New Fossil Finds from the Cambro-Silurian Meta-sediments on Hardangervidda

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The occurrence of Actinoceroid cephalopods (*Ormoceras (?)* sp.), brachiopods (*Orthis* ss.), and trilobites (*Ptychopyge* sp.) in a crystalline limestone overlying bluish quartzite on Hardangervidda indicates that Orthoceras Limestone of the Lower Ordovician Asaphus Series (Etage 3c) is present. The underlying quartzites are correlated with stage 3a–3b in the Oslo Region.

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Introduction

Hardangervidda (Fig. 1) is, outside the Oslo Region, one of the largest areas in Norway where Cambro-Silurian sediments of eastern facies (foreland facies) are exposed. The stratigraphy and structure of these rocks are not very well known, partly because of the inaccessibility of the area, and partly due to the intense deformation and lack of fossiliferous beds. Even though the fossils described in this paper are badly preserved, making identification of species in some cases uncertain and in other cases impossible, they give some information about the Cambro-Silurian stratigraphy.

The earliest contribution to the geology of Hardangervidda was made by Dahll (1861), who reported fossiliferous beds with *Dictyonema flabelliforme* (2e in the stratigraphic sequence of the Oslo Region) from Holberget (Fig. 1). Later, Brøgger (1893), after more detailed mapping, established a stratigraphic sequence for the rocks overlying the Precambrian basement. In this sequence all the rocks above the Precambrian basement were assumed to be in a normal succession. The subdivision he established was, from the base upwards: 1, Alum shale; 2, Quartizite; 3, Crystalline limestone (marble); 4, Phyllites; 5, Various crystalline rocks.

The *Dictyonema flabelliforme* reported from Holberget (Dahll 1861) was found in the upper part of the alum shale, indicating a Cambrian to Lower Ordovician age for this unit. Brøgger (1893 p. 80) correlated the crystalline limestone (3, above) with the Orthoceras Limestone, mainly on the basis of the occurrence of 4a fossils in phyllites overlying quartzite and limestone in Gausdal, some 150 km farther northeast. He also assumed that the phyllites of division 4 represented the lower part of the Silurian, while the crystalline rocks of division 5 were thought to be of upper Silurian age or younger.

Later, Reusch et al. (1902) suggested that division 5 represents a Caledonian nappe of Precambrian rocks. This hypothesis has since been generally accepted, and has been confirmed by recent mapping and geochronologic

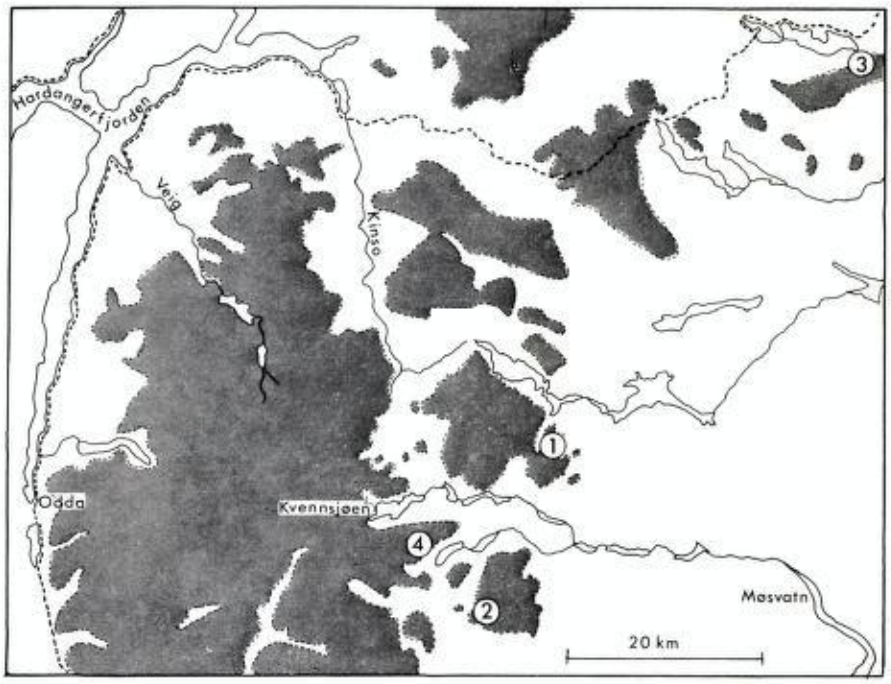

Fig. 1. Simplified geological map of Hardangervidda showing distribution of Cambro-Silurian rocks (grey) and known fossil localities. 1 = Holberget, 2 = Dvergsmednuten and Setenuten, 3 = Ustaoset, 4 = the two localities described in this publication (3 km south of Kvennsjøen.)

work (Naterstad et al. 1973, Andresen et al. in press). A subdivision into autochthonous and allochthonous Cambro-Silurian was made in the publication of Naterstad et al. (1973).

