New early Triassic Bryozoa (Trepostomata) from Spitsbergen, with some remarks on the stratigraphy of the investigated horizons

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Abstract – New trepostomatous bryozoan species, *Paralioclema winsnesi* sp. nov., *Paralioclema mariaholmensis* sp. nov. and *Paralioclema* sp. cf. *mariaholmensis* are described from the Lower Triassic succession of Spitsbergen. The investigated bryozoan faunas are associated with coarse sandstones, calcareous siltstones and shelly limestones. The bryozoan colonies are mostly well preserved *in situ*, and show limited evidence of transportation. Some zoarial fragments show bioerosion. The conodont species *Neogondolella elongata*, *Ellisonia triassica*, *Neospathodus dieneri* and *Neospathodus svalbardensis* extracted from the investigated horizons are Dienerian–Smithian in age.

1. Introduction

Triassic bryozoans are known from few localities around the world with only 33 stenolaemate species (25 of the order Trepostomata) previously described (cf. Schäfer & Fois, 1987). Bryozoans are extremely scarce in Lower Triassic rocks. The recorded Triassic faunas of Spitsbergen increase our understanding of this group of bryozoans that faced extinction(?) by the end of the Triassic (Boardman, 1984). Because conodonts are useful in dating Triassic rocks elsewhere, the conodonts are used to date these Spitsbergen bryozoan samples.

The investigated material was collected during several geological expeditions to Spitsbergen. The first Triassic bryozoan specimens were collected by T. Winsnes in 1952 from the lowermost portion of the Triassic succession at Sørkapp Land (Kovalevskifjellet, Gavrilovfjellet and Wurmbrachegga) and at Sørkappøya (Throndsenneset). In 1977, D. Worsley and A. Mørk located a rich bryozoan-bearing bed in the Bjørnskardet (= Smalegga S) section (Sørkapp Land) and Treskelen section (Hornsund). The latter section was recollected in 1982 by D. Worsley. During the Norsk Polarinstitutt 1988 expedition, T. Winsnes collected additional samples at Kovalevskifjellet. Also in 1988, the senior author undertook fieldwork at Akseløya and Mariaholmen (Bellsund) collecting Permian bryozoans. During this field period, the Triassic sections were briefly investigated, and bryozoans were collected at both islands. Localities from which collections have been made are shown on Figure 1. Triassic bryozoans have previously been reported from Spitsbergen (Worsley & Mørk, 1978, fig. 2; Mørk, Knarud & Worsley, 1982, fig. 4). Conodonts were obtained from some of the bryozoan-

bearing horizons (Fig. 2). Figured and measured material is housed in the Palaeontological Museum, University of Oslo. Nakrem is responsible for the systematic palaeontology of the bryozoans.

2. Geological framework

The Triassic succession on Svalbard is dominated by clastic deposits. In the Lower Triassic, sandstones and shales along western Spitsbergen form upward coarsening sequences which were deposited in a shallow marine environment that grades eastward into shelf deposited shales. Fauna is sparse except for in the horizons described below. This contrasts with the Permian silicified shales and limestones that often contain abundant bryozoan and brachiopod faunas. The Triassic stratigraphy of Svalbard was described by Buchan *et al.* (1965), revised by Mørk, Knarud & Worsley (1982), and further discussed by Pchelina (1983). The Triassic stratigraphy of southern Spitsbergen was treated in more detail by Sokolov & Pchelina (1967), Birkenmajer (1977) and Worsley & Mørk (1978). The stratigraphical nomenclature is under revision by a stratigraphical nomenclatural committee for Svalbard. In the present contribution the nomenclature of Mørk, Knarud & Worsley (1982) will be followed (Fig. 2).

On Sørkapp Land in the southern part of Spitsbergen, early Triassic sedimentation was controlled by the Sørkapp–Hornsund High, a late Palaeozoic high that was not inundated before late Griesbachian–Dienerian time. On this high the Lower Triassic succession is thin (< 50 m) and contains a polymict conglomerate at its base named the Brevassfjellet Bed by Worsley & Mørk (1978). The Lieddalen, Wurmbrachegga, Kovalevskifjellet and Gavrilovfjellet
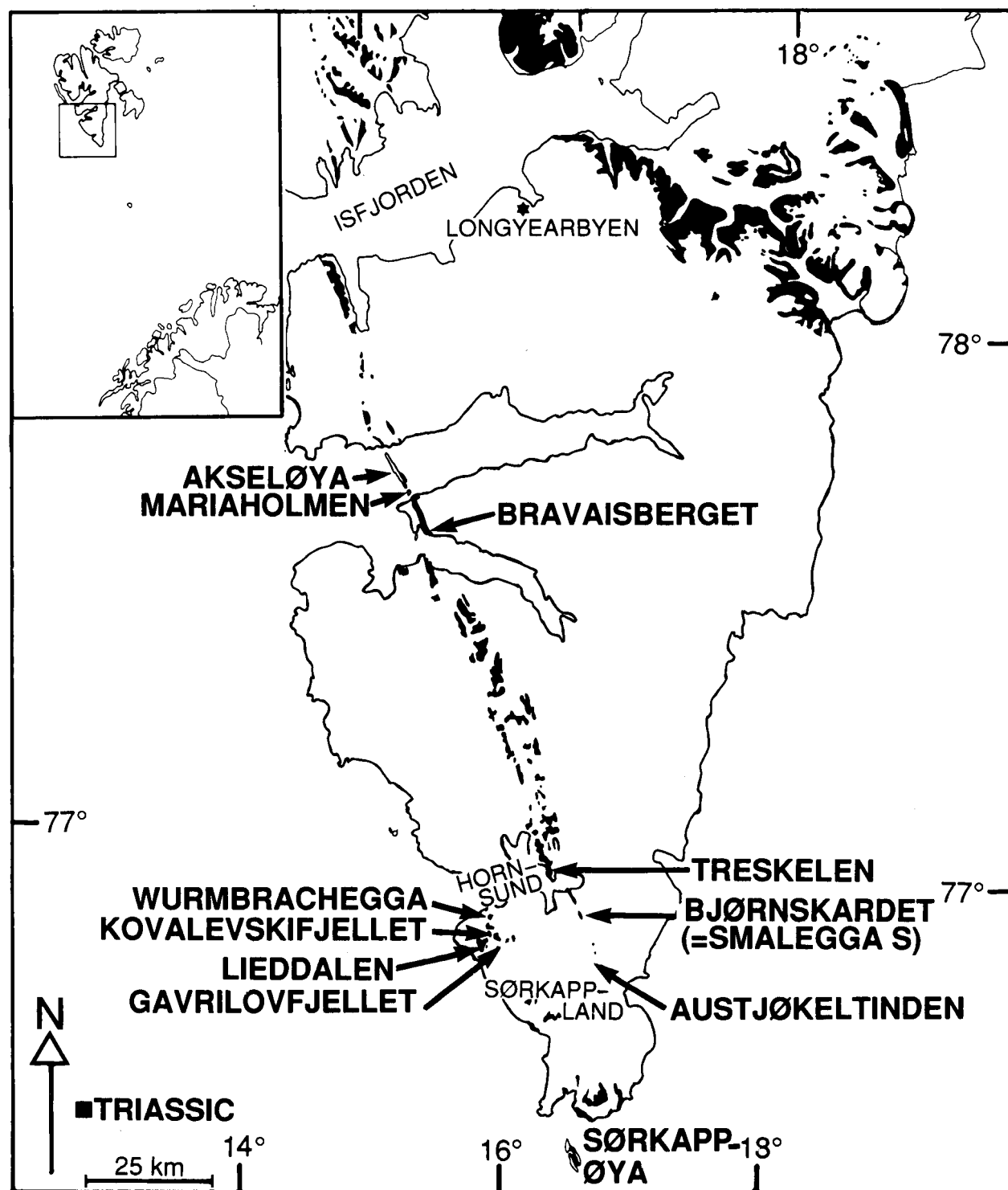
Figure 1. Map of southern Spitsbergen. Inset map shows the position of Spitsbergen in relation to the Svalbard archipelago west and north of the Norwegian coastline.

