# Bilston Burn, Midlothian

[NT 270 648] and [NT 282 648]

## Introduction

Bilston Burn is a tributary of the River North Esk, lying 9 km south of Edinburgh. Its valley, which runs across the steeply dipping north-western limb of the Midlothian Syncline, exposes one of the finest sections of Carboniferous strata anywhere in Scotland; this ranging up from the upper part of the West Lothian Oil-Shale Formation (Strathclyde Group, Brigantian) through the Lower Limestone, Limestone Coal and Upper Limestone formations (Clackmannan Group, Brigantian to Arnsbergian) into the Upper Carboniferous Passage Formation. The Lower Carboniferous exposures [NT 270 648], [NT 282 648] were, however, cut in two by culverting of the stream, which was carried out in order to reduce the underground flow of water into neighbouring collieries and which completely covered the exposures of the Limestone Coal Formation. Even in *its* restricted state, Bilston Burn still provides invaluable sections; now that mining has ceased consideration might be given to remedial conservation work at this site. The geology of Bilston Burn has been described by Peach *et al.* (1910), Macconachie (in Flett *et al.,* 1927) and Tulloch and Walton (1958). Macnair (1917), Macgregor *et al.* (1920), Robertson *et al.* (1949), Mitchell and Mykura (1962) and Wilson (1967) also give some details of the locality.

## Description

An outcrop map illustrating the distribution of the principal formations and marine intervals at Bilston Burn is illustrated in (Figure 2.21). The site includes about 100 m of strata belonging to the upper part of the West Lothian Oil-Shale Formation, the lower parts of which, induding the Cephalopod Bed and two other marine horizons (Macconachie in Flett *et al.,* 1927), are no longer exposed. However, a fourth marine band, the Bone Bed Limestone, is exposed and lies 30 m below the top of the formation (hillock) and Walton, 1958). Underneath the Bone Bed Limestone is a thin shale which has, at the base, a sandy layer with abundant and commonly fragmentary *Lingula* and fish remains. Marine fossils induding bivalves (*Sanguinolites abdenensis, Actinopteria persulcata*) and the brachiopod *Schizophoria resupinata* (Macnair, 1917) occur in the shale and there is a band rich in *Rhipidomella* Immediately below the limestone. The limestone is a bioclastic limestone (3 m) with crinoid ossicles and shell fragments. It is overlain by dark shales, grey sandy siltstone, micaceous sandstones and fireclays.

The basal bed of the Lower Limestone Formation, the Gilmerton Limestone, is obscured by old workings. Above the position of the limestone there are sandstones (some of which are ripple marked), subordinate mudrocks and a thin limestone, the Dryden Limestone (1.5 m), which rests on a bioturbated sandstone. The Dryden Limestone is sandy and contains crinoid remains and brachiopods. It is overlain by sandstone and fireday, but above this the section becomes incomplete because of old workings for coal. Two seams, the North Greens Coal (1.4 m) and the Rough Parroty Coal (0.7 m), were formerly exposed here and both had shales above them containing *Lingula.*

The North Greens Limestone is the thickest limestone (27 m) in the Lower Limestone Formation at Bilston Burn, and because it has been extensively worked the lower part (3 m) is not exposed. The exposed beds are dark, fossiliferous, bedded limestones and calcareous shales. The top metre of the North Greens Limestone is ochreous and is overlain by a thick coarse-grained sandstone (20 m), the North Greens Sandstone, which is often red stained. Above the sandstone, the outcrops again become sporadic, but within the section there are sandstones, mudrocks and two limestones, the Lower Vexhim Limestone and Upper Vexhim Limestone. Coals that occurred immediately under the limestones (Lower Vexhim Coal or Niddrie Coal and Upper Vexhim Coal) have been extracted at the surface and are no longer exposed. Coals are also recorded lower down in the section, above the North Greens Sandstone (the Under Vexhim Coal), and stratigraphically higher, below the Bilston Burn Limestone.

The Bilston Burn Limestone is another thick and bedded limestone (15 m). The bottom part of this unit, which contained corals, is no longer visible. In places the limestone is rich in bryozoans (Macconachie in Flett *et al.,* 1927) and the uppermost bed, which is dolomitized, contains the curved spreite of *Zoophycos.* Shales above the Bilston Burn

Limestone pass up into yellow sandstones (12.5 m), which near the top include a thin coal and which pass up into the Top Hosie Limestone. This is a sandy crinoidal limestone (0.75 m) capped by marine shales.

