# Stenders Quarry, Gloucestershire

[SO 659 182]

## Introduction

The Stenders Quarry GCR site is situated 0.5 km south-west of Mitcheldean in Gloucestershire. This disused quarry [SO 659 182] provides arguably the finest section of the early Courceyan Lower Limestone Shale Group in the Forest of Dean area. Sandwiched between the top of the Old Red Sandstone (Tintern Sandstone) and the base of the Lower Dolomite (George *et al.,* 1976), the sequence includes a significant part of both the Castell Coch Formation (the Castell Coch Limestone, Astridge Wood Member and Mitcheldean Member) and the Cwmyniscoy Formation (Burchette, 1987) a unit which equates with the Cwmyniscoy Mudstone Formation of the Clydach and Cardiff districts (Waters and Lawrence, 1987; Barclay, 1989) (Figure 9.2). The succession was formed in a variety of nearshore and offshore settings as sea water flooded across the exposed southern margin of the Wales-Brabant Massif during early Carboniferous times. An early site description by Sibly and Reynolds (1937) includes a detailed log of the section and a significant amount of palaeontological data. Much of this work was later reproduced in summary form by Welch and Trotter (1961). Details relating to the sedimentology are given by Burchette (1977, 1987).

The site is also referred to as the 'Cement Works Quarry' (Sibly and Reynolds, 1937), the 'Cementstone Quarry' (Burchette, 1977) and 'Wilderness Quarry' (Welch and Trotter, 1961). It is not, however, the locality referred to by Wethered (1888) as 'Wilderness Cement Works'.

## Description

The Lower Limestone Shales at this site comprise an attenuated and fossiliferous succession (*c.* 56 m thick) of mudstones, thin-bedded micritic limestones and a few developments of thicker-bedded calcarenites. The sequence, which dips steeply (*c.* 500–60°) to the south-west, lies on the eastern limb of the southward-plunging Wigpool Syncline (Figure 9.35). At its base and immediately overlying the upper part of the Tintern Sandstone, a lower unit (*c.* 9 m) representing part of the Castell Coch Limestone (Burchette, 1987) begins with locally conglomeratic sandstones and quartzose grainstones which grade upward into thick-bedded, cross-stratified oolitic and crinoidal calcarenites. While brachiopods (especially *Macropotamorhynchus* '*Camarotoechia*' *mitcheldeanensis*)*,* ostracodes and bryozoans are common in this unit, 'spirorbids' are also known at some levels (Sibly and Reynolds, 1937). Poor exposure and the gradational change from the Tintern Sandstone to the Castell Coch Limestone make it difficult to define the position of the Old Red Sandstone–Lower Limestone Shale Group boundary.

The overlying Astridge Wood Member (*c.* 11 m) is characterized by thinly bedded and occasionally sandy, bioclastic (crinoidal) limestones and thin mudstone horizons. From some particularly fossiliferous limestones near the top of this unit, Sibly and Reynolds (1937) recorded an abundant fauna of ostracodes, bryozoans, brachiopods (atrypids, rhynchonellids and small productoids) and crinoids together with modiolid bivalves, the 'calcareous algae *Solenopora* and '*Mitcheldeania*'*, Parachaetetes,* sparse echinoids (*Palaechinus*)*,* a fish tooth (*Psephodus*) and evidence of bioturbation. A loose specimen of the early Courceyan index coral *Vaughania vetus* may also have come from this level (see Sibly and Reynolds, 1937).

Above this, the Mitcheldean Member (*c.* 13 m) comprises a shale-dominated interval containing a number of thin limestone beds sandwiched between two prominent skeletal calcarenite bands. Both Sibly and Reynolds (1937) and Burchette (1977) gave a detailed description of this part of the sequence. Close to its base are micritic limestones with fenestrae. Immediately overlying this, a distinctive nodular oncoid horizon contains the 'calcareous algae — *Mitcheldeania, Solenopora* and *Spongiostrorna*' (Sibly and Reynolds, 1937) in close association with the vermiform gastropod '*Serpula*' *advena* (a form now re-assigned as a microconchid; see Weedon, 1990), ostracodes and fragmented bivalve shells. A similar association between possible microconchids and a microbial laminite occurs higher in the sequence. The significance of such 'biostromar associations recorded at other Lower Limestone Shale localities in southern Britain and from Border Group successions in the north of England is discussed by Burchette and Riding (1977).