localities of the present study are situated on this high. West of this high the only Triassic exposure is found on Sørkappøya (Throndsenneset) and shows a thicker succession ($\approx$ 160 m). East of the high the sequence thickens rapidly and is between 150 and 200 m thick (Austjøkeltinden, Bjørnskardet and Treskelen). Further northwards along the western coast of Spitsbergen (Bravaisberget, Mariaholmen and

Akseløya localities) the Lower Triassic succession has its maximum thickness on Svalbard close to 500 m.

At the base of the Kistefjellet Formation, the Brevassfjellet Bed (named the 'Brevassfjellet *Myalina* Bed' by Birkenmajer, 1977 and the 'Kistefjellet Member' by Pchelina, 1983), is a polymict conglomerate resting on metamorphic basement. This bed contains both bivalves and brachiopods and has

BRAVAISBERGET TRESKELEN BJØRNSKARDET AUSTJØKELTINDEN LIEDDALEN

450

400

350

1

300

—250

200

150

2
2
≥100

50

— 0

m si vf f m c vc
Sandstone

150

100

50

0

m si vf f m c vc
Sandstone

100

50

0

m si vf f m c vc
Sandstone

150

100

50

0

m si vf f m c vc
Sandstone

50

3 4 5
6

0

m si vf f m c vc
Sandstone

LITHOSTRATIGRAPHY & SAMPLES

BRAVAISBERGET FORMATION

BASE ANISIAN

TVILLINGODDEN FORMATION

KISTE-
FJELLET
FORMATION

HECLA
HOEK

VARDEBUKTA FORMATION

PERMIAN

S A S S E N D A L E N G R O U P

SKILISEN
BED

"MYALINA"
BEDS

BREVASS-
FJELLET
BED

◄ BRYOZOAN
SAMPLE

◁ CONODONT
SAMPLE

(n) indicate position of samples from other
localities correlated to this level

PERMIAN

(n) =
1 = AKSELØYA
2 = MARIAHOLMEN
3 = WURMBRACHEGGA
4 = KOVALEVSKIFJELLET
5 = GAVRILOVFJELLET
6 = Birkenmajer & Trammer 1975

FOSSILS

Bioturbation	
Rhizocorallium	
Polykladichnus	
Bivalves	
Coquina	
Bryozoan	
Brachiopods	
Ammonoids	
Echinoderms	
Fish remains	
Plant remains	