The cyclical succession of the Upper Limestone Formation contains a high proportion of sandstones and siltstones, but a number of marine intervals and some coals are also present. The basal bed is the brown-weathering and dolomitic Index Limestone (1.2 m), which contains the gigantoproductid brachiopod *Latiproductus* cf. *latissimus.* The shales (3.4 m) above the limestone have provided a marine fauna (Peach *et al.,* 1910) and pass up through siltstones and sandstones (1.6 m) into a thick sandstone (5.8 m), the Joppa Sandstone. Above this sandstone there are 17 m of siltstones and sandstones capped by fireclays and coals. Marine fossils including abundant orthotetoid brachiopods have been found in sandstone bands 2–3 m above the Joppa Sandstone (Tulloch and Walton, 1958). Marine fossils also occur in a thin sandstone 1.4 m higher in the succession. One of the coals, named the 'South Parroty Coal', has been worked at outcrop and is no longer exposed. An incomplete section of sandstones and siltstones (50 m) lies between the coal and the Lyoncross Limestone.

The Lyoncross Limestone in Bilston Burn is developed as a siltstone with ironstone nodules (0.75 m) and marine fossils overlying a siltstone (0.45 m) containing large carbonate concretions with a cone-in-cone structure. A thin coal lies 0.4 m lower in the section. Productoids, *Lingula,* palaeotaxodont bivalves and bellerophontids have been recorded from the Bllston Burn outcrop (Tulloch and Walton, 1958). About 40 m of strata lie between the Lyoncross Limestone and the Orchard Beds and these are noteworthy for the presence of three or four bands containing *Lingula.* The lowest of these lies only 2 m above the Lyoncross Limestone and contains fish remains as well as the characteristic inarticulate brachiopod. A thick sandstone and other strata separate this band from a thin coal and shales in which plants and possible *Lingula* fragments have been recorded (Tulloch and Walton, 1958); 2.3 m higher in the sequence is a thicker shale (1.6 m) with *Lingula* and fish remains. The highest band containing *Lingula* (0.4 m), which also contains small bivalves, lies 8 m above this.

The Orchard Beds (23 m) comprise a shale-dominated succession with interbedded siltstones, sandstones, impure limestones, ironstone (siderite) nodules and a rich marine fauna. The marine fauna is particularly abundant and diverse at the base and top of the section. The lower fauna includes productoids (*Eomarginifera, Dictyoclostus* cf. *muricatus, Latiproductus* cf. *latissimus*)and other brachiopods (*Pleuropugnoides, Scbizophoria, Composita,* spiriferoids, orthotetolds, *Lingula*), epifaunal bivalves (*Aviculopecten, Pernopecten*)and infaunal bivalves (*Cypricardella, Phestia, Nuculopsis, Sanguinolites, Parallelodon, Schizodus*), gastropods (*Eupbemites, Bucaniopsis, Glabrocingulum*), fenestellid bryozoans and crinoid remains (Tulloch and Walton, 1958). The upper fauna contains productoids (including *Latiproductus* cf. *latissimus*), spiriferoids, bivalves, gastropods, trilobites and crinoid remains.

The sequence (46 m) between the Orchard Beds and the Calmy Limestone contains a number of thin coal seams including the Wood Coal. Above the latter there are fireclays, siltstones and shales (6.3 m), and above this is a thick shale (14.7 m) capped by silty sandstone (2.2 m) on which the Calmy Limestone rests.

Within the shale there are a number of levels at which *Lingula* or marine fossils are found, and close to the base, one of these bands contains abundant *Edmondia punctatella* together with *Actinopteria* and *Sanguinolites* c.f. *clavatus. Sanguinolites* also occurs in a higher band with marine fossils. The Calmy Limestone (1.8 m) consists of three beds of limestone separated by thin shales. The limestone contains crinoids and is overlain by shales (5.2 m), which contain abundant orthotetoid brachiopods as well as *Schizophoria,* chonetoids, spiriferoids and the bivalve *Polidevcia.*