Rekstad (1903) discovered a new graptolite locality at Dvergsmednuten (Fig. 1), and Størmer (1940) has described the material from both Holberget and Dvergsmednuten. *Obolus* sp. was also described in the material from Holberget. The graptolite material has also been described by Bulman (1966). In addition to the described graptolite material from Holberget and Dvergsmednuten, O. Liestøl has collected *Dictyonema flabelliforme* at Setenuten, 3 km east of Dvergsmednuten.

Goldschmidt (1925) and Størmer (1925) described Lower Cambrian beds and fossils from Ustaoset. All the known fossil localities from Hardangervidda are plotted in Fig. 1.

Fossil localities and geological setting

The two new fossil localities are a few kilometres south of Kvennsjøen (Figs. 1 and 2). The fossils at both localities occur in isolated beds of crystalline limestone downfolded into the stratigraphically underlying bluish quartzite.

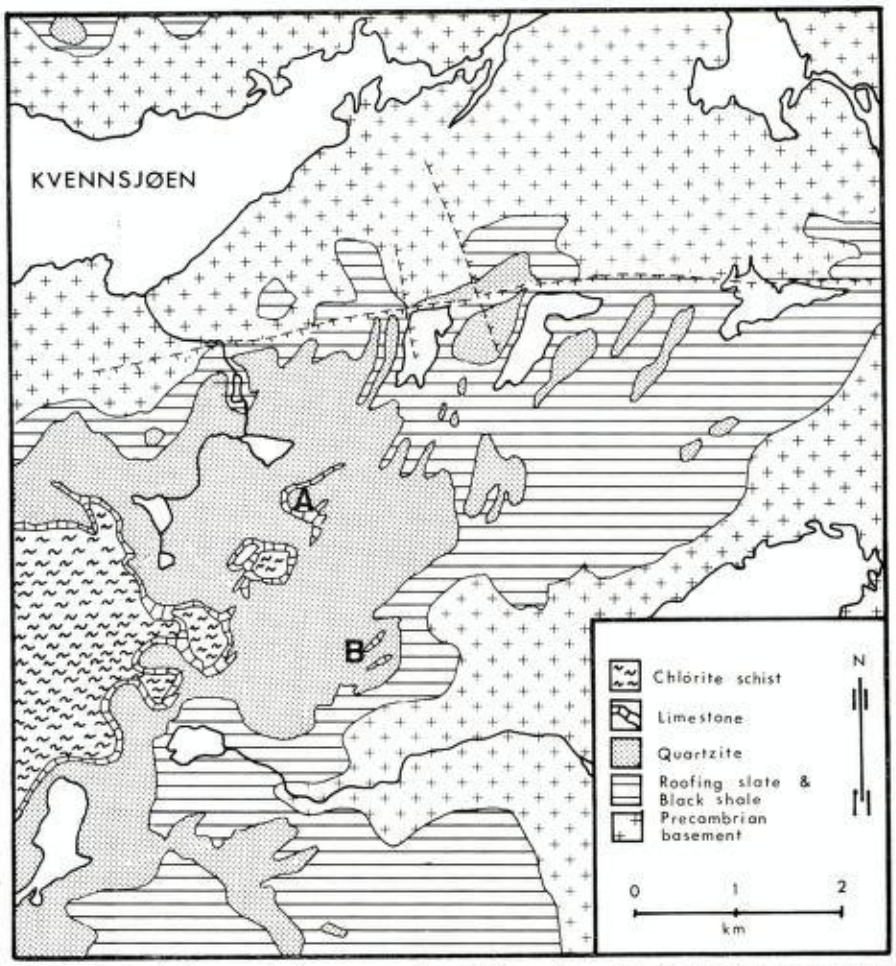

Fig. 2. Geological map of the area south of Kvennsjøen, showing the two new fossil localities (A and B). Note that the limestone (Orthoceras Limestone) has been traced as a continuous layer for several kilometres.