LITHOLOGY AND
SED. STRUCTURES

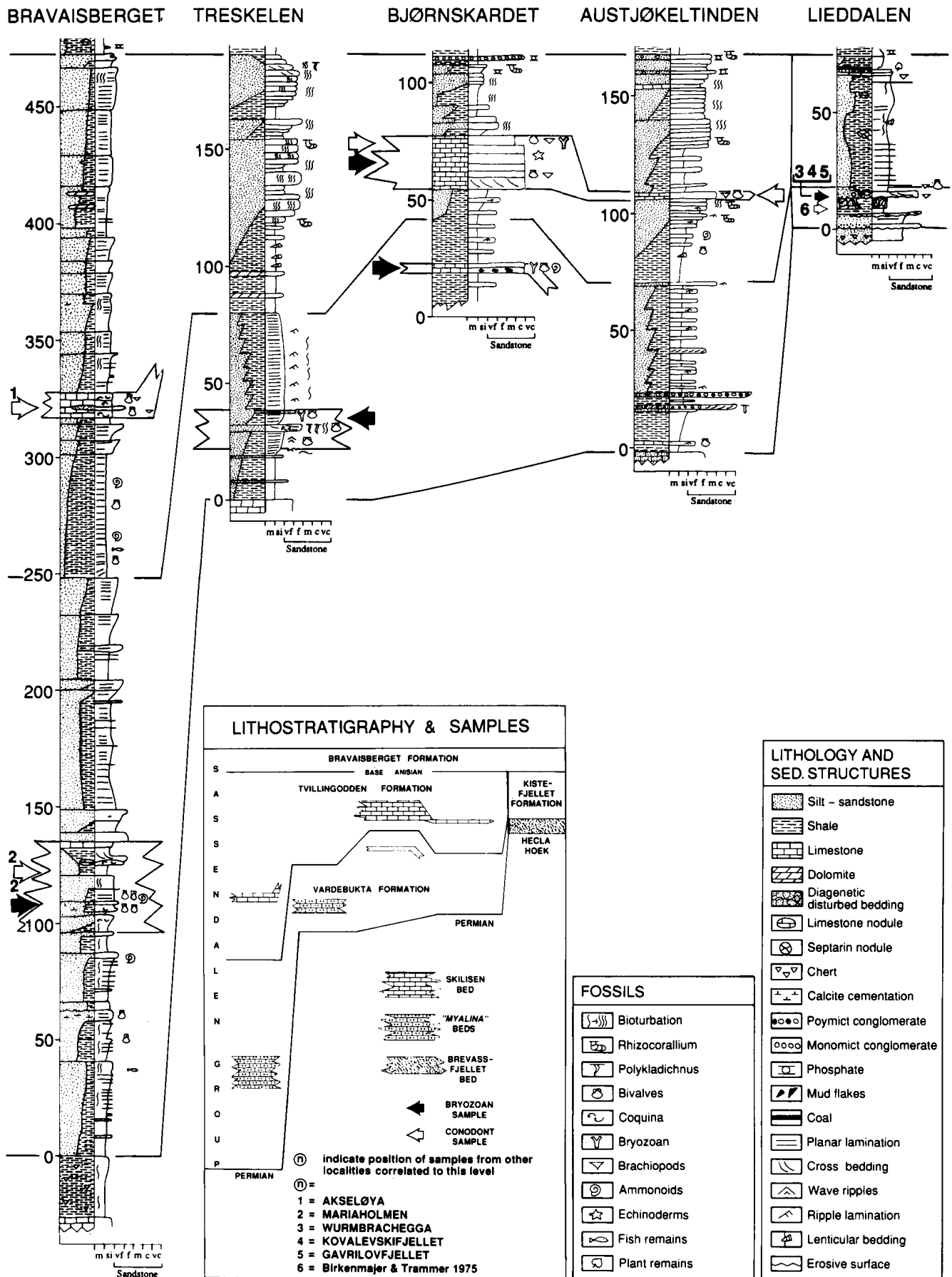|	
Silt – sandstone	
Shale	
Limestone	
Dolomite	
Diagenetic disturbed bedding	
Limestone nodule	
Septarin nodule	
Chert	
Calcite cementation	
Poymict conglomerate	
Monomict conglomerate	
Phosphate	
Mud flakes	
Coal	
Planar lamination	
Cross bedding	
Wave ripples	
Ripple lamination	
Lenticular bedding	
Erosive surface	

Figure 2. Lithological sections and stratigraphical nomenclature of the investigated area. Bryozoan samples are indicated by filled arrows; conodont samples by outlined arrows.

been studied at several localities in the present study. Northwards from the Sørkapp–Hornsund High sandstones rich in bivalves and with sparse other fossils are found some distance above the base of the section in the Vardebukta Formation. These beds (also included in the Brevassfjellet *Myalina* beds by Birkenmajer, 1977, but *not* by Worsley & Mørk, 1978) have been studied in the present work and are herein informally called '*Myalina*' beds. A limestone bed at Bjørnskardet containing bryozoans and other fossils is also included in the Vardebukta Formation.

Along the western coast of Spitsbergen a limestone marker bed occurs in the Tvillingodden Formation. This bed contains both small brachiopods and bivalves, and was called the 'Retzia limestone' by Lundgren (1887), renamed the 'Skilisen Retzia Bed' by Birkenmajer (1977), 'Skilisen Limestone Bed' by Worsley & Mørk (1978) and the 'Skilisen Bed' by Mørk, Knarud & Worsley (1982).

Our bryozoan and conodont samples are from the Brevassfjellet bed, the '*Myalina*' beds and the Skilisen Bed (Fig. 2).

3. Conodonts

Conodonts were extracted from the '*Myalina*' beds of the Vardebukta Formation at Mariaholmen, and from the Skilisen Bed at Akseløya, Bjørnskardet, and Austjøkeltinden. Few conodonts were obtained, with typically 10–20 specimens from each of the 1–2 kg large samples. All conodont samples contained an identical fauna with *Neogondolella elongata* Sweet, 1970, *Neospathodus* sp. cf. *svalbardensis* Trammer, 1978 and *Ellisonia triassica* Müller, 1956.

Neogondolella elongata has a fairly long range in the early Triassic, but is an important species of the *Neogondolella milleri* conodont zone (Sweet *et al.* 1971) and the *Neospathodus pakistanensis* conodont zone (Sweet, 1970*b*). These zones are of middle Dienerian and late Dienerian–early Smithian age respectively. *Neogondolella elongata* is present in the bryozoan samples from the '*Myalina*' bed of the Vardebukta Formation and the Skilisen Bed, giving these bryozoan-bearing beds a rather indistinct latest Dienerian–Smithian age. Occurrences of *Neogondolella elongata* from the Skilisen Bed were previously reported by Hatleberg & Clark (1984).

Conodonts were reported from the lowermost Triassic beds located close to the lowermost bryozoan-bearing beds investigated by Birkenmajer & Trammer (1975), who investigated samples collected from localities between Hyrnefjellet and Treskelen (inner Hornsund) in the '*Myalina*' bed (Brevassfjellet *Myalina* Bed of Birkenmajer, 1977). An early–middle Dienerian age was proposed based on the presence of *Ellisonia triassica* Müller, 1956, *Neospathodus dieneri* Sweet, 1970, *Neospathodus peculiaris* Sweet, 1970, and *Neospathodus svalbardensis* Trammer, 1978. The *Neospathodus dieneri* conodont zone is of middle Dienerian age (Sweet *et al.* 1971). However, *Neospathodus dieneri* itself ranges from early Dienerian to middle Smithian, and in part co-exists with *Neogondolella elongata* (Sweet *et al.* 1971).