The prominent and brachiopod-rich calcarenite band (3 m) at the top of the Mitcheldean Member is the lateral equivalent of the topmost part of the Stowe Oolite Member. This is directly superseded by a poorly exposed shale-dominated interval (*c.* 20 m) representing the upper part of the Cwmyniscoy Formation. At its base is the prominent 'Bryozoa Bed' (Sibly and Reynolds, 1937), a ferruginous and partly dolomitized crinoidal limestone that contains brachiopods and bryozoans in abundance. The remaining part of the formation includes a few thin, sharp-based and fossiliferous limestones which also contain a bryozoan–brachiopod fauna. The higher of these limestone intervals is dolomitized. The top of the Cwmyniscoy Formation is overlain by the massive dolomi-tized calcarenites of the Lower Dolomite, but only the base of this unit is seen in the quarry.

## Interpretation

Burchette (1987) interpreted the Lower Limestone Shale Group as a transgressive unit that developed as a depositional response to the major (and possibly eustatic) sea-level rise that took place at the beginning of the Carboniferous Period. Within it he recognized several depositional cycles formed during periods of shoreline advance (regressive phase) and retreat (transgressive phase). Considered in this context, the lower beds of the Castell Coch Limestone are interpreted as part of a littoral sand-sheet formed by a northward-advancing shoreline, and the higher oolitic beds part of a southward-prograding subtidal carbonate sand-body behind which sediments of the Astridge Wood Member accumulated in a shallow marine embayment or open lagoon (Burchette *et al.,* 1990). The characteristic features of the Mitcheldean Member are regarded as more typical of deposition in a restricted and hypersaline lagoon. Burchette (1987) suggested this unit developed in the lee of another southward-prograding sand-body (the Stowe Oolite) that formed a NE–SW-trending barrier complex and as part of a later depositional cycle (Figure 9.4)a. The prominent calcarenite at the top of the Mitcheldean Member probably represents a washover fan deposited as the Stowe Oolite barrier was drowned during a further transgressive episode that later resulted in the deposition of the Cwmyniscoy Formation in a deeper water offshore setting.

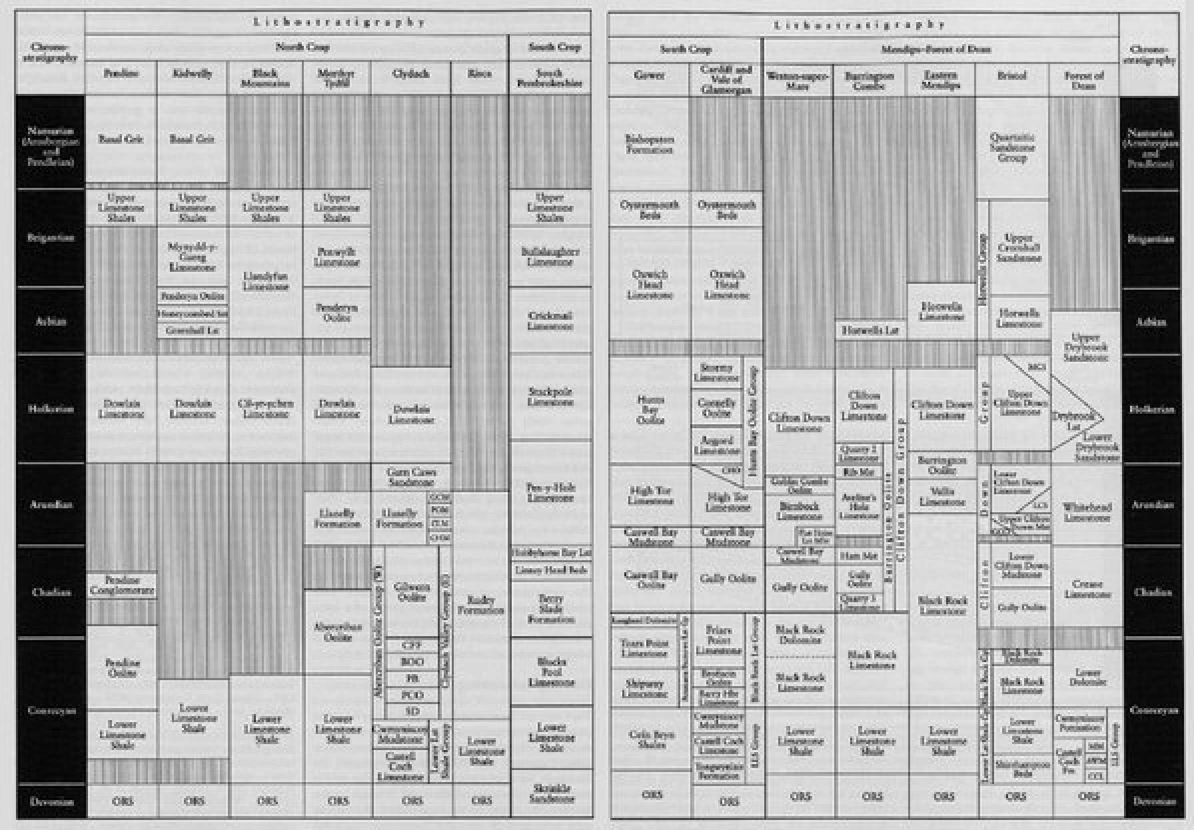
The occurrence of *M.* '*C*' *mitcheldeanensis, Cleiothyridina roissyi, Pugilis* '*Dictyoclostus*' *vaughani* and *Syringothyris cyrtorhyncha* and a possible record of *V. vetus* (Sibly and Reynolds, 1937) confirm an early Courceyan age for the Lower Limestone Shale sequence at this site (see Riley, 1993).

