River Calder, South Lanarkshire

[NS 658 547]–[NS 666 563]

Introduction

On the eastern outskirts of East Kilbride and about 2 km from the town centre, the 'Rotten Calder' runs north through the deep and picturesque Calderwood Glen [NS 658 547]–[NS 666 563]. Within the glen is exposed a southerly dipping sequence from the Lawmuir Formation (Brigantian) through the Lower Limestone Formation (Brigantian) into the basal Limestone Coal Formation (Pendleian). This succession, which lies on the southern side of the Central Coalfield Basin, is important in understanding both the stratigraphy of the area and the regional correlation of Lower Carboniferous successions across the Midland Valley. The section has been described in detail by Carruthers and Dinham (1917). Further information is provided by Macnair (1916, 1917) and Paterson *et al.* (1998).

Description

The oldest rocks in the succession, which belong to the Lawmuir Formation (Brigantian), are found in an isolated and fault-disrupted outcrop at the northern end of Calderwood Glen. They are beds of ochreous-weathering, dolomitic limestone and shale, the Netherfield Limestone, with crinoid columnals and productoids. These beds appear to lie stratigraphically about 15 m below the next outcrops, which are of another marine horizon, the Basket Shell Bed, resting on sandstone, coal and fireclay. The Basket Shell Bed has, at the base, calcareous shales with pro-ductoids (10 cm) overlain by a lenticular, argillaceous, crinoidal limestone (10 cm). Above these, there are grey shales (1 m) capped by a 5 cm-thick ironstone rib. These latter beds are noted for their fauna and flora (Carruthers and Dinham, 1917) in which cephalopods including goniatites and the bivalves *Dunbarella papyracea* and *Posidonia becheri* occur. Currie (1954) identified goniatites from the Basket Shell Bed as *Beyrichoceratoides truncatum.*

Above the Basket Shell Bed are 4.5 m of shale with thin bands of ironstone, known locally as the 'Whitestone Series' or 'Whitestone Clayband Ironstones'. The shales at the base contain ostracodes, fish scales and coprolites, and although all of the ironstone bands are less than 10 cm thick, they were once worked in the area. The shales pass up into siltstones and a variable sequence of sandstones with mudstone and siltstone bands (5.3 m). Some of the finer beds contain plant remains and a fireday and coal (0.2 m) occur at the top of this unit. Resting on the coal is a third marine horizon, the Under Limestone. This is a crinoidal limestone (0.8 m) with a thin band (7 cm) of argillacous limestone containing goniatite fragments and plants at its top. The limestone is overlain by shales with fish remains and ostracodes (15 cm) passing up into shales with ironstones (1.5 m), siltstones and sandstones (5.4 m) with fireclays and a bed with irregular pedogenic nodules at the top.

Calcareous shales with marine fossils (0.4 m) overlie the fireclays and pass up into the Main Limestone whose base marks the base of the Lower Limestone Formation. The Main Limestone is a grey crinoidal limestone (1.8 m) and is overlain by shales with ironstone bands (3.6 m), siltstones (4.3 m) and a sandstone (1.5 m). The top of the sandstone contains crinoid debris and is overlain by an unnamed sandy crinoidal limestone (12 cm) and an ironstone (12 cm) with brachiopods and bivalves. Above this are shales with ironstones (8.5 m), known as the 'Househill Clayband Ironstones', with, in the centre, two thin ostracode limestones, fireclays and a coal seam (0.3 m) correlated with the Wilsontown Smithy Coal. These are capped by fireclays with rootlets and greenish and yellow marls with irregular carbonate bands and nodules (2 m). The carbonates contain finely bioclastic ostracode debris, some complete ostracode shells, fish remains and lithoclasts. A thin band of dark shale (8 cm), which is pyritous and contains ostracodes and fish remains, separates these from the Wee Post Limestone which is a hard grey crinoidal limestone (0.5 m).