The conodont data reported by Sweet (1970*b*, p. 216), Sweet *et al.* (1971, p. 451) and Trammer (1978, p. 283) from Spitsbergen, supplied by G. Hamar, was collected from the same '*Myalina*' bed horizons as the fauna mentioned above. A review of Triassic conodont

Table 1. Micrometric measurements of *Paralioclema winsnesi* sp. nov., *P. mariaholmensis* sp. nov. and *P.* sp. cf. *mariaholmensis*, including basic statistics

	Mean	Range	STD	CV	N
Paralioclema winsnesi sp. nov.					
Zoarium diameter	1.84	0.95–2.88	0.408	22.11	69
Aperture diameter	0.148	0.12–0.18	0.021	14.26	63
Apertures per 2 mm	7.4	7–8	1.018	13.73	68
Diaphragms per 1 mm	8.11	6–21	2.894	35.69	88
Mesozooecial aperture	0.055	0.033–0.120	0.017	31.44	101
Acanthostyle diameter	0.042	0.021–0.070	0.009	21.37	136
Paralioclema mariaholmensis sp. nov.					
Zoarium diameter	4.12	3.6–5.4	0.552	13.41	8
Aperture diameter	0.150	0.12–0.18	0.026	17.32	15
Apertures per 2 mm	8.8	6–12	1.618	18.32	20
Diaphragms per 1 mm	5.79	4.5–8	0.813	14.06	20
Mesozooecial aperture	0.052	0.035–0.065	0.006	12.20	16
Acanthostyle diameter	0.047	0.035–0.065	0.009	18.81	38
Paralioclema sp. cf. *mariaholmensis* sp. nov.					
Zoarium diameter	4.5	—	—	—	1
Aperture diameter	0.175	0.17–0.18	0.005	2.86	2
Apertures per 2 mm	5.96	5–7	0.673	11.29	10
Diaphragms per 1 mm	7.84	5–10	1.019	12.99	12
Mesozooecial aperture	0.072	0.050–0.100	0.012	17.30	9
Acanthostyle diameter	0.043	0.030–0.050	0.007	15.56	6

All dimensions indicate maximum values in mm. STD: standard deviation. CV: coefficient of variation (STD × 100/mean). N: Number of counts or measurements.

faunas of Spitsbergen by Dagis & Korchinskaya (1989) supports the conodont dates presented herein.

4. Bryozoans

4.a. Bryozoan material

The investigated bryozoans are all embedded in limestone or calcareous sandstone and siltstone. Information on surface features is thus limited, and identification is based on internal features observed from acetate peels and thin sections. Preservation is generally good with silicification occurring in few specimens. Zoaria are commonly broken and abraded in the coarsest horizons. Some zoaria show evidence of short distance transportation, as they are abraded and display a coating around zoarial edges. Others were probably transported over longer distances and from different environments, as sediment in zoarial tubes is different from sediment surrounding these zoaria. Only species of *Paralioclema* are present in the investigated Triassic rocks. These faunas thus differ from those in the underlying Permian rocks containing abundant *Tabulipora*, *Rhombotrypella*, *Stenopora* and *Dyscritella*, and also cystoporate, fenestrate and cryptostomate bryozoans (Nakrem, in press). Eighty rock specimens containing bryozoans has been investigated. Seventy-five acetate peels and thin sections have been prepared. Micrometric measurements and basic statistics are presented for each species in Table 1.

4.b. Bryozoan palaeoecology

The bryozoan faunas are found in rocks representing four sedimentary regimes:

(1) Clastic polymict conglomerates of the Brevassfjellet Bed with *Paralioclema winsnesi* sp. nov. High energy.

(2) Sandstones and coquinas of bivalves in the '*Myalina*' beds on Mariaholmen and Treskelen with *P. winsnesi* sp. nov. and *P. mariaholmensis* sp. nov. High energy.

(3) Micritic limestone bed with sand and mud flake conglomerates at Bjørnskardet with *P. winsnesi* sp. nov. Low energy.

(4) Fossiliferous grainstones of the Skilisen Bed at Bjørnskardet with *P.* sp. cf. *mariaholmensis*. Low to intermediate energy.

The finely branched specimens of *Paralioclema winsnesi* sp. nov. are abundant in both siliciclastic sandstone and shelly coquina. The thicker, and more robust, zoaria of *Paralioclema mariaholmensis* sp. nov. are only found in the coarse sandstone and shelly coquina. *P.* sp. cf. *mariaholmensis* is found encrusting a brachiopod shell in the Skilisen Bed. Some zoaria may have been transported, as some zooecial tubes are filled in with extraformational sediment. Others are probably preserved more or less *in situ*, as they show

very little evidence of abrasion; their acanthostyles are well preserved and stand out in the surrounding sediment. At least one zoarium shows traces of bioerosion preserved as irregular large (diameter 0.6– 1 mm) borings (Fig. 5:5). It is thus believed that the described bryozoan faunas inhabited two different environments. The thicker zoaria and those with wide encrusting bases occur in shelly coquinas and siliciclastic conglomerates, which represent higher energy environments. The more finely branched zoaria are commonly associated with silt and mudstones, reflecting a more quiet water environment. Presence of framboidal pyrite inside some zoaria is a diagenetic feature reflecting a micro-environment devoid of oxygen.

The depositional environment is fairly similar to that of the siliciclastic bryozoan bearing horizons of Ellesmere Island (Fritz, 1961), Japan (Sakagami, 1972) and Tibet (Zhao-Xun, 1984), but different from the younger European Tethys faunas preserved in reefal facies (Schäfer & Fois, 1987).

