The Upper Palaeozoic succession of Bjørnøya[1]

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Abstract

The Upper Palaeozoic succession on Bjørnøya comprises eight formations with a maximum composite thickness of about 1300 metres. It rests unconformably on Hecla Hoek basement, and is overlain disconformably by Triassic shales. The lower formations, of Upper Devonian and Lower Carboniferous age, consist of sandstones and shales with subordinate conglomerates and coals, and were deposited in various alluvial environments. The overlying Upper Carboniferous and Permian formations consist largely of carbonates, with additional sandstones, shales, and cherts; these were deposited in shallow marine and coastal environments. Variations in facies and thickness together with palaeocurrent patterns suggest that Bjørnøya lay near the southern margin of a depositional basin during much of the Upper Palaeozoic.

Introduction

In spite of its small size, Bjørnøya is of considerable geological significance because of its isolated position near the western margin of the Barents Shelf.

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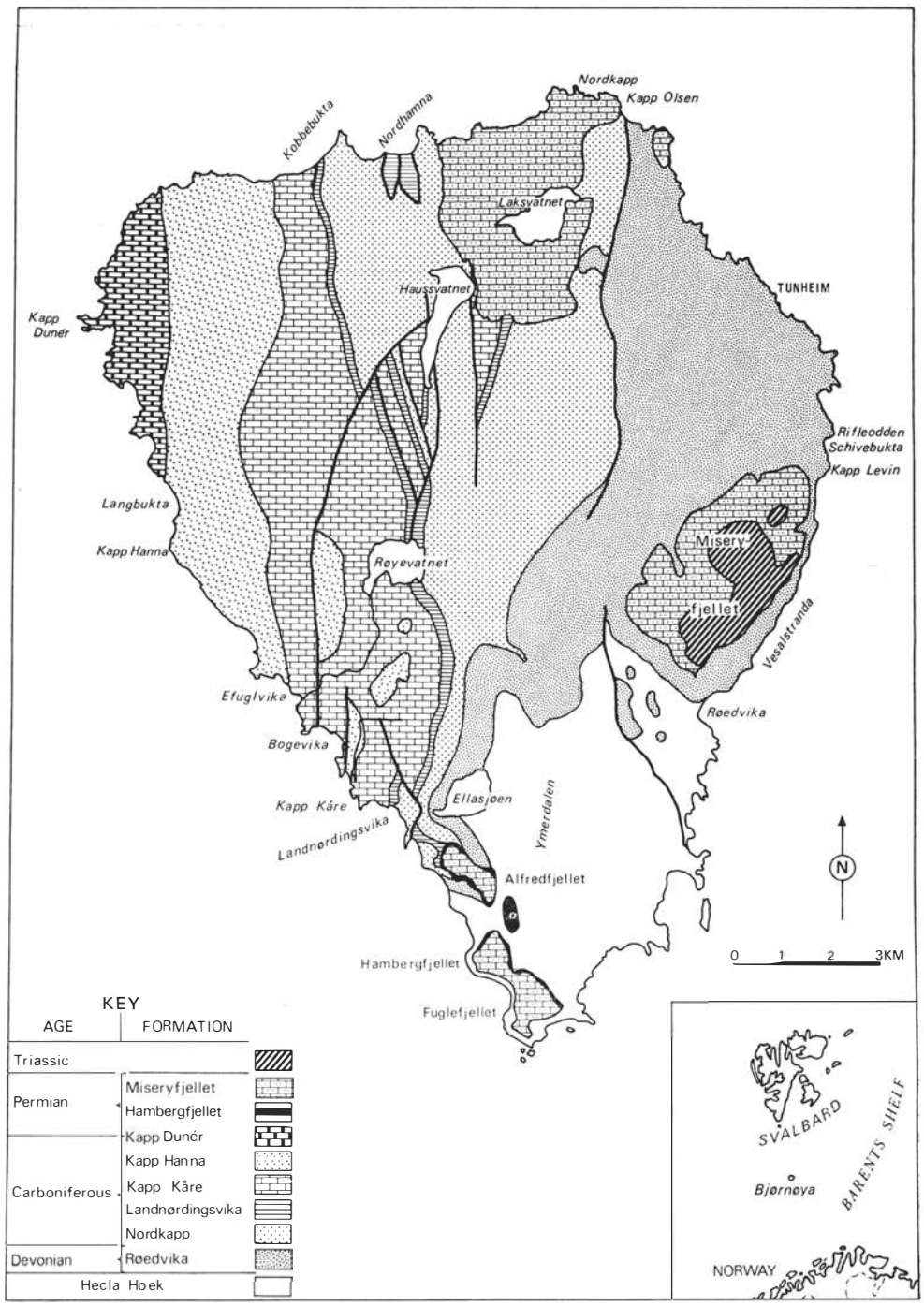

Fig. 1. *Geological map of Bjørnøya, based on* Horn and Orvin *(1928). Place-names referred to in the text are also shown.*

A general geological description of the island can be found in HORN and ORVIN (1928); three geological elements are seen:

3. Triassic – approx. 200 metres of shales and sandstones.
   – *disconformable contact* –
2. Upper Devonian to Permian – described here.
   – *unconformable contact* –
1. Hecla Hoek basement – approx. 1,200 metres of clastics and carbonates of Late Pre-Cambrian and Ordovician age.

The Upper Palaeozoic strata outcrop over most of the island (Fig. 1); until recently, only isolated aspects of their geology had been studied since coal-mining operations were abandoned in 1925. This paper presents preliminary results of an environmental analysis of these strata based on detailed sedimentological sections through much of the succession. The work is part of the Barents Sea Project, a co-operative effort with participation by several Norwegian research institutions. Field work on Bjørnøya was carried out during Norsk Polarinstitutt's expeditions to Svalbard in 1971 and 1973, and was supported by NTNFK (the Continental Shelf Division of the Norwegian Council for Scientific and Industrial Research).

