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## Little Asby Scar, Cumbria

[NY 692 085]–[NY 704 091]

### Introduction

Situated 5 km NNW of Ravenstonedale, the Little Asby Scar GCR site provides an excellent section of the top of the Ashfell Limestone (Holkerian), the Potts Beck Limestone (early Asbian) and the Knipe Scar Limestone (late Asbian). As the stratotype for the Asbian Stage and type locality for the Potts Beck Limestone, it is one of the most important reference sections in the British Lower Carboniferous Subsystem. The stratotype section is located at a south-facing crag overlooking the Potts Beck valley at the southern edge of the site [NY 6988 0827]. This crag is split into two, forming an eastern and western scarp (see the caption to (Figure 5.12)). The locality extends for approximately 1 km to the north of the stratotype area and also includes a unique coral-demosponge bioherm. Apart from the regional descriptions of the succession outlined by Garwood (1913), Taylor *et al.* (1971), Ramsbottom (1974) and Mitchell (1978), and the detailed accounts of the stratotype provided by George *et al.* (1976), Ramsbottom (1981), Strank (1981) and White (1992), there is little published material available on this site. A summary log of the succession based on information provided by Ramsbottom (1981) is presented in (Figure 5.12).

### Description

The exposed sequence dips gently to the north and includes the topmost beds of the Ashfell Limestone (c. 4 m) overlain successively by the Potts Beck Limestone (c. 70 m) and the Knipe Scar Limestone (c. 85 m). At the base of the succession the lowest beds of the Ashfell Limestone comprise dark-grey and sometimes sandy packstones–wackestones with a few shale intervals, these giving way to paler-coloured crinoidal grainstones higher up in the succession (Figure 5.12). The fauna includes a rich Holkerian foraminiferal assemblage together with a less diagnostic assemblage of conodonts, corals (particularly in the topmost bed), brachiopods and bryozoans (Ramsbottom, 1981; Swank, 1981). The boundary between the Ashfell Limestone and the Potts Beck Limestone, which also defines the base of the Asbian Stage, is marked by a thin (0.5 cm) siltstone band (bed 'e' of George *et al.*, 1976, and Ramsbottom, 1981; see (Figure 5.12)).

General descriptions of early Asbian successions (Potts Beck Limestone) in the Stainmore Basin refer to the occurrence of minor cycles of dark- to pale-coloured limestones with bioturbation fabrics and the typical early Asbian brachiopods *Daviesiella llangollensis* and *Dibunophyllum bourtonense* (Ramsbottom, 1974; Mitchell, 1978). Whereas most of these features can be recognized at the present site, no mention of the occurrence of *D. llangollensis* was made by Ramsbottom (1981) in his detailed description of the section, and his record of *D. cf. bourtonense* in the lowest of these beds has yet to be repeated (Riley, 1993).

The lower part of the Potts Beck Limestone consists of vari-coloured grainstones and packstones (Ramsbottom, 1981). Here, the succession can be subdivided into three units (Figure 5.12). The lowest unit is a spectacular, but as yet under-studied biostrome (c. 2 m thick) dominated by the in-situ and silicified remains of corals (*Siphonodendron martin* and *Syringopora geniculata*) and large bulbous calcareous chaetetid demosponges up to 40 cm in diameter (Figure 5.13). Above this, a middle unit of cross-bedded, crinoidal grainstone (12 m), with a distinctive bioturbated horizon ('pseudobreccia') near its base, is capped by a packstone unit (c. 9 m) containing dolomite, shaly bands and scattered nodules of chert. Ramsbottom (1981) records a rich coral–brachiopod fauna from the lower part of the limestone including the 'typical Asbian taxa — *Dibunophyllum*, *Axophyllum vaughani* and *Gigantoproductus maximus*'. However, the discovery of Holkerian foraminiferal assemblages extending through the lowest 19.6 m of the Potts Beck Limestone at this locality (Strank in Ramsbottom, 1981) casts doubt over the assignment of this part of the succession to the early Asbian Age (Riley, 1993). This matter is discussed further in the 'Interpretation' below. Other fossil groups reported from these beds include bryozoans, gastropods, bivalves, conodonts and a possible annelid (Ramsbottom, 1981).