5. Discussion

Conodont data in this report support the previous conodont investigations by Birkenmajer & Trammer (1975) and Dagis & Korchinskaya (1989). The Brevassfjellet Bed at Sørkapp Land and Sørkappøya, and the '*Myalina*' beds of Mariaholmen and Akseløya contain conodonts of early Dienerian to middle Smithian age. The reported presence of *Otoceras* cf. *boreale* in the bryozoan beds of the Bjørnskardet section (Worsley & Mørk, 1978) was based on a misidentification, and the ammonite in question is not of Griesbachian but of younger age (W. Weitschat, pers. comm.). The Skilisen Bed contains conodonts of Dienerian–middle Smithian age and, in a regional framework, the Tvillingodden Formation which contains the Skilisen Bed is believed to be of Smithian–Spathian age (Buchan *et al.* 1965; Mørk, Knarud & Worsley, 1982; Mørk, Embry & Weitschat, 1989; Weitschat & Dagys, 1989). Thus, the described bryozoans are clearly of Dienerian–middle Smithian (Scythian) age; an interval with only two previously unquestioned bryozoan species (Schäfer & Fois, 1987). The results also indicate that the Sørkapp–Hornsund High was transgressed in Dienerian time (cf. Birkenmajer & Trammer, 1975; Mørk, Embry & Weitschat, 1989). Despite the sparsity of ammonites in southern Spitsbergen, the conodont occurrences support the chronostratigraphical age implications as given by Mørk, Embry & Weitschat (1989) based on sequence interpretations of lithostratigraphical subdivisions and sedimentological patterns.
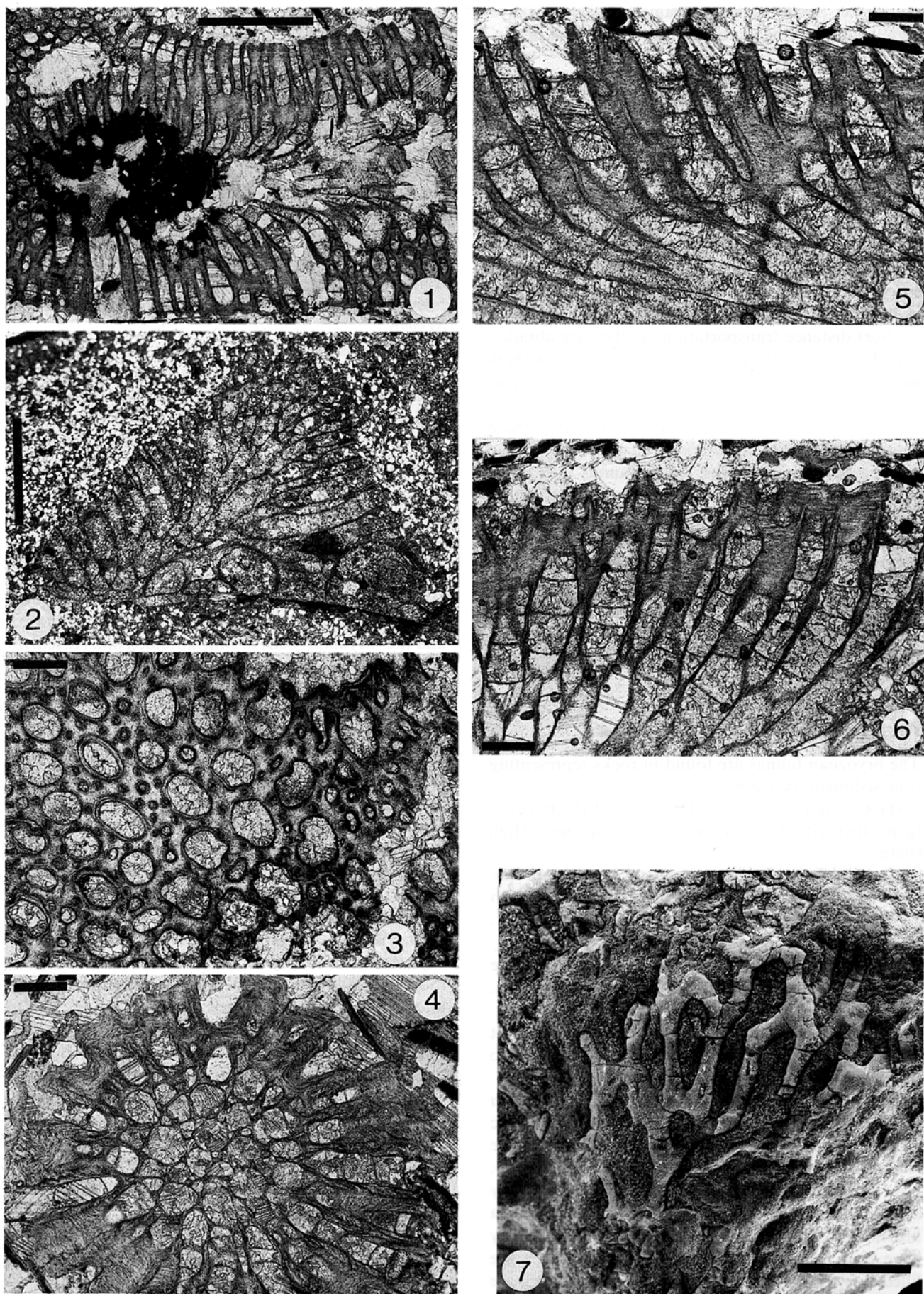
Figure 3. For legend see facing page.

6. Systematic palaeontology of bryozoans

Order TREPOSTOMATA Ulrich, 1882
Family HETEROTRYPIDAE Ulrich, 1890
Genus *Paralioclema* Morozova, 1960
Type species *Paralioclema ninae* Morozova, 1960
from the Upper Devonian (Frasnian) of the
Kuznietzkii Basin, Sibiria, U.S.S.R.

Diagnosis (from Morozova, 1960). Zoaria branching, rarely massive and encrusting. Zooecial apertures multiangular, with rounded angles. Walls in exozone irregularly and in some places hypertrophically thickened, with a clearly shown laminar structure. Numerous acanthostyles of different size. Number of mesozooecia variable.

Paralioclema winsnesi sp. nov.
Figure 3

Diagnosis. Paralioclema with branching and anastomosing zoaria. Endozone and exozone clearly separated. Diaphragms common in both autozooecial and mesozooecial tubes, both in endozone and exozone. Basal diaphragms closely spaced in outermost exozone. Acanthostyles with varying diameter developed around zooecial apertures. Endozonal walls very thin, exozonal walls of varying thickness.

Description. Zoarium finely branched and anastomosing (Figure 3:7) with diameter 0.95–2.88 mm; average 1.85 mm. Branching loci commonly 7–9 mm apart. Exozone, 0.30–0.70 mm wide, is clearly distinguished from endozone. Autozooecial apertures 0.12–0.20 mm, average 0.148 mm. In shallowest section, apertures are irregularly shaped, with acanthostyles indenting zooecial chambers. In slightly deeper section, the zooecial openings are circular to irregularly oval; oval apertures are 0.10–0.14 mm wide and 0.16–0.20 mm long. There are 7–8 apertures per 2 mm in any direction. Some apertures and zooecial tubes display a clear calcitic lining which is possibly the bent edges of basal diaphragms. Zooecial tubes are orientated sub-parallel in endozone, they bend abruptly at the endozone-exozone transition, and meet zoarium surface at angles between 70 ° and 90 °. Mesozooecial apertural diameter is 0.033–0.120 mm, average 0.055 mm. Mesozooecia vary in number around each autozooecium, usually 4 to 6, but larger variation is recorded (3–8 per autozooecium). Mesozooecial tubes contain abundant basal diaphragms,

commonly equal to autozooecial tubes in numbers per mm. There are commonly 4–6 acanthostyles around each autozooecial aperture; diameter of acanthostyles ranges from 0.021 to 0.070 mm, average value 0.042 mm. Acanthostyles originate in outer endozone and can there be seen as clear calcitic rods. Autozooecial wall thickness in exozone is 0.035–0.070 mm; in endozone approximately 0.001 mm. Abundant basal diaphragms are present in autozooecial and mesozooecial tubes. Diaphragms are common, widely spaced in endozone, more closely spaced in exozone. In outermost exozone, diaphragms are extremely closely spaced (14–21 per mm), whereas in endozone and transition between endozone and exozone there are commonly 6–9 diaphragms per mm. In outer exozone, the diaphragms are fairly thick, 0.010–0.020 mm; in endozone clearly thinner, commonly 0.002 mm.