Stratigraphy

The formations described are listed in Fig. 2 together with their thicknesses and approximate ages; the "Series" names established by ANDERSSON (1900) are also shown. CUTBILL and CHALLINOR (1965) introduced formal lithostratigraphical names for the two lower formations on the basis of the account of HORN and ORVIN (1928). KRASILŠČIKOV and LIVŠIC (1974) presented, but did not define, names for the remainder of the succession. Where we consider these names justified we have adopted them and defined them on the basis of our work; however, several of the names introduced by KRASILŠČIKOV and LIVŠIC are inappropriate and are rejected. We have also introduced formal members in two of the formations described.

RØEDVIKA FORMATION

Name

The lower part of the "Ursa Sandstone" of earlier workers was renamed by CUTBILL and CHALLINOR (1965) after Røedvika (Fig. 2) where the lower parts of the formation are exposed; a complete section through the formation is not seen at any single locality.

Lithology and thickness

The formation consists of sandstones and shales with subordinate conglomerates and coals. Bore-hole data (HORN and ORVIN 1928) indicate a thickening over a distance of about 12 km from about 100 metres at Ellasjøen (SW) to about 360 metres around Tunheim (NE).

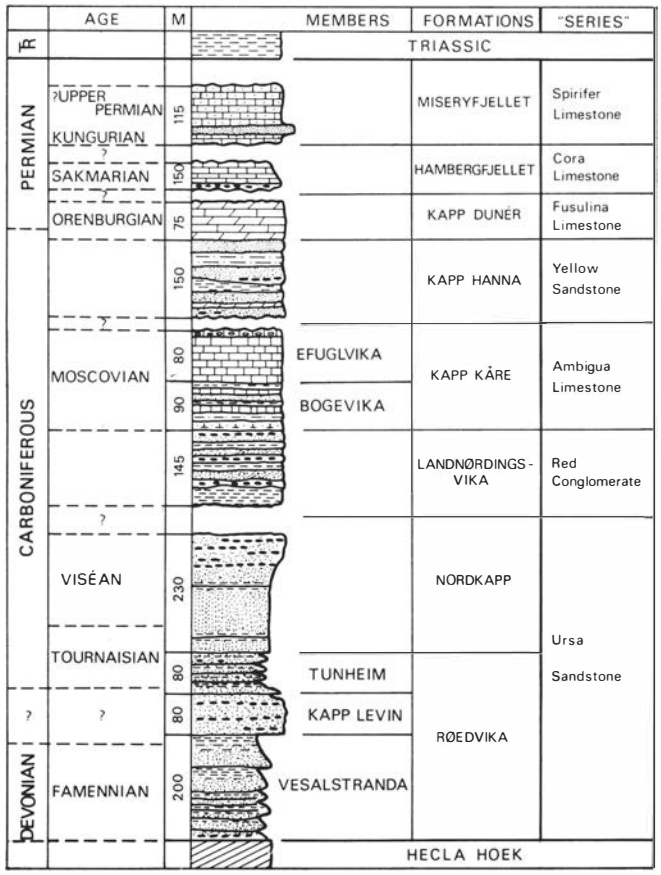

Fig. 2. *Composite section through the Upper Palaeozoic succession of Bjørnøya, with lithology, thickness, and tentative correlation of the formations and members proposed here. The "Series" names used by earlier workers are also shown.*

Boundaries

The formation rests unconformably on the Hecla Hoek with locally developed basal conglomerates. The top of the formation is not exposed, and was somewhat arbitrarily located by Horn and Orvin (1928) in some of their bore-holes. Cutbill and Challinor (1965) misquote Horn and Orvin as having suggested an unconformable relationship between the Røedvika and overlying Nordkapp Formations; Horn and Orvin (1928, p. 21) merely noted the possibility of such a relationship to explain the formations' geographical variations in thickness, but left this question open. Krasilščikov and livšic (1974) suggest that the thickness variation is a result of thrusting of the formation over the Hecla Hoek; although some tectonic deformation of this lower junction may have occurred, exposures do not indicate thrusting of the magnitude necessary to be alone responsible for such large thickness variation. Further, such thrusting cannot explain the lateral variation in thickness of the overlying Nordkapp Formation.

Age

The formation has traditionally been assigned to the Upper Devonian because of its plant and fish macrofossils (e.g. *Archaeopteris* and *Holoptychius*). Although CUTBILL and CHALLINOR (1965) suggested that palynomorphs indicated a Lower Carboniferous age, more extensive palynological studies by KAISER (1970, 1971) indicate that the formation spans the Devonian/Carboniferous boundary, ranging from the Famennian to the Lower Tournaisian.

Sedimentation

The formation was deposited under fluvial conditions. It is here subdivided into three members based on sedimentological studies on the east coast.

VESALSTRANDA MEMBER

This member outcrops along Vesalstranda ("the desolate shore") from Røedvika to just south of Kapp Levin, and here comprises the lower 200 m of the Røedvika formation. The outcrop area's name refers to the unstable scree slopes with continually falling debris. Exposure is generally poor, but a few sections can be measured (see HORN and ORVIN 1928, Plate II).