The strata (124 m) between the Calmy Limestone and Castlecary Limestone are principally noteworthy for the occurrence of a group of thin marine bands, which are the local representatives of the Plean Limestones. The lowest of these, lying 64 m above the Calmy Limestone, rests on a coal (0.3 m) and contains *Lingula, Orbiculoidea* and *Sanguinolites.* Another thin shale (15 cm), which lies 4 m higher, contains the bivalves *Promytilus, Sanguinolites* and *Sedgwickia,* and 3.6 m above that there is a thin (8 cm) shale with bivalves, conchostracans (*Euestheria*)and fish remains. The highest of these marine bands is 21 m higher in the sequence and 30 m below the Castlecary Limestone. It contains a more diverse fauna than the other horizons, including fenestellid bryozoans, the productoids, *Dictyoclostus* aff. *muricatus* and *D. pugilis,* orthotetoids, bivalves and gastropods. The Castlecary Limestone, which marks the top of the Upper Limestone Formation, is made up of two beds (1.1 m and 1.4 m) of fine-grained, brown-weathering limestone with

a shale parting. It is overlain immediately by sandstone of the Passage Formation.

## Interpretation

The upper West Lothian Oil-Shale Formation and the Lower Limestone Formation in Bilston Burn show the Yoredale-type cycles, which typify this part of the Scottish Lower Carboniferous succession. In these, the limestones and marine shales were deposited in open shallow-shelf conditions (Wilson, 1974, 1989) and the cycle passes up through delta-front shales, siltstones and sandstones into the sandstones, fireclays and coals of the delta top. However, as in other parts of the Midland Valley, the succession in the Midlothian Basin shows considerable thickness and facies variations (Tulloch and Walton, 1958). Thus, the relatively thick sequence at Bilston Burn provides an important reference section for the basin and for correlations between this area and other parts of the Midland Valley.

The beds immediately below the Gilmerton Limestone are one case where the sections on either side of the Midlothian Basin show marked differences and have presented correlation problems (Macnair, 1917; Tulloch and Walton, 1958). Tulloch and Walton (1958) have suggested that the Bone Bed Limestone correlates with the Lower Crichton Limestone of East Lothian and that the latter correlates with the Catcraig Middle Limestone of Dunbar. Westwards the Bone Bed Limestone correlates with the Under Limestone of West Lothian (Tulloch and Walton, 1958) and through this with the Blackbyre Limestone of the Paisley district (Wilson, 1989). Thus the Bilston succession forms an important link between the eastern and the western ends of the Midland Valley (Figure 2.4).

This is also true at higher horizons, where the Gilmerton Limestone is the correlative of the Hurlet Limestone of Paisley and the Catcraig Upper Limestone of Dunbar, and the Dryden Limestone correlates with the Craigenhill Limestone of the west and the Skateraw Lower Limestone of the east. By the same token, the North Greens Limestone correlates with the Blackhall Limestone of the Central Coalfield and the Skateraw Middle Limestone of Dunbar (Figure 2.4).

In the strata between the Dryden Limestone and the North Greens Limestone the development of coals is interesting, and the Rough Parroty Coal lies at the level of the well-known Gilmerton Ironstone, which is found to the north of Bilston (Peach *et al.,* 1910; Macgregor *et al.,* 1920;Tulloch and Walton, 1958). The North Greens Sandstone, which occurs above the North Greens Limestone, is best developed in the northern parts of the Midlothian Basin and has been compared with the Seafield Tower Sandstone of West Fife (Macconachie in Flett *et al.,* 1927).

The four limestones in the upper part of the Lower Limestone Formation correlate with the four limestones of the Hosie Limestones of the Central Coalfield (Macgregor, 1930; Wilson, 1989) although the Midlothian succession is lithologically more varied than that of the Central Coalfield. This correlation is supported by the similarity between the coal under the Bilston Burn Limestone and the Lillie's Shale Coal of Paisley (Tulloch and Walton, 1958).

The Upper Limestone Formation also exhibits a Yoredale cyclicity, but the marine horizons tend to be more uniform and older local names for the major marine horizons have been replaced by the standard nomenclature developed in the Central Coalfield. However, the detailed correlation of some of the other horizons is less certain and the Bilston Burn succession provides valuable information about these and about the stratigraphy and palaeoenvironments of the formation as a whole.