Remarks. Zoaria are often attached to small foraminifera, and self overgrowth is common possibly as a reaction against environmental stress. Also, the thickening and crowding of diaphragms are possibly reactions against environmental stress or a result of damage or death of parts of the colony.

Comparison. The anastomosing growth pattern distinguishes this species from other Triassic species of *Paralioclema*. In the measured characters, this species resembles *P. dagysi* Morozova, 1969, described from the Carnian of Caucasus and Hungary, but differs in the smaller acanthostyles, fewer mesozooecia around each autozooecial aperture, and the better distinction between endozone and exozone. It is distinguished from *P. amurense* Morozova, 1969, described from the Anisian of the Maritime Territory, in possessing larger zooecial apertures.

Etymology. The species is named in honour of palaeontologist Thore Winsnes who first collected the Triassic bryozoans at Spitsbergen.

Type material. Holotype: rock specimen PMO 120.648 from the Brevassfjellet Bed at Gavrilovfjellet. Paratypes: PMO 120.728, PMO 120.730, PMO 120.732.

Material. This species is present in 69 rock specimens, and the identification is based on 60 acetate peels and thin sections (PMO 120.614–120.662, PMO 120.674, PMO 120.726–120.741, PMO A40414).

Figure 3. *Paralioclema winsnesi* sp. nov.
(1) Longitudinal section; black areas are framboidal pyrite aggregates. Treskelen. Scale bar = 1 mm. PMO 120.732. Paratype. (2) Longitudinal section showing calcareous foraminifera as encrustation basis. Kovalevskifjellet. Scale bar = 1 mm. PMO 120.641. (3) Tangential section. Sørkappøya. Scale bar = 0.2 mm. PMO 120.736. (4) Transverse section. Treskelen. Scale bar = 0.2 mm. PMO 120.728. Paratype. (5) Longitudinal section. Treskelen. Scale bar = 0.2 mm. PMO 120.730. Paratype. (6) Longitudinal section. Treskelen. Scale bar = 0.2 mm. PMO 120.732. Paratype. (7) Rock specimen, holotype. Gavrilovfjellet. Scale bar = 10 mm. PMO 120.648.
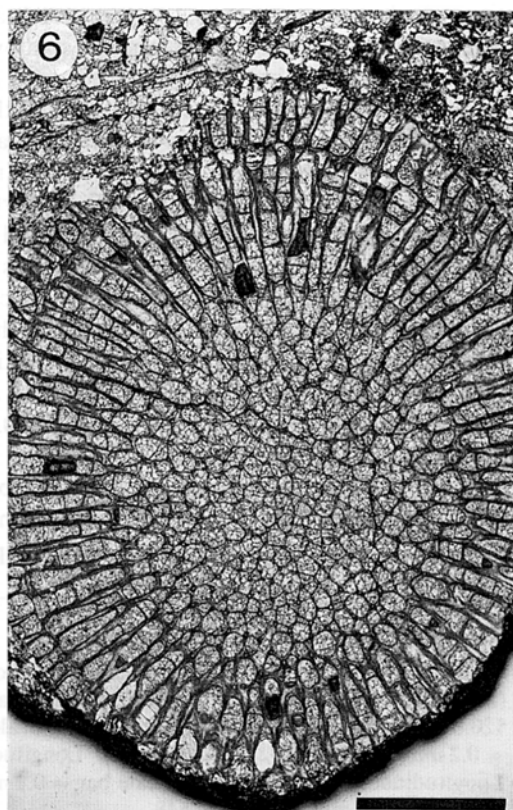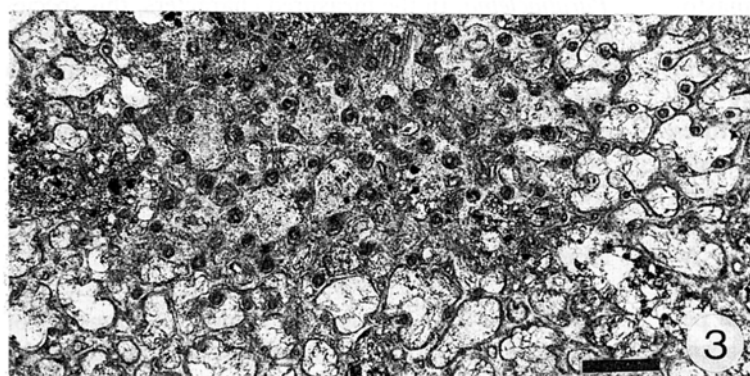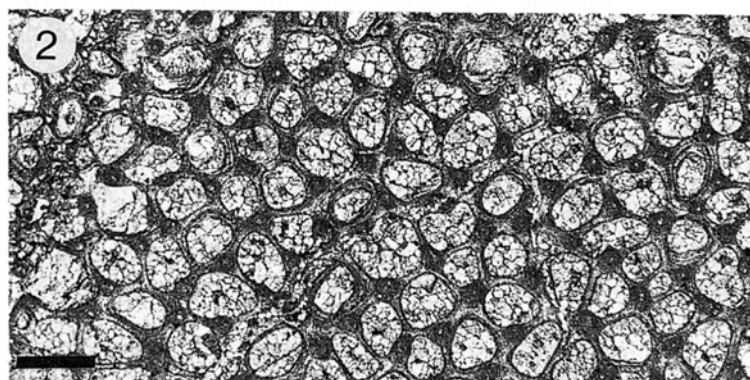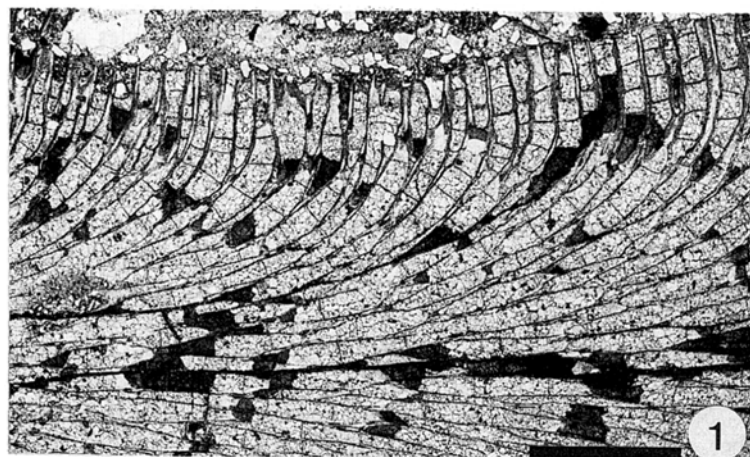
Figure 4. For legend see facing page.