Outcrops of the Lower Limestone Shale Group also occur at Tongwynlais Road Section and Maesbury Railway Cutting (see GCR site reports, this chapter). While the Mitcheldean (Stenders Quarry) section is clearly younger than that at Tongwynlais in the Taff Gorge (see Burchette, 1987), its relationship to the section at Maesbury, in the Mendips, remains unclear, though a broadly comparable age is suspected. Together these complementary sections provide detailed evidence of the palaeogeographical changes that resulted from the major marine transgression that swept northwards across parts of southern England and South Wales at the beginning of the Carboniferous Period.

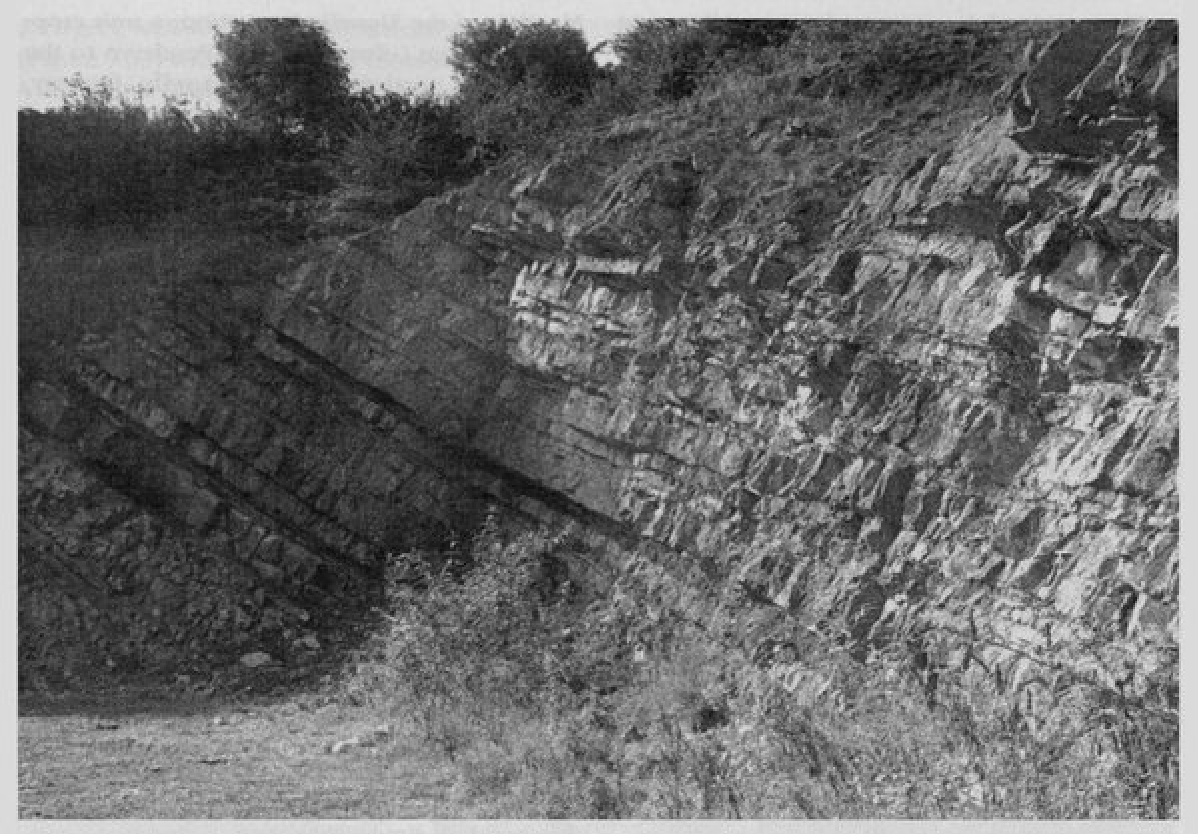
## Conclusions

The Lower Limestone Shale Group at Stenders Quarry offers an outstanding section of nearshore peritidal and lagoonal deposits in complex association with barrier-shoreline and offshore deposits. The succession represents part of a transgressive 'start-up' phase of carbonate ramp sedimentation (Kendall and Schlager, 1981) and provides critical evidence for the understanding of the palaeogeographical evolution of southern England during early Carboniferous (Courceyan) times.