The member consists of grey and purple sandstones and shales in units up to 25 m thick. Conglomerates are scarce and a few thin coal seams (the Misery series of HORN and ORVIN 1928) occur. Shales contain abundant plant fossils,

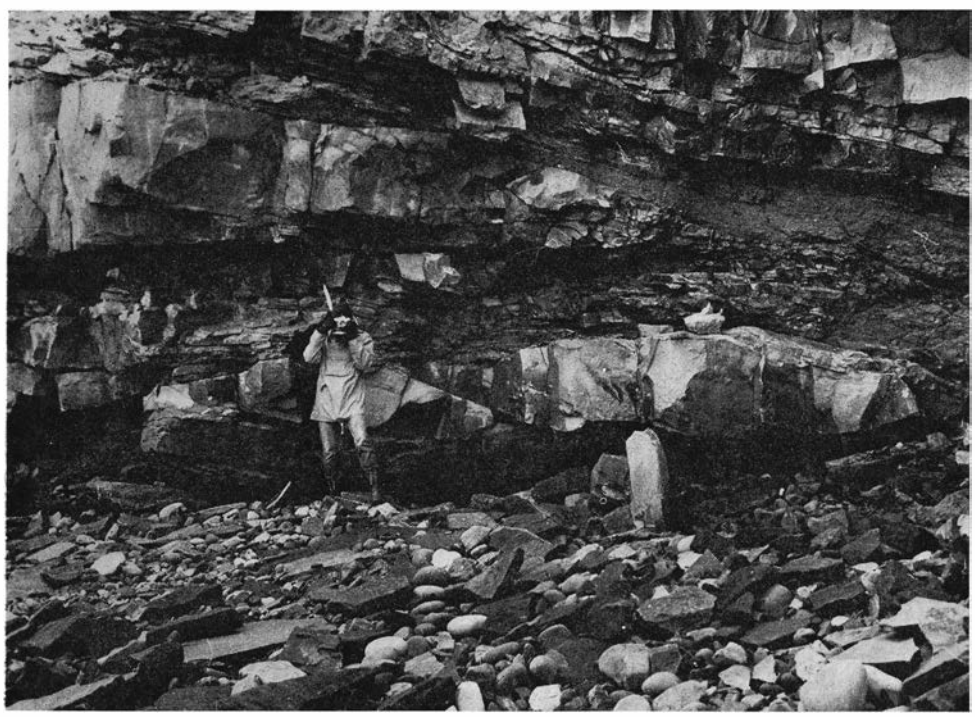

Fig. 3. *Cross-stratified sandstones with large scours filled by sandstone and shale. Flow directions to the north. Kapp Levin Member at Kapp Levin.*

and underclays are developed. The arrangement of lithologies in fining-up sequences indicates deposition by meandering rivers. Limited observations on cross-bedding indicate that currents flowed to the W, N, and E.

The underclays, coals, and shales at the top of the member are overlain sharply by conglomeratic sandstones of the Kapp Levin Member.

KAPP LEVIN MEMBER

This member is exposed around Kapp Levin and north to Schivebukta and is about 80 m thick.

Grey cross-stratified sandstones, conglomeratic sandstones, and conglomerates dominate the succession and shale is scarce (Fig. 3). The coarse textures, abrupt changes in grain-size and absence of well-defined fining-up sequences suggest deposition by braided streams. Palaeocurrents towards all directions but SW were recorded.

The coarse deposits which dominate this member are overlain by a 10 m thick shale sequence which marks the junction with the sandstones of the Tunheim Member.

TUNHEIM MEMBER

This member is exposed around Tunheim, the site of the mining camp where coal was produced from 1916 to 1925, and along the coast from Schivebukta to south of Kapp Olsen. The upper series of coal seams in the Røedvika Formation (the Tunheim Series of Horn and Orvin 1928) occur in this member.

The member is about 80 m thick and consists of grey sandstones and shales with local conglomerates and coals. Sandstones are massive, cross-stratified, and parallel-laminated. As in the Vesalstranda Member, plant fossils are abundant in the shales, and underclays are developed. Well-defined fining-up sequences with sandstone units from 5 to 25 m thick are attributed to deposition by streams meandering across a densely vegetated flood-plain (Fig. 4). Cross-bedding indicates current flow to the NW, N, and NE.

The base of the member is defined by the onset of cyclic sedimentation. The Rifleodden Conglomerate Bed is a useful marker horizon which occurs within approximately 20 m of the base of the member. As indicated previously, the top of the member is not exposed.

NORDKAPP FORMATION

Name

The upper part of the "Ursa Sandstone" was called the Nordkapp Formation by Cutbill and Challinor (1965) after the northernmost point on Bjørnøya. As with the Røedvika Formation, no complete section exists through the formation at any single locality.