The fossiliferous beds correspond to division 3 of Brøgger (1893); thus they are younger than the earlier described fossiliferous beds from Holberget and Dvergsmednuten (Etage 2e). At both localities the limestone unit shows variable thickness due to isoclinal folding but is usually from 3–10 m thick. On the basis of lithologic variations, the limestone unit can be subdivided into three parts. The lowermost part is composed of a calcareous sandstone, always less than 0.5 m thick. Clastic grains are mainly quartz with average grain-size about 1 mm. Above this zone is a rather pure crystalline limestone (marble), 3–6 m thick. A 3–7 m thick zone of white mica/chlorite-rich marble makes up the uppermost part of the unit. Pure marble beds are also sometimes found within this upper unit.

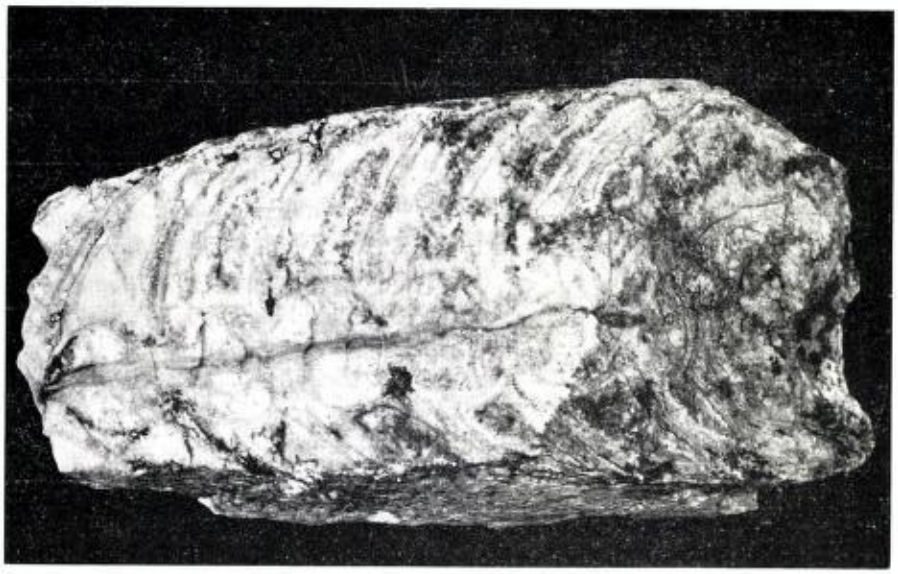

Fig. 3. Longitudinal section through the siphuncle of Actinoceroid cephalopoda (*Ormoceras* (?) sp.) from locality A. Length of specimen 10 cm.

Fossils

All the described fossils are collected from locality A (Fig. 2); the single cephalopod observed at locality B was too strongly deformed and badly preserved for description and identification. The cephalopod from locality B was observed in the middle unit of pure limestone. At locality A fossils were found both in the calcareous sandstone and in the pure limestone.

A rich shelly fauna of brachiopods and trilobite fragments was found in a loose boulder belonging to the calcareous sandstone horizon. A single gastropod and a larger number of small rodlike bodies about 1 mm across and 1–2 cm long were also observed in the same bed. Even though the trilobite fragments are strongly deformed and sheared, one of them shows a trilobite pygidium of Asaphid type. The overall elongated outline, relatively flat, somewhat pleural field, and long tapering rachis, faintly ringed, suggest *Ptychopyge* sp. rather than *Asaphus*. Associated with the trilobite fragments were several brachiopods of genus *Orthis* ss. Some of these are well preserved and rather like several *Orthis* of *calliframma* type from 3c. The gastropod is of the planispiral type and about 1 cm across. Further identification is not possible.

A cephalopod was found in the pure limestone overlying the calcareous sandstone with its shelly fauna at locality A (Fig. 3). polished section parallel to the siphuncle shows a 60 mm long specimen with five chambers and with diameter varying from 48 mm to 36 mm, giving an apertural angle of 12°. The siphuncle extension has a height equal to its length and the siphuncle itself is ventrally placed, with a distance from the centre of the siphuncle to

the wall equal to 3/10 of the width of the couch. The data are sufficient to identify this as an Actinoceroid type cephalopod, but the lack of finer structures makes a precise definition of genus uncertain. Earlier descriptions of Actinoceroid cephalopods from the Lower Ordovician of the Fennoscandian/Baltic Shield (Troedsson 1926) include species which strongly resemble the present specimen. Of these the *Ormoceras oelandicum* from the Platyurus Limestone (Upper Red Orthoceras Limestone) shows especially great similarities. It is therefore concluded that the cephalopos from Hardangervidda is an Actinoceroid cephalopod, *Ormoceras(?)* sp.

