sections of the Arctic Russia region. These observations are similar to the data of Middle Ordovician bryozoans fauna from New York and Vermont, USA, studied in detail by Ross (1964, 1972). Lower Devonian fistuliporids from Rusanov Formation of Severnaya Zemlya are similar Emsian fistuliporids from Taimyr. Of particular interest is the discovery of *Fistulotrypa* Bassler, 1929 in Rusanov Formation (Emsian) on Severnaya Zemlya. Here described, *Fistulotrypa* sp. A is the oldest species of the genus which was known only in Middle/Upper Devonian (Kopajevich 1984) and Permian (Bassler 1929). Monotonous dyscretellids from Zhuravlev strata (Lower/Upper Permian) on Severnaya Zemlya represented by *Dyscritella* cf. *lucida* Morozova, 1986 are similar to *D. lucida* from the Kapp Starostin Formation of Svalbard (Morozova & Kruchinina 1986). Occurrence of *Dyscritella* in Zhuravlev strata on Severnaya

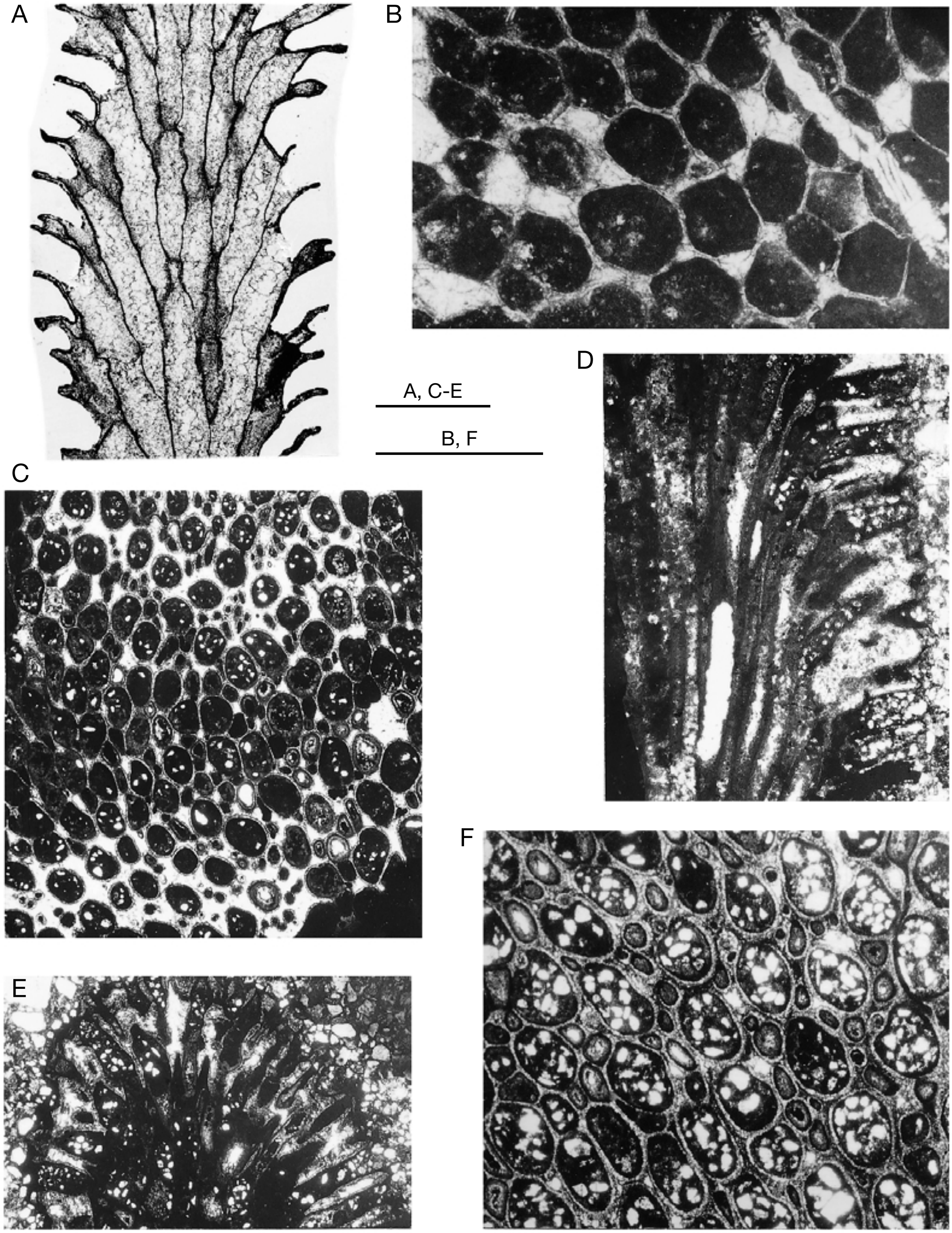

FIG. 3. — **A**, **B**, *Halloporina severozemelica* n. sp.; **A**, longitudinal section, showing narrow exozone and rare diaphragms in some zooecia at the endozone-exozone boundary, CNIGR Museum, 4c/13009; **B**, tangential section, CNIGR Museum, 4a/13009, Ozernaya Formation, Middle Ordovician; October Revolution Island, Strojnaya River, loc. 49; **C**-**F**, *Dyscritella* cf. *lucida* Morozova, 1986; **C**, **F**, tangential sections, CNIGR Museum, 9a/13009, and 10a/13009; **D**, longitudinal section, CNIGR Museum, 7a/13009; **E**, oblique transverse section, CNIGR Museum, 8a/13009, Zhuravlev Strata, Kungurian-Ufimian, Permian; Komsomolets Island, Slabyj Stream, loc. 20369. Scale bars: A, C-E, 1 mm; B, F, 0.5 mm.

Zemlya broadens the geographical distribution of this genus which is common in Permian (Morozova 1970).

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