The Index Limestone of Bilston Burn is not as fossiliferous as its counterpart in the Central Coalfield but does contain *Latiproductus* cf. *latissimus* which is widespread at this horizon (Wilson, 1967). The reduced marine influence in this and other marine horizons in the formation, when compared with equivalent strata in the Central Coalfield Basin, may reflect a closer proximity to the delta of the river system, which was flowing in from the north-east end of the Midland Valley (Figure 2.3). The Joppa Sandstone and some of the other thick sandstones within the succession may represent major distributary channel sandstones deposited during phases of delta advance. The Joppa Sandstone lies at about the same level as the Bishopbriggs Sandstone of the Glasgow district, and the unnamed marine horizons above it correspond broadly with the Huntershill Cementstone of the Central Coalfield (Tulloch and Walton, 1958). The overlying group of coals and fireclays, including the South Parroty Coal, represent delta-top environments.

The occurrence of the Lyoncross Limestone at Bilston Burn is the only surface outcrop of this horizon within the Midlothian Basin. Like the Index Limestone, it is less fossiliferous than the same horizon in more westerly areas (Wilson, 1967). The bands containing *Lingula* between the Lyoncross Limestone and the Orchard Beds lie at a similar level to thin *Lingula* or marine beds in the Stirling–Clackmannan and Central Coalfield areas (Macgregor *et al.,* 1925; Francis *et al.,* 1970). They represent restricted marine and estuarine or brackish-water environments. In contrast, the Orchard Beds contain the most diverse fauna in the Bilston Burn Upper Limestone Formation succession and this is true of its development throughout the Midland

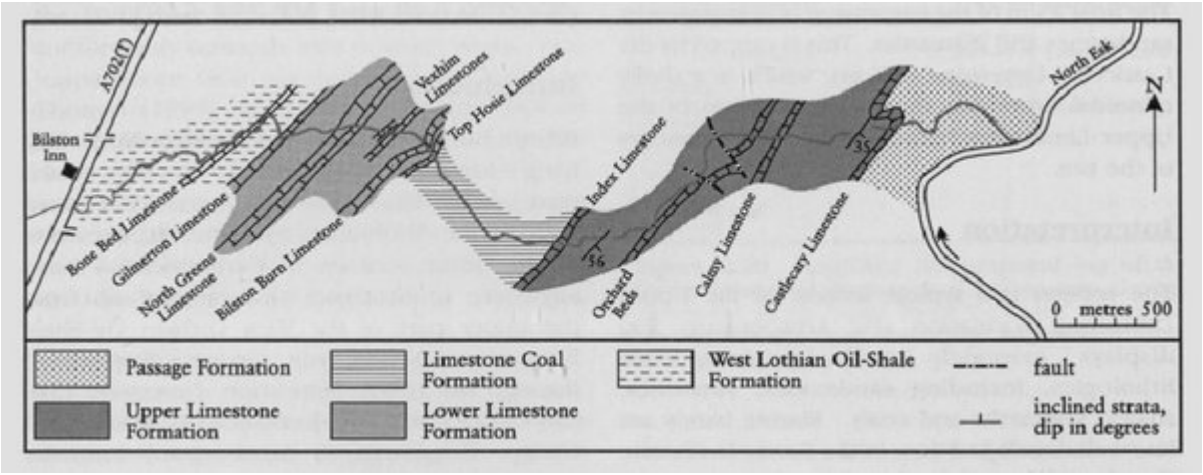
Valley (Wilson, 1967). The presence of *Latiproductus* cf. *latissimus* in the Bilston Burn fauna is of interest. This species has a restricted distribution at this horizon and is commonly found only in more southerly and easterly parts of the Midland Valley (Wilson, 1967). The upper parts of the Orchard Beds are also the only horizon in the Bilston Burn succession at which trilobite remains, mucronate pygidia of *Paladin,* are common.

The Calmy Limestone is poorly fossiliferous as compared to much richer developments in the Central Coalfield Basin (Wilson, 1967) and the most interesting feature of this marine horizon is the fauna of the underlying shales. These contain a band rich in *Edmondia punctatella,* which is also characteristically found in a thin band immediately below the Calmy Limestone at other localities throughout the Midland Valley. In the Central Coalfield this interval is usually a highly carbonaceous shale but in the Bilston Burn it is a lighter-coloured silty mudstone (Tulloch and Walton, 1958). The marine bands, which are found between the Calmy Limestone and Castlecary Limestone, equate broadly with the Plean Limestones of the Stirling–Clackmannan Basin. However, the detailed correlation of individual horizons is uncertain. At Bilston Burn it is the highest of these bands that contains the richest marine fauna, while in the type area it is the lowest of the three limestones of the Plean Limestones that has the most diverse fauna (Wilson, 1967). The Castlecary Limestone has not yielded a distinctive fauna but is commonly overlain by a shale with *Curvirimula* and fish remains (Wilson, 1967). This shale is present at Joppa Shore to the north (see GCR site report, this chapter) but at Bilston Burn an erosively based sandstone rests directly on the limestone. In the southern and western parts of the Midlothian Basin the Castlecary Limestone is apparently entirely absent due to an unconformity (Tulloch and Walton, 1958). Similar erosive loss of the Castlecary Limestone occurs elsewhere in the Midland Valley (Macgregor, 1930; Francis in Craig, 1991).