Occurrence. Brevassfjellet Bed at Gavrilovfjellet, Kovalevskifjellet and Wurmbrachegga; Treskelen (34.5 m above formational base); Bjørnskardet (at formational base, and 34.5 m above base of formation); '*Myalina*' beds at Mariaholmen (120 m above base of exposure) and at Akseløya (section not measured); and at an unspecified position at Throndsenneset.

Age. This species is associated with the conodont species *Neogondolella dieneri* in the lowermost samples, and with *Neogondolella elongata* in some higher samples. These conodonts are reported to have an early Dienerian–middle Smithian distribution.

Paralioclema mariaholmensis sp. nov.
Figure 4

Diagnosis. Zoaria ramose, circular in cross-section. Endozone and exozone clearly separated, long zooecial tubes arranged in parallel pattern in endozone, bending sharply into exozone. Diaphragms common in both autozooecial and mesozooecial tubes, both in endozone and exozone. Acanthostyles with little size variation developed around zooecial apertures.

Description. Zoarial diameter ranges from 3.6 to 5.4 mm, average 4.1 mm. Lateral branches diverge at short intervals, commonly 5 to 6 mm apart, giving rise to a rigid bush-like zoarium. Regeneration and self encrustation is common, thickness of encrusting layers is 0.32 to 0.38 mm, less common up to 0.60 mm. Exozone, 0.70–0.90 mm wide, clearly separated from endozone. Autozooecial apertures are indented by acanthostyles and irregularly shaped in shallowest section, becoming more oval in deeper tangential section. Diameter of circular apertures is commonly 0.15–0.18 mm, oval apertures 0.11–0.12 mm wide and 0.14–0.16 mm long. The apertures are not arranged in any regular pattern, and there are 6–14 (average 9) apertures per 2 mm in any direction. Several apertures and zooecial tubes display a clear calcitic lining which is possibly the continuation of basal diaphragms. Zooecial tubes are arranged sub-parallel and irregularly in endozone (longitudinal view). Zooecial tubes bend gradually at the endozone–exozone transition, and meet zoarial surface at an angle of 90 °. Mesozooecial apertures 0.035–0.065 mm in diameter, average 0.052 mm. Abundant diaphragms are developed both in autozooecial tubes and in mesozooecial tubes, commonly 4.5–8 per mm. Extensive development of diaphragms in outermost exozone has produced stereom-like skeletal structures in parts of zoarial surface (Fig. 4:3). When observed in tangential sections, these areas appear as maculae devoid of zooids. Four to six mesozooecia are developed around each autozooecial aperture. Average acanthostyle diameter is 0.047 mm ranging from 0.035 to 0.065 mm. There are commonly 3–5 acanthostyles developed around each autozooecial aperture. Acanthostyles display a clear calcitic central rod.

Comparison. This species is distinguished from *P. winsnesi* sp. nov. in its non-anastomosing growth pattern, in the larger zoarial diameter, shorter distance between branching loci and in having closer spaced zooecial apertures. In its large zoarial diameter this species resembles *P. abnorme* Morozova, 1969, described from the Carnian of Caucasus, but differs in the larger and closer spaced zooecial apertures.

Etymology. The species name refers to the little island Mariaholmen in Bellsund from where this species is described.

Type material. Holotype PMO 120.725; 120.725/1: longitudinal thin section; 120.725/2: transverse thin section; 120.725/3: tangential thin section; 120.725/4: rock specimen. Paratypes: PMO 120.744 and PMO 120.750; rock specimens.

Material. The description is based on 12 acetate peels and thin sections chosen from 10 rock specimens, PMO 120.725/1–4 (thin sections), 120.725/A–H (acetate peels), 120.724–120.750 (rock specimens); all from Mariaholmen.

Occurrence. The '*Myalina*' beds at Mariaholmen (120 m above base of exposure).

Age. This species occurs together with the conodont species *Neogondolella elongata* which has a Dienerian–middle Smithian range.

Paralioclema sp. cf. *mariaholmensis*
Figure 5

Description. The zoarium is encrusting a brachiopod shell forming a covering sheet with erect branches originating from the encrusting layer. The encrusting layer is 0.60–1.60 mm thick, and diameter of branches is 4.50 mm. Exozone, in ramose forms 1.40–2.00 mm wide, is clearly separated from endozone. Zooecial apertures are slightly oval, 0.13–0.16 mm wide and

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Figure 4. *Paralioclema mariaholmensis* sp. nov. All figures of holotype.