Although there are no site-specific descriptions of the remaining and higher parts of the succession, Mitchell (1978) identified a 'shale and ferruginous sandstone' at the top of the Potts Beck Limestone 'in the area of Little Asby Scar', and the overlying Knipe Scar Limestone (late Asbian) is known to contain a number of limestone-dominated cyclothem in which pseudobreccias are common — particularly in the lower and upper parts of the formation (Garwood, 1913; Ramsbottom, 1974; Mitchell, 1978). A further terrigenous siliciclastic interval, above the Knipe Scar Limestone but beneath the Robinson Limestone (Mitchell, 1978), may also crop out within the bounds of the site. These siliciclastic intervals are believed to represent the forerunners of the Yoredale facies better developed within Brigantian successions seen elsewhere in the region (Mitchell, 1978).

## Interpretation

The junction between the Ashfell Limestone and the overlying Potts Beck Limestone was originally used to mark the position in the Ravenstonedale succession of Ramsbottom's (1973) 'Major Cycle 4–5' boundary. Significantly, this same boundary was used by George *et al.* (1976) to define the base of the Asbian Stage, which broadly equates to the Lower *Dibunophyllum* Subzone (D<sub>1</sub>) of Garwood (1913). Subsequently, the recognition of two major (mesothemic) cycles in the Asbian Stage (Ramsbottom, 1977a) enabled Mitchell (1978) to assign the Potts Beck Limestone to the lower part of the Asbian Stage (mesothem D5a) and the Knipe Scar Limestone and Robinson Limestone to the upper part of the Asbian Stage (mesothem D5b). However, Riley (1993) has indicated that since the first repeatable record of the Asbian coral *Dibunophyllum* occurred in association with the first Asbian foraminifera reported by Strank (in Ramsbottom, 1981) 19.6 m above the base of the Potts Beck Limestone, there was a case for the re-definition of the Asbian boundary at this higher level to coincide with the base of the Cf6a foraminiferal subzone (see (Figure 1.4), Chapter 1), but 'no need to relocate the stratotype'. The recent discovery by M. Aretz and J.R. Nudds (unpublished) of *Axophyllum nanum*, *Clisiophyllum garwoodi*, *C. keyserlingi* and *Siphonophyllia siblyi* without associated *Dibunophyllum* in the biostrome at the base of the Potts Beck Limestone would appear to support this view (Q. Nudds, pers. comm., 2001).

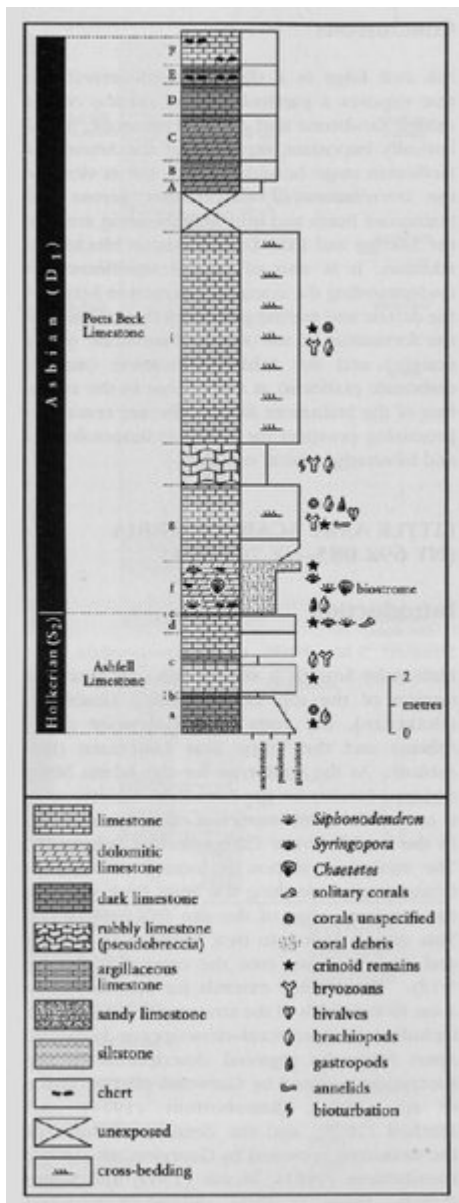
Despite the lack of published research, the general character of the exposed beds, with their diverse faunas, coral-sponge biostrome and varied lithofacies (argillaceous wackestones and packstones, bioclastic grainstones and burrowed horizons) indicates that the succession probably formed as a shallow, subtidal and open marine carbonate platform deposit during late Holkerian and Asbian times.