The Wee Post Limestone is overlain by a thick sequence of shales with ironstone nodules (26 m), which contain a marine fauna at the base. Towards the top, the shales become sandier and some thin bands of ostracode limestone are present. They are overlain by the thick Hosie Sandstone (30 m), which is a bedded sandstone with siltstone and fireclay bands and a bioturbated horizon. The top of the sandstone contains crinoid columnals and is sharply overlain by the Main Hosie

Limestone (1 m). This is a crinoidal limestone and is separated from the similar Mid Hosie Limestone (0.5 m) by highly fossiliferous shales (1.4 m), which are rich in brachiopods and bryozoans. Above the Mid Hosie Limestone there are partial exposures of shales with ironstone nodules (3 m) which pass up into fireclay (0.5 m) on which there is a thin coal (14 cm). Above this there is a coarse quartzose grit (0.7 m) with a shale parting. The remaining sequence is dominated by shales with two thin limestones, the Second Hosie Limestone and the Calderwood Cementstone or Top Hosie Limestone. The Second Hosie Limestone is a crinoidal limestone (0.3 m) while the Top Hosie Limestone is a compact argillaceous limestone (0.25 m). The shales contain marine fossils and in the beds both above and below the Calderwood Cementstone there are bedding surfaces strewn with valves and shells of *Lingula squamiformis* (Figure 2.32). The shell structure and preservation of these has been studied by Cusak and Williams (1996) and Williams and Cusak (1997). The top of the Top Hosie Limestone marks the top of the Lower Limestone Formation, and the shales above, which pass up into sandstones, lie within the Limestone Coal Formation.

Interpretation

The lowest three marine horizons in the sequence, the Netherfield Limestone, the Basket Shell Bed and the Under Limestone, belong to the Lawmuir Formation and are correlated with the Dykebar Limestone, Hollybush Limestone and Blackbyre Limestone respectively of the Paisley district (Whyte, 1981; Wilson, 1989; and see (Figure 2.4)). However, all three limestones show some interesting differences from the typical developments of the Paisley area and are thus of stratigraphical and palaeogeographical significance. The Netherfield Limestone in the River Calder appears to be transitional between the ferruginous, argillaceous limestone of Dykebar and the calcareous shales and thin bioclastic limestones of the same horizon at Strathaven. The Basket Shell Bed with its crinoidal and goniatite–bivalve facies is markedly different from the coral and gigantoproductid facies of the Hollybush Limestone of the type area near Paisley. The goniatite–bivalve facies is found elsewhere at this horizon in the southern part of the Central Coalfield Basin and is of significance in correlating this horizon eastwards into the Lothians. The goniatite–bivalve fauna is also particularly significant since it supports a P_1 age for these beds. The Under Limestone resembles the Blackbyre Limestone in its shelly and crinoidal character. However, the direct upward passage of the Blackbyre Limestone into a pale mudstone with pedogenic limestone nodules overlain by fireclay, which is seen in the Paisley district, is not seen in the River Calder, where there are nearly 7 m of strata between the Under Limestone and the overlying zone with carbonate nodules and fireclay. The effects of the disconformity, which these features indicate, are less marked at Calderwood Glen than at Paisley and to the west (Whyte, 1981).

The Main Limestone is correlated with the Hurlet Limestone (Macnair, 1917; Whyte, 1981; Wilson, 1989) and the shales at the base contain representatives of the Abden (or Macnair) Fauna (Carruthers and Dinham, 1917). The un-named limestone between the Main Limestone and the Wee Post Limestone may be correlated with the Craigenhill Limestone of Carluke and the Shields Bed of Campsie (Whyte, 1981; Wilson, 1989; and see (Figure 2.4)). This limestone is an impersistent horizon and marine conditions did not appear to penetrate to the Paisley area or to the Strathaven area to the south-east of East Kilbride. The strata above are regionally variable (Whyte, 1981) and the presence in the River Calder of a coal seam, which lies at about the position of the Wilsontown Smithy Coal of the eastern side of the Central Coalfield, is significant.

The Wee Post Limestone is correlated with the Blackhall Limestone of the Hurlet district (Carruthers and Dinham, 1917; Macnair, 1917; Whyte, 1981; Wilson, 1989) and in its crinoidal character resembles the upper post of that limestone (Figure 2.4). The lower leaf of the Blackhall Limestone, which is a lagoonal ostracode limestone, may be represented at Calderwood by the marls and carbonate nodules that underlie the Wee Post Limestone. These, however, also contain rootlets and suggest that Calderwood lay close to the margin of the lagoonal area at this time. The shales immediately above the Wee Post Limestone contain, as was first pointed out by Neilson (1874, 1913), the Neilson Shell Bed Fauna (Carruthers and Dinham, 1917).

