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## Taxonomy and biostratigraphy of Ordovician brachiopods from northeastern Ny Friesland, Spitsbergen

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## Abstract

We describe Early and Middle Ordovician brachiopod faunas from northeastern Spitsbergen and discuss their biostratigraphical and palaeoecological implications. We recognise 60 species and 41 genera representing both linguliform and rhynchonelliform brachiopods. These include one new genus, the obolid *Lenticulella* with the type species *Lenticulella amphora* (Krause & Rowell, 1975), and 23 new species: *Ectenoglossa? oviforma*, *Elliptoglossa vulgaris*, *Rosobolus? elongatus*, *Broeggeria obscura*, *Mirilingula? svalbardensis*, *Schizotreta marginalis*, *Conotreta convexa*, *Cyrtonotreta profilbekkiensis*, *Cyrtonotreta spinosa*, *Eurytreta subtriangularis*, *Hisingerella manifoldis*, *Semitreta basisslettaensis*, *Semitreta pustulosa*, *Semitreta spitsbergensis*, *Numericoma? proclina*, *Eoconulus subquadratus*, *Dictyonites mugilis*, *Pelonomia sulcata*, *Leptella (Leptella) inequicostellata*, *Protoskenidioides promontorium*, *Anomalorthis rossi*, *Nothorthis subpyramidalis* and *Phragmorthis noda*.

The Ordovician succession contains both intertidal and deep-sea deposits with brachiopod faunas from nearly the whole range of environments. The Tremadocian is represented by a succession of low-diversity, rhynchonelli-

form-dominated assemblages occupying shallow-marine environments. With the abrupt and large-scale drowning during the Floian, these faunas were replaced by a sparse slope fauna of micromorphic linguliforms. The outer shelf environments established in the latest Floian were occupied by a highly diverse brachiopod fauna dominated by micromorphic linguliform taxa. As the environment shifted toward the mid-shelf during the Darriwilian, however, the composition of the fauna changed to an *Orthidiella*-dominated assemblage of mostly rhynchonelliform taxa. The very late occurrence of the *Orthidiella* assemblage suggests that the Dapingian *Orthidiella* Zone found in America is probably diachronic. Although it includes many endemic species, the Middle Ordovician fauna shows a strong resemblance to the brachiopod fauna of Nevada. This study is based on approximately 16 500 brachiopod specimens obtained from both crack-out samples and acetic-acid-treated bulk samples.

**Key words:** Brachiopoda, Laurentia, Linguliformea, *Orthidiella* zone, palaeoecology, Rhynchonelliformea, Svalbard

## Introduction

The Lower Palaeozoic of the Svalbard archipelago has been a subject of extensive study during the last century (see Harland *et al.* 1997 for a review). Brachiopods are one of the most commonly reported fossil groups from these deposits; although they are usually not a dominant fossil group, brachiopods are generally present at all levels containing shelly fossils. The first report of Lower Palaeozoic brachiopods from the Svalbard archipelago was published by Andersson (1899) and Lindström (1899), who described an Upper Ordovician strophomenoid from the southernmost island, Bjørnøya (Bear Island) (Fig. 1). This specimen was collected during the Swedish polar expedition in 1898 and was later described by Holtedahl (1918), but unfortunately, its whereabouts are unknown today. The second contribution was by Kulling (1934), who reported *Obolus* and *Lingulella* from the Lower Cambrian Sparreneset Formation in Nordaustlandet. Major & Winsnes (1955) described *Obolella* cf. *atlantica* Walcott from the uppermost Lower Cambrian Slaklidalen Formation and *Diaphelasma* cf. *brevisseptatum* Ulrich & Cooper from the Rasstupet Member of the Lower Ordovician Hornsundtind Formation in southern Spitsbergen. Later, Hallam (1958) described an *Obolus* from the Lower Cambrian Ditlovtoppen Dolomite of the Tokammane Formation and from the Lower Oslobreen Limestone of the Lower Ordovician Kirtonryggen Formation. He also described *Archaeorthis* (cf.) *groenlandica* Poulsen from the Middle Oslobreen Limestone of the Kirtonryggen Formation in central-eastern Spitsbergen. Gobbett & Wilson (1960) added *Lingulella?* sp. from the Ditlovtoppen Dolomite, and *Eoorthis?* cf. *multicostata* Poulsen and an orthid from the Lower Oslobreen Limestone to the list of brachiopods from central-eastern Spitsbergen. Northeastern Ny Friesland contains the most extensively studied fossiliferous Ordovician deposits in the archipelago. From this location, Vallance & Fortey (1968) and Fortey & Bruton (1973) reported lingulid brachiopods in the upper part of the Tokammane Formation, *Syntrophina* sp. from the Spora Member, and several unidentified specimens, including an orthid from the Nordporten Member of the Kirtonryggen Formation. In the same area, Vallance & Fortey (1968), Fortey & Bruton (1973) and Fortey (1975) also reported acrotretids and other linguliform brachiopods from the Olenidsletta Member and *Skenidioides*, *Orthidiella*, *Camerella*, *Lingulops* and *Scaphelasma* from the Profilbekken Member of the Middle Ordovician Valhallfonna Formation. Among the most recent studies noting new brachiopod discoveries are Birkenmajer (1978a, 1978b), who reported *Lingulella ferruginea* (Salter, 1866) from the Upper Cambrian Nørdstetinden and Hornsundtind formations in southern Spitsbergen, and Hjelle *et al.* (1979), who reported brachiopods from the Upper Ordovician and Lower Silurian Bulltinden Formation in central-western Spitsbergen. The most recent study on brachiopods from Svalbard (Hansen & Holmer 2010) discussed the fluctuations in diversity and biogeography of the brachiopod fauna from northeastern Spitsbergen. Despite the many findings of Lower Palaeozoic brachiopods from Svalbard, little, and only preliminary taxonomic work has been published.

In the present study, we focus on the brachiopod fauna from the Ordovician deposits in northeastern Ny Friesland. This succession, especially the Valhallfonna Formation, has been the subject of extensive investigation. It was first investigated during the Cambridge University Expedition in 1967 and the joint expedition of the Norwegian Polar Institute and the Palaeontological Museum in Oslo, Norway, in 1971. In 2005, a Russian expedition led by Andrei Teben'kov re-examined the Lower Palaeozoic succession in northeastern Ny Friesland, leading to a re-description of the lithological units by Kosteva & Teben'kov (2006). A German expedition sampled the locality in 2007 and is currently studying the conodont fauna. The present study is primarily based on material collected during the 2008 Ny Friesland expedition led by Nils-Martin Hanken of the University of Tromsø.