Away from the Stainmore Basin, the Potts Beck Limestone thins dramatically and much if not all of the early Asbian sequence appears to be missing from the successions across neighbouring block areas (Turner in Parkinson, 1950a; Ramsbottom, 1973, 1974; Mitchell, 1978; Akhurst *et al.*, 1997). However, the discovery of foraminiferal assemblages in the Lower Urswick Limestone and Sixth Limestone of Cumbria which are broadly comparable to those of the early Asbian Potts Beck Limestone at the present site (Strank, 1981; Athersuch and Strank, 1989) indicate that a major non-sequence between the Holkerian and Asbian stages over the whole of the Lake District Block is unlikely.

## Conclusions

Little Asby Scar is the regional stratotype for the Asbian Stage and the standard section for the correlation of Asbian sequences throughout the British Isles. The exposed succession, which includes one of the thickest and most complete sections of the Asbian Stage in the north-west of England and the finest chaetetid biostrome in the Stainmore Basin, was probably deposited in open marine conditions on a gently subsiding carbonate platform. The section presents a varied lithofacies and biofacies mix, making it a prime site for future research, particularly in areas of biostratigraphy, sedimentology and palaeoecology.

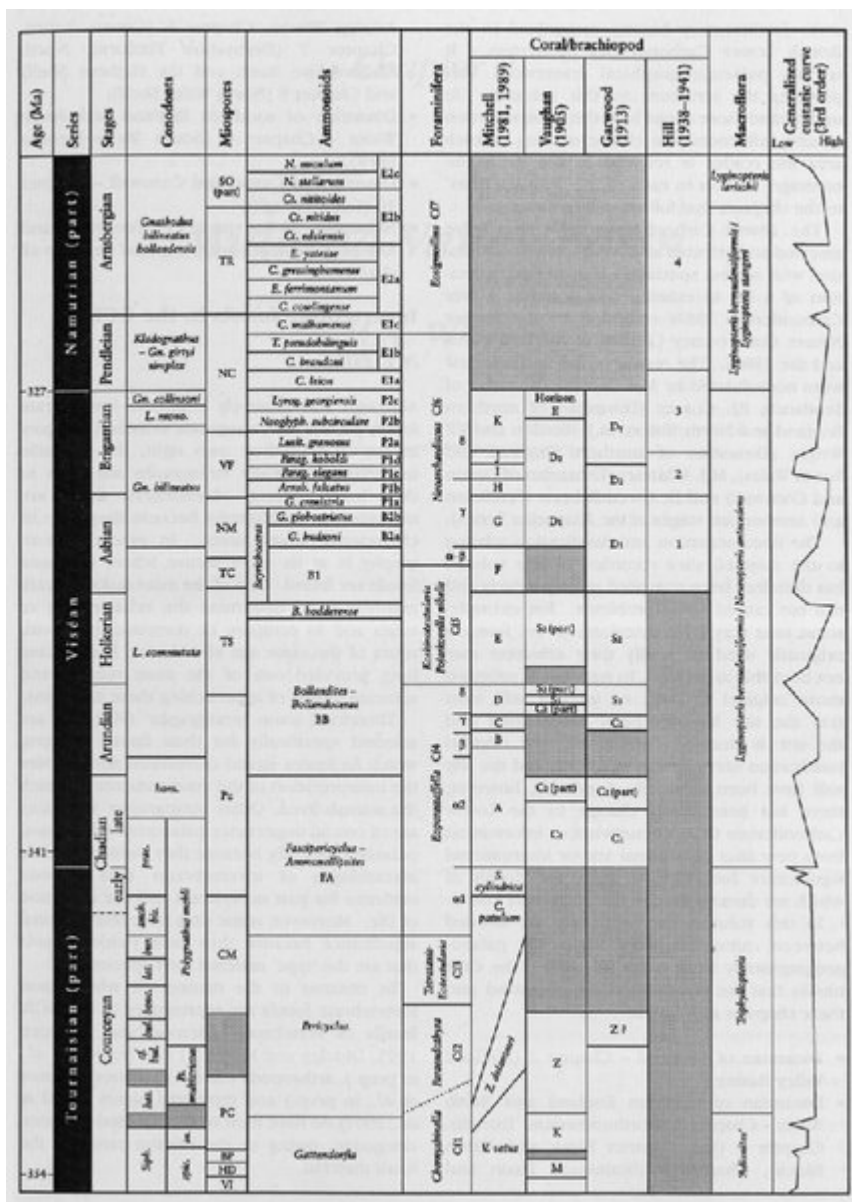
## [References](#)



(Figure 5.12) Sedimentary log across the Ashfell Limestone–Potts Beck Limestone boundary at the Asbian stratotype section, Little Asby Scar. Compilation after information in Ramsbottom (1981). Upper case bed letters are for the eastern scarp; lower case bed letters are for the western scarp.