(1) Longitudinal section. Mariaholmen. Scale bar = 1 mm. PMO 120.725/1. (2) Deep tangential section. Mariaholmen. Scale bar = 0.2 mm. PMO 120.725/3. (3) Shallow tangential section. Mariaholmen. Scale bar = 0.2 mm. PMO 120.725/3. (4) Transverse section; detail of regenerated growth in outer exozone. Mariaholmen. Scale bar = 0.2 mm. PMO 120.725/2. (5) Longitudinal section; detail of regenerated growth in outer exozone. Mariaholmen. Scale bar = 0.2 mm. PMO 120.725/1. (6) Transverse section. Mariaholmen. Scale bar = 1 mm. PMO 120.725/2.
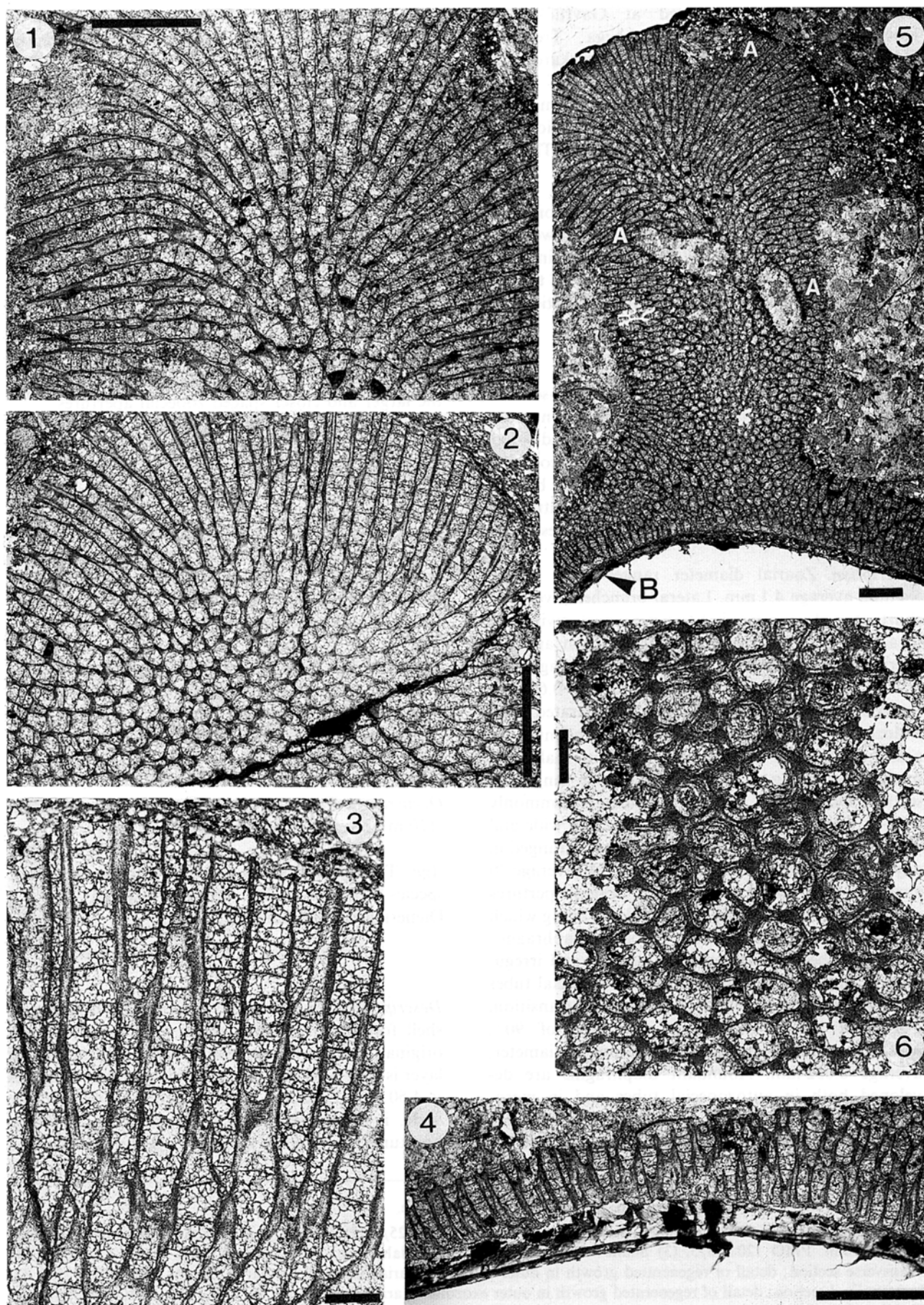
Figure 5. For legend see facing page.

0.20 mm long, or more circular, diameter 0.17–0.18 mm; 5–7 per 2 mm in any direction. Mesozooecia range in diameter from 0.050 to 0.100 mm, average diameter 0.072 mm. Acanthostyles range in diameter from 0.030 to 0.050 mm, average diameter is 0.043 mm. There are commonly 4–5 acanthostyles around each autozooecial aperture. Zooecial walls are 0.012–0.014 mm thick in endozone, 0.035–0.040 mm thick in endozone where acanthostyles are not present. Autozooecial and mesozooecial tubes contain abundant basal diaphragms, 5–10 per mm, average 8 per mm. Each autozooecial tube contain maximum 12 diaphragms.

Comparison. The current specimen is most similar to *Paralioclema mariaholmensis* sp. nov. based on zoarium diameter, whereas apertural diameter and number of apertures per 2 mm is different from most of the other bryozoans specimens investigated from the Triassic of Spitsbergen. In zooecial dimensions, crowding of basal diaphragms and zoarium diameter, the current specimen also resembles *P. abnorme* Morozova, 1969, from the Upper Triassic (Carnian) of Caucasus. Because only one specimen is available for study this is assigned to *Paralioclema* sp. cf. *mariaholmensis* rather than to a separate new species.

Material. One single zoarium is collected from the Tvillingodden Formation at Bjørnskardet (98.0 m above formational base) near the top of the Skilisen Bed. Measurements and identification has been carried out on three acetate peels prepared from this specimen (PMO 120.668).

Age. The described specimen occurs together with the conodont species *Neogondolella elongata* which has a late Dienerian–middle Smithian distribution.

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Figure 5. *Paralioclema* sp. cf. *mariaholmensis*.

(1) Longitudinal section. Bjørnskardet. Scale bar = 1 mm. PMO 120.668/4. (2) Transverse section. Bjørnskardet. Scale bar = 1 mm. PMO 120.668/3. (3) Detail of transverse section showing crowded diaphragma and weathered surface. Bjørnskardet. Scale bar = 0.2 mm. PMO 120.668/3. (4) Longitudinal section along margin of colony. Bjørnskardet. Scale bar = 1 mm. PMO 120.668/4. (5) Longitudinal section of main part of zoarium. Encrustation base, brachiopod shell, removed during natural weathering. A: Three possible borings; B: Trapped calcareous foraminifer shell which encrustated the removed brachiopod. Bjørnskardet. Scale bar = 1 mm. PMO 120.668/4. (6) Tangential section. Bjørnskardet. Scale bar = 0.2 mm. PMO 120.725/4.

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