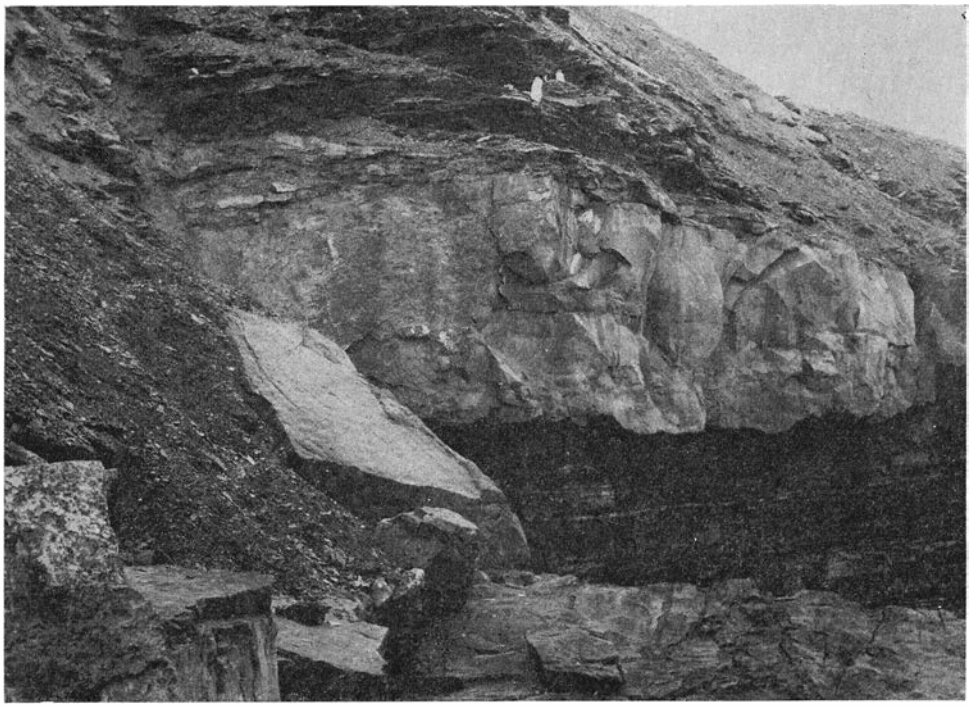

Fig. 4. *Fining-upwards sequence in the Tunheim Member north of Tunheim. The base of the sequence is marked by the erosive contact between a 6 m thick massive sandstone and the underlying shale containing the "A" coal of* HORN and ORVIN (*1928*).

Lithology and thickness

The formation consists of cross-bedded grey sandstones with occasional conglomerates and rare shales with thin coals. The thickness apparently increases northwards over a distance of about 11 km from 110 m at Ellasjøen to 230 m in a bore-hole at Haussvatnet (HORN and ORVIN 1928); faulting obscures the true thickness of the formation in exposures on the north coast.

Boundaries

Although the base of the formation is not exposed, the uniform development of sandstone contrasts with the cyclic development seen in the underlying Tunheim Member.

Extensive conglomerates occur in the upper part of the formation at Landnørdingsvika, just below the first red beds of the Landnørdingsvika Formation.

Age

The formation was first distinguished as a discrete part of the Ursa Sandstone on the basis of plant fossils found in a bore-core from Laksvatnet in 1916; these were dated as Lower Carboniferous by ANTEVS and NATHORST (1917). A microflora from the upper part of the formation at Nordkapp contains elements of the *aurita* assemblage of Spitsbergen; it was assigned to the

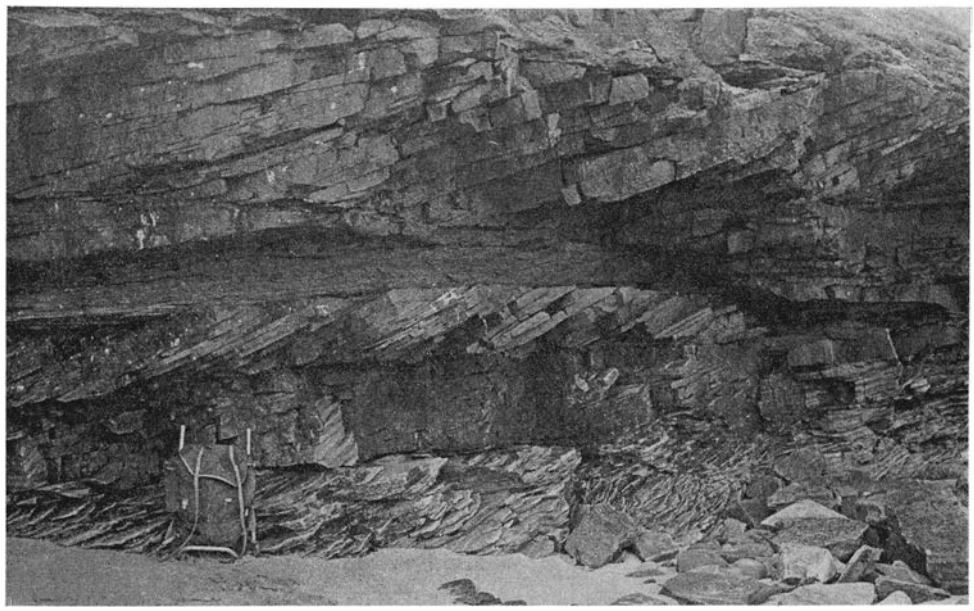

Fig. 5. *Cross-stratification in the Nordkapp Formation east of Nordhamna. The lenticular tabular cross-set in the middle of the picture shows asymptotic bases to the foresets. Uppermost is a large cross-set with reactivation surfaces. Flow directions to the east.*

Viséan by PLAYFORD (1962, 1963) and to the Namurian by CUTBILL and CHALLINOR (1965). KAISER (1970) reassigned this part of the formation to the Viséan. A coal seam of Upper Tournaisian age outcropping south of Ellasjøen probably belongs to this formation and not, as suggested by KAISER, to the Røedvika Formation.

Sedimentation

The uniform cross-bedded sandstones suggest deposition in eastward flowing braided streams (Fig. 5).

LANDNØRDINGSVIKA FORMATION

Name

A complete section through this formation is exposed at Landnørdingsvika. The name replaces "Red Conglomerate Series" of earlier workers.

