Yoredale Group, Carboniferous of the Tweed and Northumberland-Solway basins

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Introduction

Illustrative logs and interpretations for some high-frequency clastic sequences within the Yoredale and Scottish Coal Measures groups in the south of Scotland (after Tucker et al., 2003). P912353.
The Yoredale Group does not crop out in the Scottish sector of the Tweed Basin sensu stricto, but does appear on the North Sea coast to the north of Berwick, separated from the Tweed Basin succession by the Eyemouth outcrop of Silurian strata. The following account therefore refers mostly to the northern margin of the Northumberland–Solway Basin.

**Tyne Limestone Formation**

The lowest division of the Yoredale Group is the Tyne Limestone Formation, a sequence of highly variable, marine to deltaic, ‘Yoredale’-type upward-coarsening cycles in which a thin but extensive bed of marine limestone is overlain by mudstone and sandstone commonly topped by a seatearth and a thin coal seam (P912353); there is much lithostratigraphical variation both vertically and laterally. The formation is largely Asbian in age and locally exceeds 2000 m in thickness. It has a wide outcrop across Northumberland and northern Cumbria and extends across the border into Scotland from south-west Liddesdale to Ecclefechan and the north Solway coast.

The base of the Tyne Limestone Formation is locally marked, between Langholm and Canonbie, by the volcanic rocks of the Glencartholm Volcanic Member, about 150 m of tuffs and basaltic lavas. Sedimentary rocks associated with the tuffs contain a marine fauna of brachiopods and bivalves, but are notable for rich arthropod and fish faunas, the former including crustaceans, eurypterids and scorpions. The fossils indicate a level near the base of the Asbian Stage. Above the Glencartholm Volcanic Member, the Tyne Limestone Formation comprises ‘Yoredale’ cyclical sequences consisting predominantly of marine mudstone and limestone with subordinate sandstone and a few seatearths and thin coal seams. Many of the beds are fossiliferous with a fauna noted for extensive coral colonies and layers of large brachiopods. More arenaceous strata follow, succeeded in turn by 30 m of marine mudstone, the Dinwoodie Beds, which are notable for their rich and varied fauna of corals, brachiopods and bryozoans, perhaps the most diverse fauna of the entire Carboniferous sequence.

In the lower part of the Tyne Limestone Formation there is a lateral eastward transition into a sequence of lacustrine–deltaic cycles of limestone, mudstone, sandstone and thick coal seams (up to 2 m) traditionally known in Northumberland and Berwickshire as the ‘Scremerston Coal Group’. In Berwickshire, this division is about 300 m thick (though much thicker in Northumberland) and is succeeded by a return of the marine–deltaic lithofacies. In this, typically, the sedimentary cycles comprise a limestone overlain by mudstone, which commonly shows evidence for storm-driven reworking of the sediment, followed by shallow-marine sandstone. Some of the cycles are topped by a terrestrial development of calcrete, seatearth and coal, perhaps indicating a semi-arid but
seasonally wet environment.

The Tyne Limestone Formation strata that crop out along the north Solway coast in the Kirkbean Outlier are assigned to the Arbigland Limestone Member. Strata include thickly bedded, bioturbated, calcareous sandstones with coalified plant casts, thin sandy limestones, locally with ooliths and algal debris, dark grey carbonaceous mudstones and thin coal partings. The limestones and mudstones have an abundant and diverse fauna that includes brachiopods, bivalves, gastropods, crinoids, bryozoa, orthocones and corals, the latter including colonies of *Lithostrotion*. An Asbian age is likely and the sedimentary features are consistent with deposition in a restricted, lagoonal environment in which there was only limited reworking of sediment. A more active depositional regime is shown by the stratigraphically highest part of the member, where thickly bedded, bioturbated, ripple cross-laminated sandstone is interbedded with calcareous mudstone and some argillaceous limestone. These strata have been much affected by slump folding and are steeply inclined and locally overturned. Shallow, sandstone filled scours and washouts are common.

**Alston Formation**

The Alston Formation is the lowest division of the Yoredale Group present on the south side of the Northumberland–Solway Basin, where it succeeds the platform limestone of the Great Scar Limestone Group. The base is less well defined on the north side of the basin, where Brigantian ‘Yoredale’ cycles conformably succeed those of Asbian age that are assigned to the Tyne Limestone Formation. The top of the Alston Formation is defined by the Great Limestone Member and its correlatives, which are of Pendleian (earliest Namurian) age. The Alston Formation has a relatively restricted outcrop on the northern side of the Northumberland and Solway basins, but is present between Langholm and Canonbie and near Ecclefechan; from these localities it dips beneath the Canonbie Coalfield (Westphalian — see below) where its concealed strata have been proved in boreholes.

Between Langholm and Canonbie the limestone–mudstone–sandstone, ‘Yoredale’ cyclicity is well developed. Nine or ten cycles are developed over an interval of about 120 m, with the highest of the fossiliferous limestones, the Catsbit Limestone, being a correlative of the Pendleian Great Limestone Member; it therefore marks the top of the Alston Formation. A lower limestone, the Penton Limestone, is exposed in the hinge zone of the anticline illustrated in [P221694](#). All of the limestones contain a relatively rich fauna with corals and brachiopods (Plate 34), and the overlying mudstones yield many brachiopods and molluscs. Assemblages of foraminifera occur in places.

**Stainmore Formation**

Across parts of northern England the Stainmore Formation comprises a largely deltaic, cyclical succession of sandstone, mudstone and poor-quality coal: a few limestone beds occur, mostly in the lower part of the formation. Some of the sandstones occur as large, channel-fill deposits, fining upwards and with erosional bases cross-cutting the underlying strata. Although the general term ‘Millstone Grit’ has been used for this Namurian succession, it has long been recognised that the lithological assemblage in the Northumberland–Solway Basin is distinct from the thick development of coarse ‘gritstone’ and marine mudstone of the Millstone Grit Group’s type area in the south Pennines. Rather, across northern England and into the Canonbie area of southern Scotland, ‘Yoredale’ cyclicity dominates, albeit limestone beds are relatively scarce. This northern Namurian sequence is now defined as the Stainmore Formation. Its base overlies the Pendleian Great Limestone Member (and correlatives); the top of the formation is defined at the base of the Subcrenatum Marine Band, which marks the base of the Westphalian Pennine Coal Measures Group.
Strata of the Stainmore Formation in the Canonbie area are about 400 m thick but, in a further lateral variation in lithofacies, limestone and calcareous mudstone generally take the place of the dark goniatite-bearing mudstone that forms the basis for the traditional biostratigraphical zonation farther south. At Canonbie, goniatites are rare and the macrofossils, though abundant at many horizons, are not particularly diagnostic of stratigraphical position. Rather, the fauna is an impoverished continuation of that seen in the Alston Formation. Towards the top of the formation at Canonbie, the ‘Yoredale’ cycles pass up into a sequence of sandstones, seatearths and thin coals, collectively called the Penton Coals, which have been worked locally. This division also contains several interbedded units of mudstone with *Lingula*, whilst a few thin beds of limestone and calcareous mudstone have marine faunas.

**Bibliography**


Leeder, M R. 1975. Lower Border Group (Tournaisian) stromatolites from the Northumberland


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