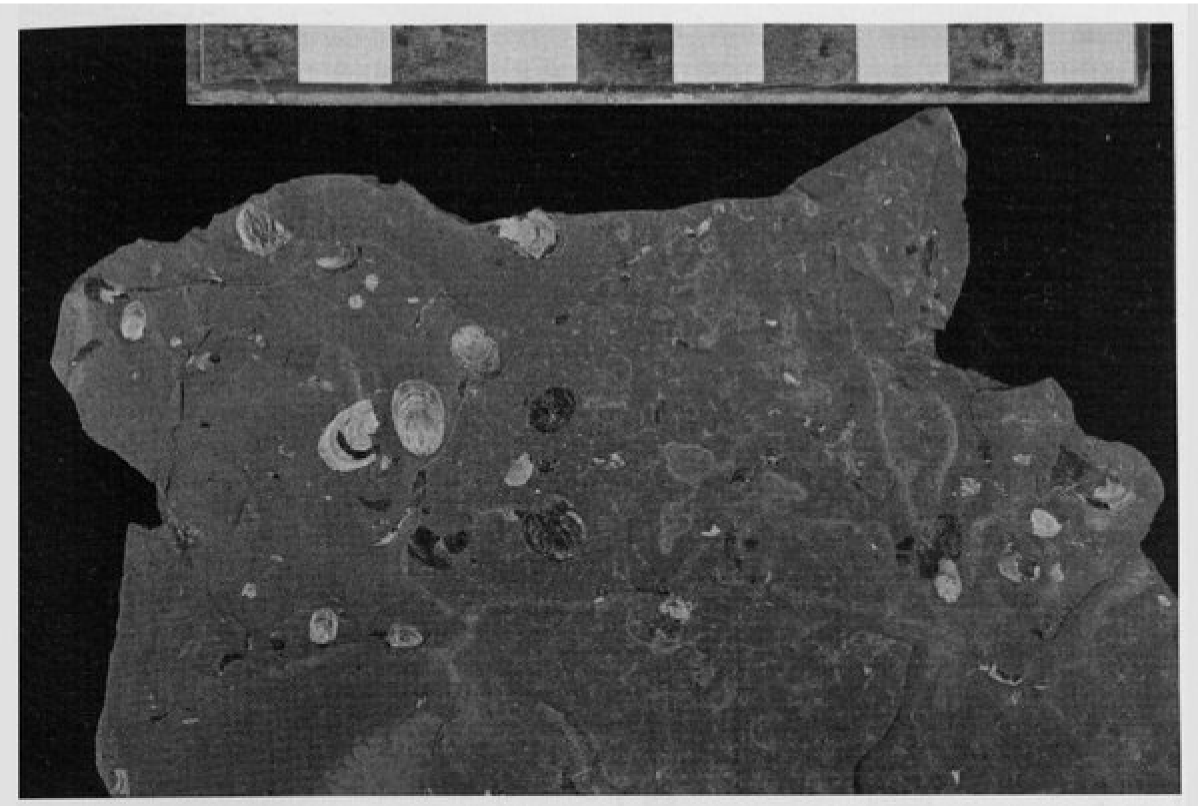
The Calderwood section as noted by Carruthers and Dinham is important as the only natural section in the area that allows the relationships of the Hosie Limestones to the underlying succession to be established. The Main Hosie Limestone and Mid Hosie Limestone are separated from the Second Hosie Limestone and Top Hosie Limestone by fireclay and coal, which are equivalent to the Lillie's Shale Coal and Hosie Fireclay of the Paisley district. This may mark the position of a regionally important disconformity, and the coarse sandstone above it in the River Calder may indicate uplift and rejuvenation of the source area.

The Hosie Limestones and also the Wee Post Limestone and Main Limestone have in the past been extensively exposed in quarries around East Kilbride, and these attracted the attention of many geologists and collectors including Ure (1793), Davidson (1851–1886, 1860), Young and Robertson (1873), Patten (1885) and Neilson (1895). Many records of plants, foraminifera, corals, annelids, bryozoans, ostracodes, brachiopods, bivalves, cephalopds, gastropods and fish have been documented from these limestones by Murdoch (1904). The surviving exposures of these limestones in the River Calder are thus of great significance. Snook (1999) has carried out a detailed study of the Calderwood succession in his regional analysis of the fossil associations and facies in the Hosie Limestones. From specimens collected from the shales associated with the Calderwood Cementstone in the East Kilbride area, Currie (1954) identified the goniatites *Dimorphoceras* aff. *plicatilis* and a new species of *Cravenoceras* (*C. scoticum*). These are of major stratigraphical significance as they uniquely indicate the presence of the E_l Zone in Scotland and were used by Currie (1954) to place the P_2–E_1 boundary just below the Top Hosie Limestone.