Lithology and thickness

The lower part of the formation consists of friable red (and occasionally green) mudstones with occasional erosively based sandstone beds up to several metres thick. Cornstones and desiccation cracks are sparsely developed in the mudstones near the base. Conglomerates gradually appear approximately 40 m above the base; these are an important component of the upper part of the formation, mainly at the expense of mudstone. Both sandstone and conglomerate beds are often lenticular. The conglomerates are of fine pebble to

fine cobble size, are moderately to poorly sorted, and consist mainly of dolomite, limestone, chert, and sandstone. The formation is 145 metres thick in Landnørdingsvika. HORN and ORVIN (1928) estimated a thickness of about 50 m on the north coast; however a 70 m thick succession in Nordhamna, assigned by them to the overlying Ambigua Limestone, is clearly a lateral equivalent of the Landnørdingsvika Formation in Landnørdingsvika. Thus the formation is at least 120 m thick on the north coast, and although faulting prevents any determination of true thickness, there is no evidence to suggest such large regional variation in the thickness of this formation as previously supposed. However, the northern development represents a more distal facies with little conglomerate and more fine-grained clastic material.

Boundaries

In Landnørdingsvika the base of the formation is placed at the appearance of red mudstones; the top is taken at the last prominent conglomerate bed; this occurs almost simultaneously with the appearance of carbonates in the rhythms typical of the overlying Kapp Kåre Formation. The upper contact on the north coast is obscured by faulting.

Age

Fossils found in the upper part of the formation, and the gradational upper contact, suggest a slightly older age than that of the overlying Moscovian Kapp Kåre Formation. This would indicate an appreciable break in deposition between the Nordkapp and Landnørdingsvika Formations, a conclusion supported by the sedimentological dissimilarity of the two formations.

Sedimentation

The vividly coloured sandstones and mudstones in the lower part of the succession at Landnørdingsvika are arranged in fining-up sequences which suggest deposition on an alluvial plain. The conglomerates in the upper part of the formation are likewise associated with fining-up rhythms and often occur in channels, or clearly erosive beds, so that these are also associated with channel deposition; however, alluvial fan deposits may also be represented. Scattered observations on cross-bedding indicate that currents were highly variable, but flowed mostly towards W, N, and E.

KAPP KÅRE FORMATION

Name

The type section is fully exposed in the cliffs of Landnørdingsvika (access only by boat) and on the coast around Kapp Kåre. The formation here approximates to the "Ambigua Limestone" of ANDERSSON (1900) and later workers; KRASILŠČIKOV and LIVŠIC (1974) renamed the unit as the Kobbebukta Formation, and included the exposures in Nordhamna in this formation (see above). The succession in Kobbebukta is obscured by faulting and we consider it more

reasonable to use the south coast exposures as the standard section against which the partial northern exposures can be compared. The formation's earlier name refers to the occurrence of the brachiopod *Composita ambigua*.

Lithology and thickness

The formation is approximately 170 m thick in type section. Other exposures, on both the west and north coast, are fragmentary because of faulting. In type section the lower, Bogevika Member consists of alternations of carbonates, shales, and sandstones. These are overlain by cherty biomicrites assigned to the upper, Efuglvika Member.

Boundaries

The lower boundary in Landnørdingsvika is marked by the disappearance of thick conglomerates and the introduction of carbonates in the succession; isolated thin conglomerates do, however, occur in the lower part of the formation. The upper boundary is clearly marked to the north of Kapp Kåre by intraformational conglomerates which underlie the extrabasinal conglomerates of the Kapp Hanna Formation.

Age

Early workers assigned the Landnørdingsvika, Kapp Kåre, and Kapp Hanna Formations to the Middle Carboniferous. GOBBETT (1963) noted that the brachiopods of the Kapp Kåre Formation suggest a correlation with the Middle Carboniferous (Bashkirian/Moscovian) of the Moscow Basin. On the basis of fusulinids, CUTBILL and CHALLINOR (1965) and FLOOD et al. (1971) placed the formation entirely in the Upper Moscovian. This correlation is supported by studies on corals (FEDOROWSKI 1975) which, however, apparently were collected from intraformational conglomerates high in the formation, and not, as stated by FEDOROWSKI, "from the lower part of the so-called Ambigua Limestone".

Sedimentation

The formation was apparently deposited in lagoonal to open marine conditions. The lower, Bogevika Member represents restricted marginal environments, while the Efuglvika Member represents phases of marine carbonate deposition alternating with periods of silicification and erosion. Current patterns are complex, but the general development of the formation suggests more normal marine conditions to the NW.

BOGEVIKA MEMBER

This member is 90 m thick in type section in the cliffs of Landnørdingsvika and consists of limestones, dolomites, sandstones and shales. Many beds have a characteristic greyish-red colour, although greyish-green and variegated beds

