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## Barker Scar, Cumbria

[SD 332 785]–[SD 338 775]

### Introduction

Located 3 km to the WSW of Holker on the eastern side of the Leven Estuary, this coastal site reveals a near-continuous section from the top of the Dalton Beds (Arundian), through the Park Limestone (Holkerian) and into the base of the Urswick Limestone (Asbian). The sequence is exposed in a line of cliffs that flank an area of salt marsh on the western side of Old Park Wood. Discontinuous outcrops extend from the northern end of Barker Scar [SD 332 785] southwards to Capes Head [SD 333 778] then south-east to Raven's Barrow Point [SD 338 775]. The locality was originally proposed as the stratotype for the base of the Holkerian Stage (George *et al.*, 1976) and as such it is one of the most important British Lower Carboniferous stratigraphical sites. Although, more recently, Riley (1993) questioned its suitability as a stratotype and Johnson *et al.* (2001) re-defined the position of the Dalton Beds–Park Limestone boundary, claims of a non-sequence in the section have yet to be substantiated and an alternative stratotype section has yet to be proposed.

The site is mentioned briefly by both Garwood (1913) and Mitchell (1978), but the account that follows is based mainly on the detailed measured sections and palaeontological records provided by Rose and Dunham (1977) and Ramsbottom (1981). Additional sedimentological information is provided by Abdel Aziz (1989).

### Description

At the northern end of the site and at the base of the exposed succession, Rose and Dunham (1977) identified a 30 m sequence of the Dalton Beds dipping gently to the south-east. The lower part of this sequence comprises well-bedded, medium-dark grey, argillaceous, dolomitic and occasionally carbonaceous limestones with intercalated shales. Increasing concentrations of sand and decreasing levels of mud characterize the upper beds where the limestones become more massive. The dominant lithofacies of the Dalton Beds here is of dolomitized peloidal and bioclastic packstone (Abdel Aziz, 1989). Rose and Dunham (1977) and Ramsbottom (1981) recorded an Arundian faunal assemblage from these beds. This included a diverse array of brachiopods, corals, foraminifera and conodonts, several of which are regarded as diagnostic for the stage (e.g. *Linoprotonia cf. hemisphaerica*, *Composita ambigua*, *C. ficoidea*, *Megachonetes cf. papilionaceus*, *Clisiophyllum multiseptatum*, *Haplolasma subibicina*, *Amplexizaphrentis ashfellense*, 'Zaphrentis' cf. *kentensis*, *Palaeosmia murchisoni*, *Siphonodendron martini*, *Globodiscus aff. oblongus*, *Eoparastaffella aff. iniqua*, *Mestognathus beckmanni*, *Apatognathus*, *Ligonodina levis*, *Spathognathodus cristulus*, *Neoprioniodus* and *Hindeodella*). The *Clisiophyllum multiseptatum* Band identified by Garwood (1913) as a marker for the top of the *Michelinia grandis* Zone occurs 3.5 m above the base of the section. A sandy mudstone (0–0.15 cm) recessed by weathering occurs 2.25 m from the top of the formation and helps to define the position of the Arundian–Holkerian stage boundary. The stratotype point is located towards the top of the Barker Scar section at [SD 3330 7827] (Figure 4.10), between beds and 'k' of George *et al.* (1976), Rose and Dunham (1977) and Ramsbottom (1981).

In the Cartmel and Holker districts, the Park Limestone sequence (c. 120–130 m) is dominated by pale-coloured and massive limestones that contain less clay than the underlying Dalton Beds (Rose and Dunham, 1977). The lower 45 m of Park Limestone at Barker Scar are described by Ramsbottom (1981) as medium- to pale-grey calcarenites with a few coral–brachiopod bands. Abdel Aziz (1989) identified these beds as peloidal and bioclastic grainstones, and from them Rose and Dunham (1977) and Ramsbottom (1981) recorded a typical Holkerian fauna. This included both the stage-diagnostic brachiopod *Linoprotonia corrugatohemispherica* and the coral *Axophyllum vaughani* from the base of the sequence and, towards the top of the succession, a number of other corals that made their first entry in the Holkerian Stage, namely *Diphyphyllum smithi*, *Caninophyllum bristoliense*, *Lithostrotion araneum* and *Clisiophyllum rigidum* (Mitchell, 1989; Riley, 1993). Other significant taxa recorded from these beds include the foraminifera *Pojarkovella nibelis*, *Holkeria avonensis* and several archaetid species (Ramsbottom, 1981; Strank, 1982b).