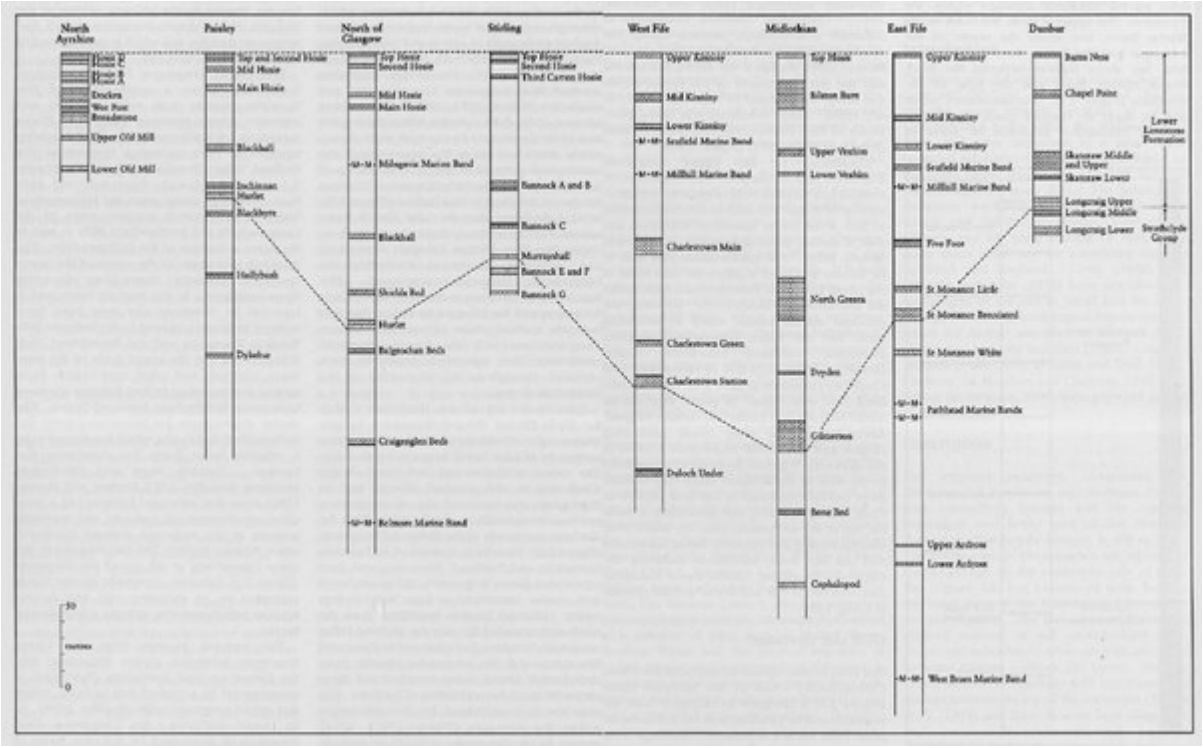
## Conclusions

Bilston Burn is a major, inland Lower Carboniferous section proving much of the local Carboniferous succession and providing an invaluable standard for the upper West Lothian Oil-Shale Formation and the Lower Limestone Formation and Upper Limestone Formation of the Midlothian Basin. This is an irreplaceable section for the Lower Carboniferous rocks in the Lothians and is of vital importance for comparisons between sites in the Midland Valley. The sedimentary facies and faunal associations are of great significance to the understanding of palaeoenvironmental and palaeogeographical change during the Brigantian–Arnsbergian time interval.