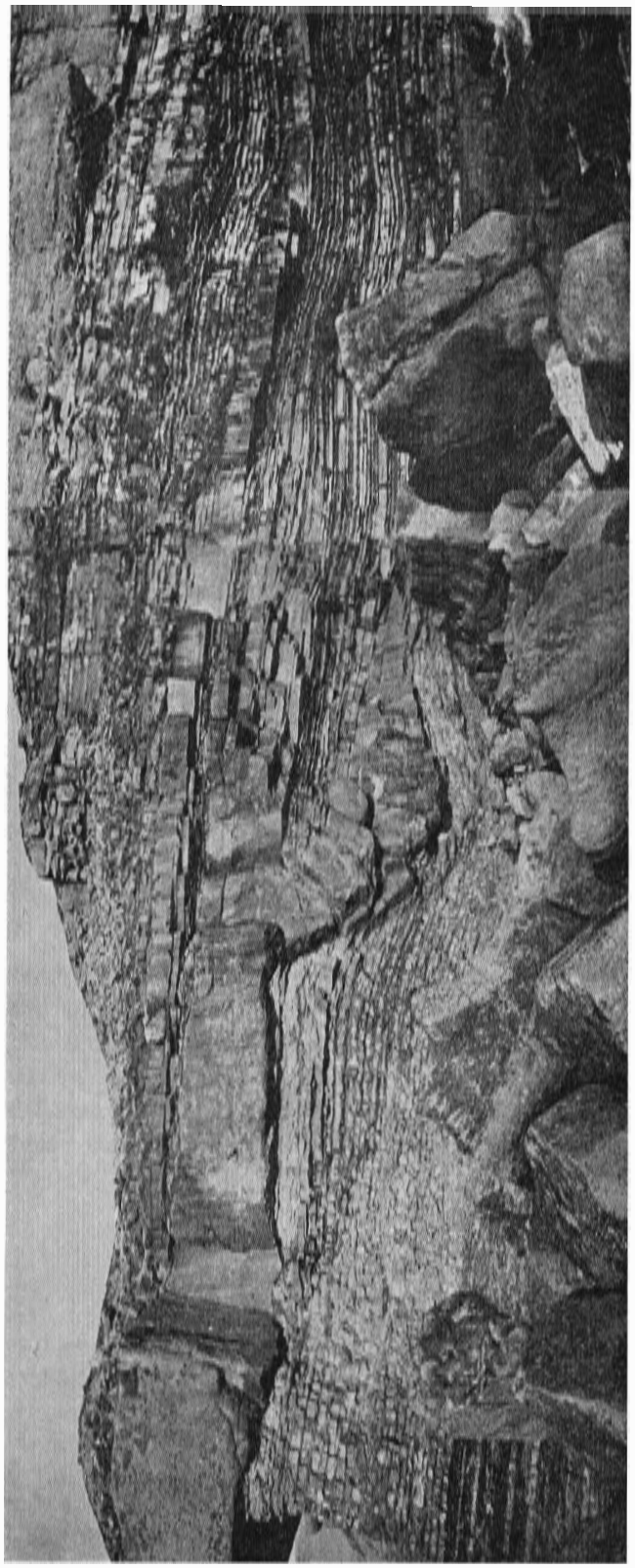

Fig. 6. *Facies variation and sedimentary structures in the upper part of the Efuglvika Member at Kobbebukta. About 20 m of section are exposed. Channels cutting into biomicrites and shales are filled with conglomerates which pass laterally into sandy limestones and shales (to the south).*

also occur. Pale grey biomicrites become more common upwards in the succession, and the junction with the overlying Efuglvika Member is taken where these occur to the virtual exclusion of shales and sandstones.

The upper part of the member is exposed in slightly more accessible cliff-sections in Bogevika, 2 km to the north of Landnørdingsvika. Exposures in the eastern part of Kobbebukta are also assigned to this member, but the succession here is dominated by grey rather than red beds.

The lithologies encountered in these localities often show well-developed rhythmic sequences of limestone, shale and sandstone in 3 to 8 m thick units. These rhythms probably originated in marginal marine environments, and the faunal associations seen suggest variation between marine and brackish water conditions: corals and brachiopods are locally abundant in the limestones and some shales, while shales and sandstones in the upper parts of the rhythms contain bivalves, gastropods, ostracodes, and plant remains. In the upper parts of the member in Landnørdingsvika and Bogevika, limestones with stenohaline faunas alternate with greyish-red shales with bivalves. Oncolitic limestones occur at several horizons.

EFUGLVIKA MEMBER

The member is fully exposed around Kapp Kåre, a promontory marking the western limit of Landnørdingsvika. It is also well exposed in the vicinity of Efuglvika and on the north coast in Kobbebukta.

In the Kapp Kåre section the member consists of 80 m of cherty biomicrites, but the thickness may vary regionally because of differential erosion of the top of the member. Massive cherty biomicrites occur in several metre thick units which are separated by thinly bedded biomicrites; the latter are associated with apparent erosion surfaces. Intraformational conglomerates at the top of the member contain both chert and, less commonly, limestone pebbles.

Exposures in Kobbebukta show a more complex development; several massive conglomerates occur, some of which show channelled bases and abrupt lateral facies changes (Fig. 6). Between the conglomerates are cherty biomicrites with marine faunas. Both chert and, to a lesser extent, fossils are found as intraformational debris in the conglomerates. As on the south coast, early silicification is suggested by the abundance of intraformational chert clasts.

KAPP HANNA FORMATION

Name

The formation outcrops for several kilometres along the north and west coasts. Minor faults, and undulating gentle dips have caused stratigraphic repetition so that a single type section cannot be designated. However, the salient features of the formation are well exposed in the vicinity of Kapp Hanna on the west coast. The formation was earlier called the "Yellow Sandstone".

Lithology and thickness

The formation is approximately 150 m thick and consists of medium-grained well-sorted sandstones with numerous conglomerates, dolomites, and shales. The conglomerates often contain both extra-basinal pebbles and chert clasts which apparently were derived from the underlying Kapp Kåre Formation.

Boundaries

The upper boundary is obscured by faulting on the west coast; on the northwest coast the boundary is taken at the appearance of the massive dolomites of the overlying Kapp Dunér Formation.

Age

The formation's age has been inferred from its relation to the under- and overlying units as the only fossils known until now were crinoid stems and a rugose coral found by HOLTEDAHL (1920). It is hoped that recent finds of corals, bivalves and plant fossils may aid correlation.

Sedimentation

The formation was apparently deposited in coastal and shallow marine environments. The coarse clastic sediments occur both in coarsening upwards sequences and in units with deeply erosive bases; both bar and channel facies are suggested. Fossils found in the shales suggest deposition in brackish lagoons with periodic marine incursions. The cements in the sandstones are varied; calcite, dolomite, and celestite have been identified. The latter is interesting in the context of the evaporitic environments suggested by SIEDLECKA (1972, 1975) in the overlying Kapp Dunér Formation.