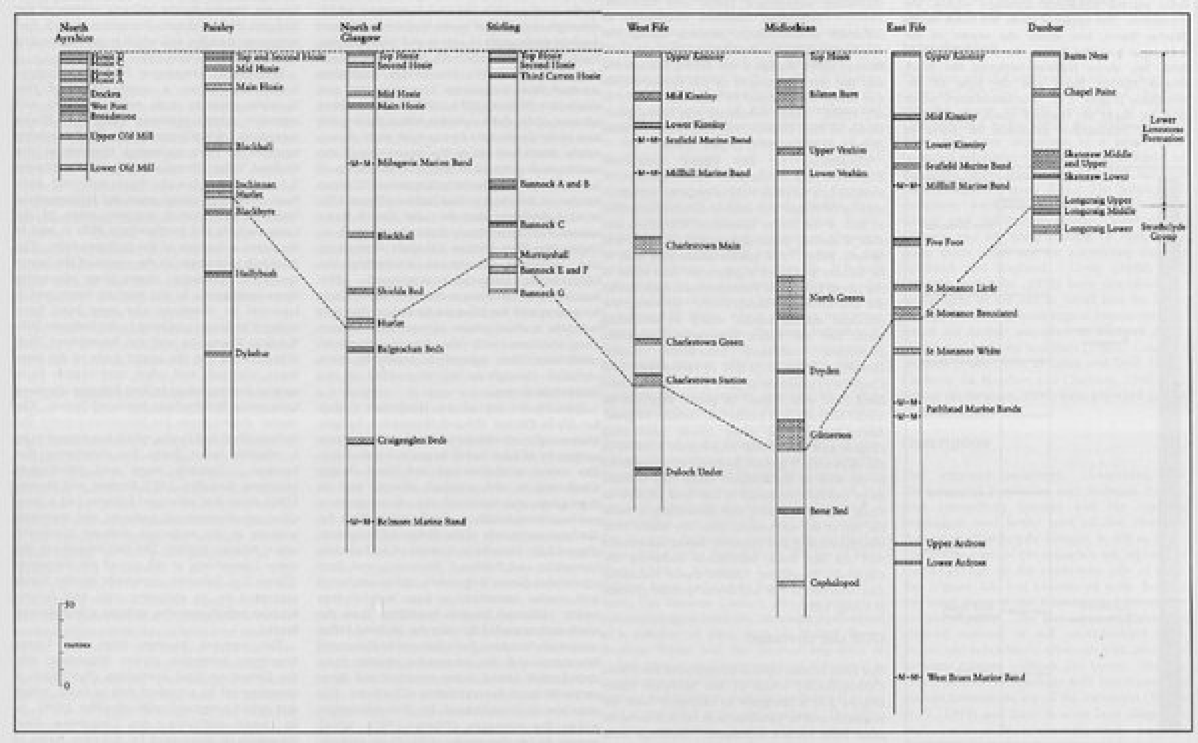
Conclusions

The River Calder GCR site provides an unusually complete section of the Lawmuir Formation and Lower Limestone Formation and shows the relationships of key horizons within these Brigantian to basal Pendleian strata. The three marine horizons within the Lawmuir Formation can be compared to marine bands in the Paisley district but show some significant differences in facies that are of correlative and palaeogeographical importance. Within the Lower Limestone Formation, valuable sections relating the limestones and intervening clastics are available. The faunas of the marine horizons are of stratigraphical and palaeoecological importance, and a unique feature of the locality are the stratigraphically useful goniatite–bivalve faunas, which indicate that the succession spans from the P_1 to E_l zones.

References



(Figure 2.32) Shale containing Lingula from the base of the Limestone Coal Formation (Clackmannan Group, Pendleian) overlying the Top Hosie Limestone. The specimen is approximately 6 cm across. (Photo: M.A. Whyte.)



(Figure 2.4) Correlation of the principal marine horizons in the Brigantian Lower Limestone Formation and uppermost part of the Strathclyde Group in the Midland Valley from North Ayrshire to Dunbar. Note that most of the named units figured here are, unless otherwise stated, limestones (names abbreviated). Based on various sources and including information from George et al. (1976), Cameron and Stephenson (1985), Wilson (1989) and Francis (1991).