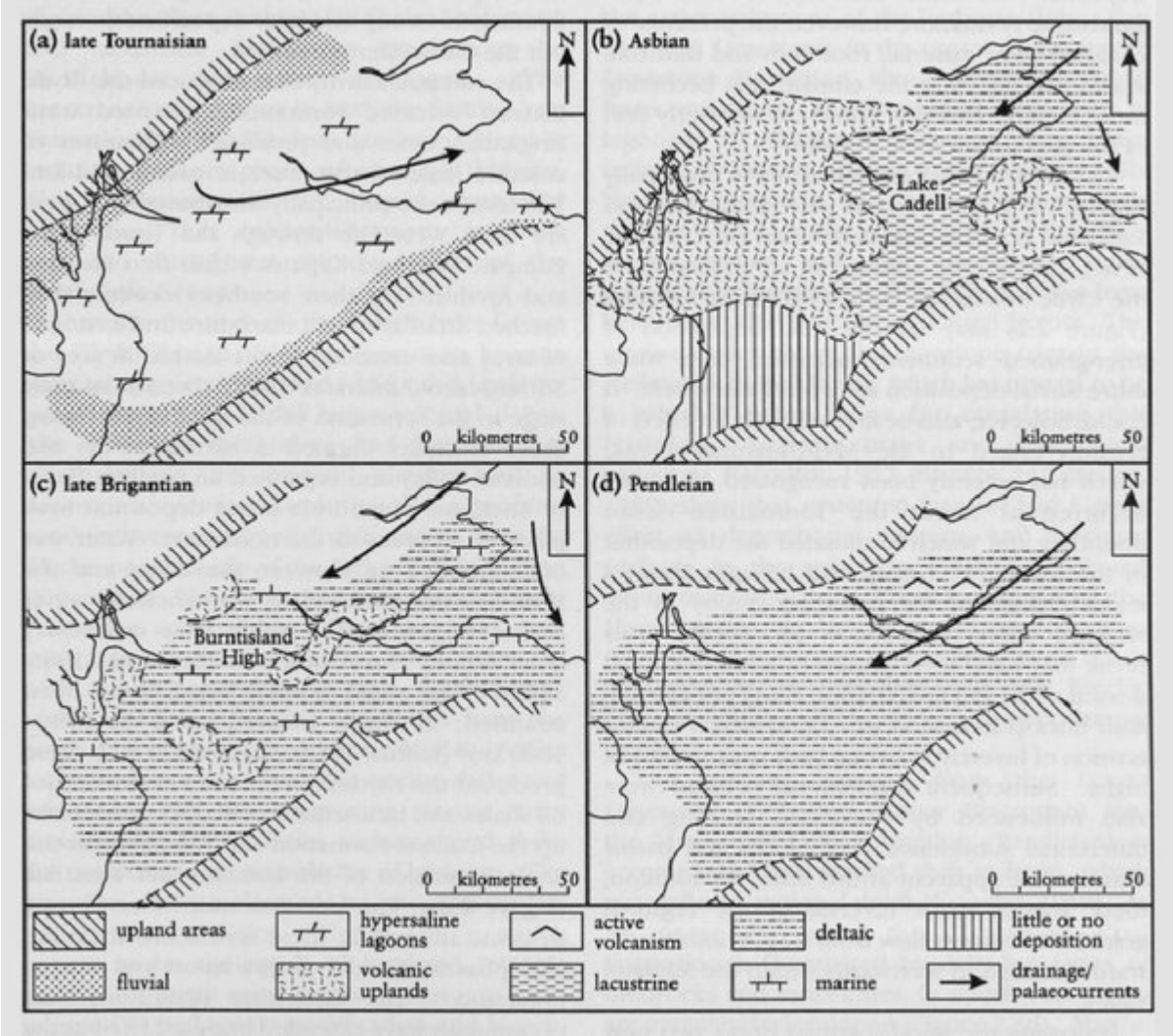
**References**



*(Figure 2.21) Simplified geological map of the Bilston Bum GCR site showing the outcrop distribution of the principal marine intervals and lithostratigraphical units in formations of the Clackmannan Group. After Macconachie in Flett et al. (1927).*




*(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).*




*(Figure 2.3) Lower Carboniferous palaeogeographical reconstructions of the Midland Valley area: (a) late Tournaisian (Ballagan Formation, Inverclyde Group); (b) Asbian (Sandy Craig Formation, Strathclyde Group); (c) late Brigantian (Lower Limestone Formation, Clackmannan Group); (d) Pendleian (Limestone Coal Formation, Clackmannan Group). Based on various sources and including information from Craig (1991) and Whyte (1994).*