KAPP DUNÉR FORMATION

Name

The carbonates formerly assigned to the "Fusulina Limestone" outcrop on the western coast of Bjørnøya over a distance of 8 km. Good exposures through the formation are seen in the cliffs on and around Kapp Dunér.

Lithology and thickness

Exposures indicate a minimum thickness of 75 m for this formation; its top is not seen, and the uppermost beds exposed dip gently seawards. Dolomites dominate the succession, but distinctive grey fusulinid biomicrites are also seen.

Boundaries

The upper boundary with the Hambergtjellet Formation is not exposed, but is clearly unconformable (see below).

Age

CUTBILL and CHALLINOR (1965) and FLOOD et al. (1971) assigned the formation to the Orenburgian zone of *Rugofusulina arctica*, possibly extending upwards into the Asselian.

Sedimentation

HOLTEDAHL (1920) noted "a compact layer, 15 metres thick, of a limestone of a peculiar brecciated character" in this unit. There are in fact three massive lenticular dolomites in the lower part of the exposed succession, and these are exposed for several kilometres along the western coast. Large coral colonies, bryozoan thickets, *Stromatactis* structures, and apparent intraformational conglomerates suggest that these beds represent a series of dolomitised shallow water carbonate banks. They apparently form the base of a partial section through the formation studied by SIEDLECKA (1972, 1975) and FOLK and SIEDLECKA (1974). These authors suggest predominantly sabhka and "schizohaline" (fluctuating hypersaline to fresh water) environments of deposition for the beds in this section. They also note the occurrence of some lagoonal deposits characterised by partially dolomitized biomicrites. The rich fossil content of such biomicrites (e.g. fusulinids, corals, brachiopods, gastropods and echinoderms) clearly indicates normal and probably vigorous marine environments in these lagoons. Likewise coral colonies and bryozoans seen in some of the "hypersaline" dolomite banks indicate either significant periods of normal marine conditions or that the mineralogical criteria used to interpret such hypersaline conditions are in fact a secondary and not a depositional feature of these bodies.

HAMBERGFJELLET FORMATION

Name

This formation is found only in the extreme southwest of the island where it oversteps all older formations from the Hecla Hoek to the Landnørdingsvika Formation (Fig. 7). The most accessible exposures occur on the eastern slopes of Hambergfjellet; lithologies and faunas can also be studied in land-slips immediately underneath these exposures in Ymerdalen. The unit has earlier been called the "Cora Limestone" because of the occurrence of the brachiopod *Linoproductus dorotheevi* (identified by ANDERSSON 1900, as *Productus cora*).

Lithology and thickness

The unit attains a maximum thickness of 50 m on Hambergfjellet, Fuglefjellet and Alfredfjellet; it wedges out eastwards so that the overlying Miseryfjellet Formation rests directly on the Røedvika Formation on Miseryfjellet. Basal pebbly sandstones are overlain by sandy limestones with corals. The middle of the unit consists of rubbly limestones with rich brachiopod faunas, and loose blocks studied indicate that biomicrites dominate the uppermost beds exposed.

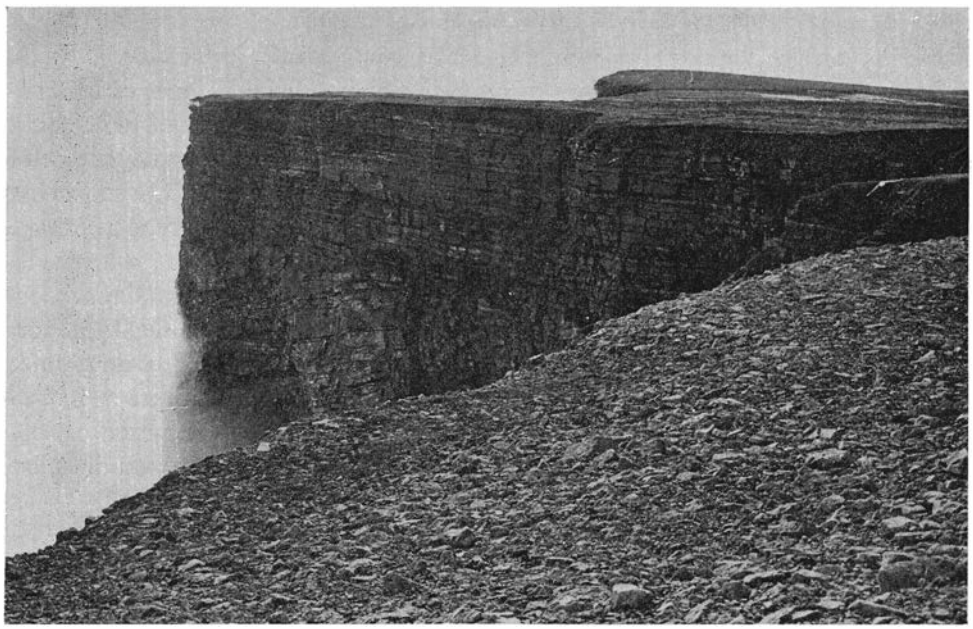

Fig. 7. *Gently dipping limestones of the Hambergfjellet Formation rest unconformably upon faulted sandstones and shales of the Røedvika Formation. About 30 m of the Hambergfjellet Formation are exposed. Western cliffs of Alfredfjellet.*

Boundaries

The formation has unconformable lower and upper boundaries. Deformation and extensive erosion occurred between the deposition of the Kapp Dunér and Hambergfjellet Formations. This erosion exposed Hecla Hoek rocks in the southern part of Bjørnøya and successively younger pre-Permian units westwards in the northern plain. Subsidence and deposition of the Alfredfjellet Formation was followed by warping and denudation prior to the deposition of the Miseryfjellet Formation.