(Figure 5.13) Biostrome containing *Siphonodendron martini*, *Syringopora geniculata* and *Chaetetes* at the base of the Potts Beck Limestone (early Asbian), Little Asby Scar. (Photo: P.J. Cossey.)



(Figure 1.4) Chronostratigraphical and biostratigraphical classification schemes for the Lower Carboniferous Subsystem. After Riley (1993, fig. 1) with additional information for the Pendleian and Arnsbergian stages supplied by the same author. Absolute age data from Guion et al. (2000) based mainly on information by Lippolt et al. (1984), Hess and Lippolt (1986), Leeder and McMahon (1988) and Claoue-Long et al. (1995). Ammonoid abbreviations used in this figure: N. — Nuculoceras; Ct. — Cravenoceratoides; E. — Eumorphoceras; C. — Cravenoceras; T. — Tumulites; Lyrog. — Lyrogoniatites; Neoglyph. — Neoglyphioceras; Lusit. — Lusitanoceras; Parag. — Paraglyphioceras; Arnsb. — Arnsbergites; G. — Goniatites; B. — Bollandoceras. Conodont abbreviations used: Gn. — Gnathodus; Gn. collinsoni — Gnathodus girtyi collinsoni; L. mono. — Lochriea mononodosa; L. — Lochriea; horn. — Gnathodus homopunctatus; prae. — Mestognathus praebeckmanni; and. — Scaliognathus anchoralis; bis. — Polygnathus bischoffi; bur. — Eotaphrus burlingtonensis; lat. — Doliognathus latus; bout. — Dollymae. bouckaerti; bul. — Eotaphrus bultyncki; has. — Dollymae bassi; siph. — Siphonodella; Ps. — Pseudopolygnathus; in. — Polygnathus inornatus; spit. — Polygnathus spicatus. Stipple ornament shows interzones (conodonts and miospores) or non-sequences (brachiopods).