The middle and upper parts of the Park Limestone are discontinuously exposed between Capes Head and Raven's Barrow Point, but few details of this part of the section have been published. Rose and Dunham (1977) recorded some 5 m of Urswick Limestone with an Asbian coral–brachiopod fauna resting on top of the Park Limestone at Raven's Barrow Point.

## Interpretation

George *et al.* (1976) defined the base of the Holkerian Stage at the junction between the Dalton Beds (Arundian) and the overlying Park Limestone (Holkerian). This was positioned at the distinctive lithological break below the bed at the base of the Park Limestone in which Holkerian faunas first enter the sequence. The boundary corresponds to the line of division between Major Cycles 3 and 4 of Ramsbottom (1973) and the junction between the Gastropod Beds (= upper Dalton Beds) and *Cyrtina carbonaria* Subzone of Garwood (1913). The bulk of the section (including the Arundian–Holkerian stage boundary) therefore falls in Garwood's *Productus corrugato-hemisphericus* Zone (see (Figure 4.2)). The Holkerian Stage thus broadly equates with the S<sub>2</sub> Zone of Vaughan (1905). However, more recent work by Riley (1993) has indicated that a significant non-sequence might be present in the Barker Scar section and that the stratotype may need relocating. Suspicions of a non-sequence here are based on the apparent absence both of Garwood's (1913) *Davidsonia carbonaria* Beds (Ramsbottom, 1981; Burgess in Riley, 1993) and of a late Arundian transition fauna comprising foraminifera and *Siphonodendron* colonies with a cerioid tendency, which are both widely recognized in areas where thicker and more complete Arundian and Holkerian sequences are known. An alternative view considers that the absence of the *Davidsonia carbonaria* Beds might be more apparent than real and that their presence may be masked by the extensive effects of dolomitization that Abdel-Aziz (1989) reported in the section. To date, unequivocal evidence of a non-sequence in the Barker Scar section has yet to be presented and further work is clearly required in order to establish the facts (Riley, 1993). Thus, until such evidence is reported, it seems likely that the Holkerian stratotype will remain at the present site. Note that in a recent re-evaluation of the section Johnson *et al.* (2001) used lithological criteria to define the position of the Dalton Beds–Park Limestone boundary a few metres below the position of the Arundian–Holkerian stage boundary (at the base of bed 'j' of George *et al.*, 1976; Rose and Dunham, 1977; Ramsbottom, 1981), but made no mention of relocating the stratotype to a different site.

Adams *et al.* (1990) suggested that the Dalton Beds were deposited well below wave-base as a mid- to outer-ramp facies on a rapidly subsiding, southward-dipping carbonate ramp, and that the Park Limestone was formed as inner-ramp facies in shallow waters of around 10–30 m close to wave-base. Increased levels of carbonate and reduced levels of clay and bituminous material at the top of the Dalton Beds and in the overlying Park Limestone were attributed to progressive shallowing caused either by a slowdown in the subsidence rate, or by an increased rate of carbonate production that resulted in the shallow-water facies of the Park Limestone prograding over the deeper-water facies of the Dalton Beds (Adams *et al.*, 1990). The suggestion that increased levels of dolomite at the top of the Dalton Beds might also be a sign of shallowing (Ramsbottom, 1973) was rejected by Adams *et al.* (1990) who considered the dolomite as a product of burial diagenesis.

## Conclusions

This site provides the finest and most complete section of the upper part of the Dalton Beds and Park Limestone in south Cumbria. The limestone-dominated succession was largely formed between fair-weather and storm wave-base on a gently dipping sea floor during mid-Dinantian times. As the accepted regional stratotype for the Holkerian Stage, Barker Scar is recognized as the standard section for the correlation of Holkerian sequences throughout northern England. Despite concerns regarding its suitability as a stratotype section, the site remains critical to the understanding of Lower Carboniferous stratigraphy in Britain.

## [References](#)