Age

GOBBETT (1963) noted the similarity between the brachiopod fauna of this formation and that of the Upper Wordiekammen Limestone of Bünsow Land in Spitsbergen; he assigned both formations to the Sakmarian. CUTBILL and CHALLINOR (1965) and FLOOD et al. (1971) suggested a correlation with the Artinskian, but did not support this conclusion with any new faunal evidence. On this basis GOBBETT's correlation appears to be more tenable until our material has been evaluated, especially as we have found fusulinids in a loose block apparently derived from this unit (fusulinids have not been seen previously on Svalbard in rocks younger than the Sakmarian).

Sedimentation

The transgressive clastic deposits at the base of the formation are overlain by fossiliferous limestones indicative of normal marine environments.

MISERYFJELLET FORMATION

Name

Sections through the whole formation are only seen on the slopes of Miseryfjellet, although exposure in any single locality is poor. PČELINA (1972) used the name "Laksvatnet Formation" for this unit, but we consider this choice of name to be unfortunate as boreholes at Laksvatnet (HORN and ORVIN) show that only the basal 20 m of the formation occur here and exposure is minimal.

Lithology and thickness

The formation is fully developed only on the slopes of Miseryfjellet where it is approximately 115 m thick. Sandy and partially silicified biosparites dominate, although a 12 m thick quartzitic sandstone with a thin conglomerate at its top occurs 20 m above the base. The formation's lower parts are exposed on the north coast and in the southernmost mountains, and sections studied by SIEDLECKA (1972, 1975) represent the basal 12 to 15 m of the unit.

Boundaries

Basal local conglomerates and calcareous sandstones rest unconformably on various older units. On Miseryfjellet the top of the formation appears to be disconformably overlain by Triassic shales.

Age

The brachiopod faunas of the formation are similar to those of the Kapp Starostin Formation in Spitsbergen, suggesting a Kungurian and Upper Permian age. The upwards extent of deposition into the Upper Permian has not yet been satisfactorily resolved.

Sedimentation

The sandy biosparites of the formation suggest a high energy environment of deposition in shallow marine conditions. The sandstone unit mentioned above shows tabular cross-bedding directed to the south-east, and contains *Skolithos* burrows (see HOLTEDAHL 1926) and bivalves at certain horizons. This body may represent an offshore bank with cross-bedding directed shorewards.

An interesting ecological observation which has yet to be studied in detail is the large size of the brachiopods of the Miseryfjellet Formation compared to their counterparts in Spitsbergen and Greenland (DUNBAR 1955).

Discussion

It is expected that further investigation of material collected in the course of this study will improve correlation between Bjørnøya and Spitsbergen. Meanwhile, several general features of the Bjørnøya succession should be pointed out.

The Late Devonian to Early Permian sequence is relatively complete, with marine deposition first developed in the Moscovian Bogevika Member. The

lower parts of the Røedvika Formation may represent the first deposits in Svalbard after the Svalbardian folding phase; corresponding deposits in Spitsbergen have been dated as Tournaisian and younger (PLAYFORD 1962, 1963). Continental conditions also appear to have prevailed longer on Bjørnøya – the Spitsbergen lithological equivalent of the Bogevika Member, the rhythmic Ebbadalen Formation, is of Namurian/Bashkirian age (HOLLIDAY and CUTBILL 1972).

Further studies should investigate whether the conglomerates of the Efuglvika Member and Kapp Hanna Formation represent major breaks in sedimentation. Otherwise, sedimentation rates in the Upper Carboniferous of Bjørnøya were apparently intermediate between the extremes seen in the contemporaneous block and trough deposits of Spitsbergen. The 400 m thick sequence of the Kapp Kåre, Kapp Hanna, and Kapp Dunér Formations was deposited entirely in shallow, often marginal conditions; an arid climate towards the end of the depositional period is suggested by SIEDLECKA (1972, 1975). This long depositional phase was followed by deformation and uplift at some time in the early Permian. Uplift and erosion in the order of 1–2 km has occurred in southern Bjørnøya where the Hambergfjellet Formation rests directly on the Hecla Hoek. In Spitsbergen tectonic activity in the Mid-Carboniferous is marked by a complex system of fault-bounded troughs and blocks which probably represent readjustment after the Svalbardian folding phase. However, post-Moscovian deposits indicate increasing crustal stability (HARLAND 1969) and the early Permian deformation on Bjørnøya is not seen in the central parts of Spitsbergen. Nevertheless, deposits of Namurian to Kungurian age are missing on Sørkappland, while deposition in the same period in Hornsund was apparently discontinuous. It is not yet certain whether these breaks result simply from non-deposition or whether erosion of previously deposited sediments also occurred here.

The two Permian formations on Bjørnøya are much thinner than their counterparts in Spitsbergen. This probably reflects breaks in deposition rather than low sedimentation rates. There was a second, as yet undefined, period of renewed uplift and erosion between the deposition of the two formations; the magnitude of the break in sedimentation above the Miseryfjellet Formation is also uncertain. The Artinskian of Spitsbergen is characterised by the evaporites of the Gipshuken Formation; such deposits are not seen on Bjørnøya, although probable evaporitic diapirs of this age occur further south in the Barents Sea in the Tromsø basin (RØNNEVIK et al. 1975).

This Upper Palaeozoic sequence was deposited entirely in continental and coastal environments. Both thickness and facies changes, and current patterns through much of the succession indicate a general northerly palaeoslope, suggesting that Bjørnøya lay on the southern margins of a depositional basin which is probably preserved in the Barents Shelf between Bjørnøya and Spitsbergen.

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