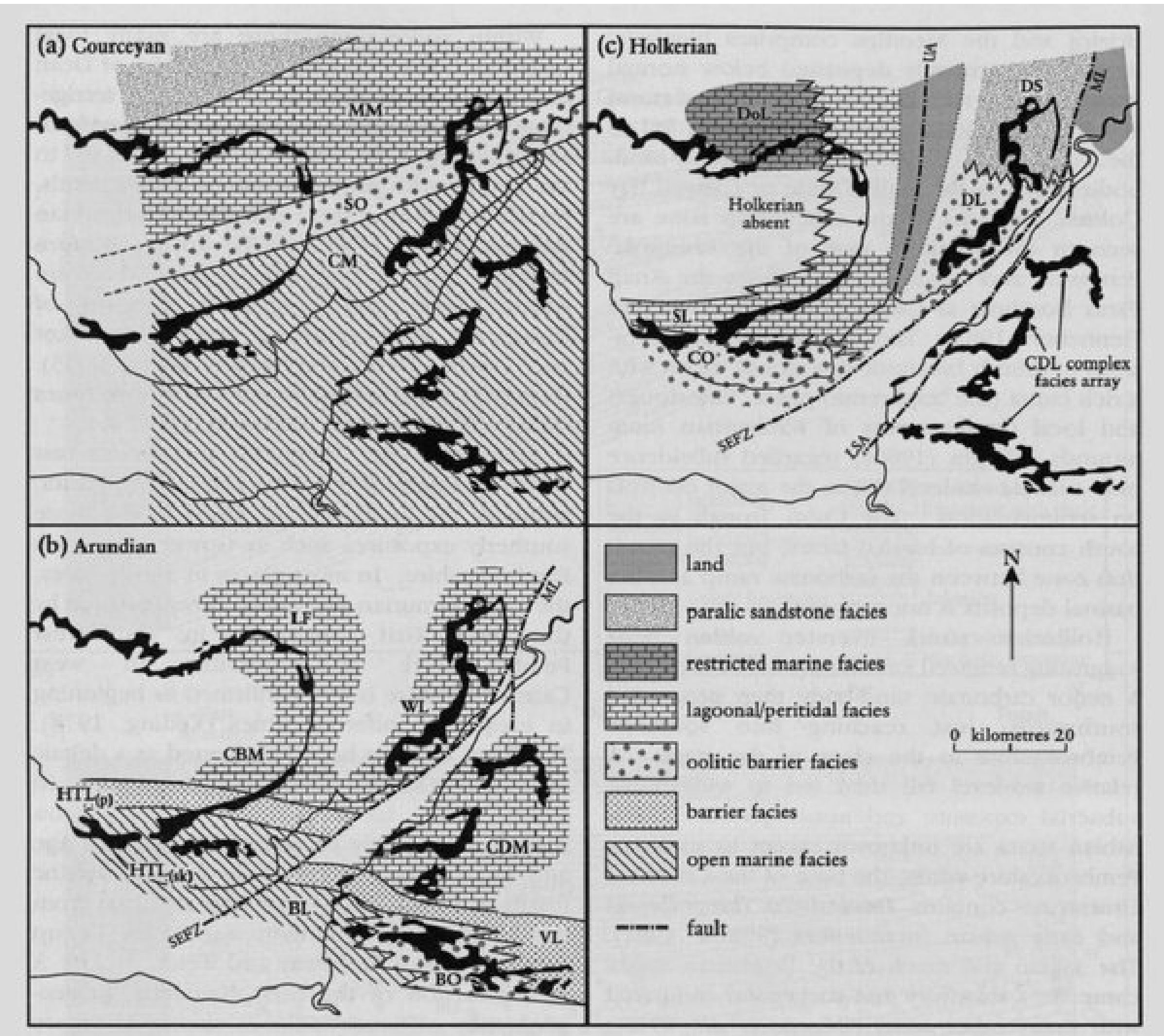
**References**




*(Figure 9.2) Simplified stratigraphical chart illustrating the most widely used lithostratigraphical terms for the Lower Carboniferous sequences in South Wales, the Forest of Dean, Bristol and the Mendips. (SD — Sychnant Dolomite; PCO — Pwil y Cwm Oolite; PB — Pantydarren Beds; BOO — Blaen Onnen Oolite; CFF — Coed Ffyddlwn Formation; CHM — Clydach Halt Member; CLM —Cheltenham Limestone Member; POM — Penllwyn Oolite Member; GCM — Gilwern Clay Member; LIS —Lower Limestone Shale; CHO — Cefnyrhendy Oolite; CCL — Castell Coch Limestone; AWM — Astridge Wood Member; MM — Mitcheldean Member; GCO — Goblin Combe Oolite; LCS — Lower Cromhall Sandstone; MCS — Middle Cromhall Sandstone.) Areas of vertical ruling indicate non-sequences. Not to scale. Based on information from and after Welch and Trotter (1961), Green and Welch (1965), Institute of Geological Sciences (1973, 1977c), George et al. (1976), Wright (1982b), Whittaker and Green (1983), Burchette (1987), Waters and Lawrence (1987), Barclay et al. (1988), Scott (1988), Barclay (1989), Wilson et al. (1990) and Kellaway and Welch (1993).*



(Figure 9.35) Interbedded limestones and shales of the Courceyan Lower Limestone Shale Group at the Stenders Quarry GCR site in the Forest of Dean. (Photo: P.J. Cossey.)



*(Figure 9.4) The Lower Carboniferous palaeogeography of south-east Wales and part of southern England illustrating the distribution of facies for the (a) Courceyan, (b) Arundian, and (c) and Holkerian stages. (MM — Mitcheldean Member; SO — Stowe Oolite; CM — Cwmyniscoy Mudstone; LF — Llanelly Formation; CBM — Caswell Bay Mudstone; HTL — High Tor Limestone (p — peloidal; sk — skeletal); BL — Birnbeck Limestone; BO — Burrington Oolite; VL — Vallis Limestone; CDM — Clifton Down Mudstone; WL — Whitehead Limestone; DL — Drybrook Limestone; DoL — Dowlais Limestone; SL — Stormy Limestone; DS — Drybrook Sandstone; CO — Cornelly Oolite; CDL — Clifton Down Limestone; UA — Usk Axis; ML — Malvern Line; SEFZ — Severn Estuary Fault Zone; LSA — Lower Severn Axis.) Based on Burchette (1987) and Wilson et al. (1988).*