Discussion and conclusions

The occurrence of *Ormoceras(?)* sp., *Ptychopyge* sp. and *Orthis* ss. in the limestone above the bluish quartzite on Hardangervidda indicates that the limestone is equivalent to the Orthoceras Limestone of the Lower Ordovician Asaphus Series (Etage 3c). The *Ptychopyge* sp. indicates 3c age generally, while *Ormoceras*(?) sp. indicates the upper part of the Orthoceras Limestone. From the rather restricted number of fossils found to date, it is difficult to correlate the lithologic variation observed in the Orthoceras Limestone on Hardangervidda with the subdivision (3cα, 3cβ, 3cγ) of the Oslo Region. The pure limestone with *Ormoceras*(?) sp. may, however, correspond to the Endoceras Limestone (3cγ). The calcareous sandstone below, and possibly also the upper part of the quartzite, should then be correlated with 3cα-β while the white mica/chlorite rich limestone above should represent the transition zone between the Endoceras Limestone and the Upper Didymograpthus Shale (Etage 44aα_{1-2}).

Bjørlykke (1965) described a distinct change in mineralogy and chemistry of shales in the Oslo Region lying below and above the Orthoceras Limestone. The shales above (4a) have a higher chlorite/illite ratio and a higher content of Mg. This change in chemistry and mineralogy is even more pronounced on Hardangervidda, as the shales or schists above the limestone unit are chlorite schists, while those below are black shales. This is further evidence in support of the proposed correlation.

Since *Dictyonema flabelliforme* (2e) occurs just below quartzite (Holberget and Dvergsmednuten) and Orthoceras Limestone (3c) has now been identified above, the massive bluish quartzite and underlying roofing slate must be restricted to stage 3a–b.

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REFERENCES

Andresen, A., Heier, K. S., Jorde K. & Naterstad, J., 1974: A preliminary Rb/Sr geochronological study of the Hardangervidda–Ryfylke Nappe System in the Røldal area, south Norway. *Norsk geol. Tidsskr.* In press.

Bjørlykke, K. 1965: The Middle Ordovician of the Oslo Region, Norway 20. The geochemistry and mineralogy of some shales from the Oslo Region. *Norsk geol. Tidsskr. 45,* 435–456.

Brøgger, W. C. 1893: Lagfølgen på Hardangervidden og den såkalte 'høifjeldskvarts'. *Norges geol. Unders. 11,* 142 pp.

Bulman, O. M. B. 1966: On the type material of *Dictyonema norvegicum* Kjerulf. *Norsk geol. Tidsskr. 46,* 289–298.

Dahll, T. 1861: Om Telemarkens geologie. *Nyt. Mag. Naturvidensk. 11,* 137–172.

Goldschmidt, V.M. 1925: Ueber fossilführende untercambrische Basalablagerungen bei Ustaoset. *Fennia 45 (1),* 1–11.

Naterstad, J., Andresen, A. & Jorde, K. 1973: Tectonic succession in the Caledonian nappe front of the Haukelisæter–Røldal area, south-west Norway. *Norges geol. Unders. 292,* 1–20.

Rekstad, J. 1903: Fra høifjeldsstrøket mellom Haukeli og Hemsedalsfjeldene. *Norges geol. Unders. 36,* 1–54.

Reusch, H., Rekstad, J. & Bjørlykke, K. O. 1902: Fra Hardangervidden. *Norges geol. Unders. 34,* 1–80.

Størmer, L. 1925: On a Lower Cambrian Fauna at Ustaoset in Norway. *Fennia 45 (1),* 12–22.

Størmer, L. 1940: Dictyonema shales outside the Oslo Region. *Norsk geol. Tidsskr. 20,* 161–179.

Troedsson, G. T. 1926: On the Middle and Upper Ordovician faunas of Northern Greenland. I. Cephalopods. *Medd. Grønland 71,* 1–157.