Touchadam, Stirling

[NS 761 906]

Introduction

The Touchadam GCR site lies in the valley of the Bannock Burn [NS 761 906], a short distance below North Third Reservoir and about 6 km south-west of Stirling. Here there are faulted outcrops on both limbs of a small easterly pitching syncline, which is a drag feature related to movement along the nearby Wallstale Fault. Sherrif (1796) mentioned the limestone workings at Craigend, by which Touchadam was formerly known, and commented on the quality of the limestone, but the first detailed geological account of the area was that of Dinham (1920). Further details have been published by Dinham (in Flett *et al.,* 1927), Dinham and Haldane (1932), Read (1959) and Francis *et al.* (1970). The sequence shows excellent sections of the Kirkwood Formation and Lawmuir Formation and lower part of the Lower Limestone Formation (resting on the Clyde Plateau Volcanic Formation), which, together with sections of broadly comparable age from Todholes (see GCR site report, this chapter) to the south, are of critical significance to the correlation of Strathclyde Group successions in the Stirling–Clackmannan Basin. The upper limit of the Touchadam section is defined by an intrusive contact at the base of the thick Midland Valley Sill.

Description

Details of the succession at Touchadam are presented in (Figure 2.25). The basal beds of the Kirkwood Formation (formerly known as the 'Volcanic Detritus') are patchily exposed and neither the basal junction with the lavas nor the upper junction of the unit can be observed. These beds are derived from the re-distribution of material eroded and weathered from the lavas and are very variable in character. They vary in grade from fine clays to conglomerates and are typically highly coloured in green, purple or chocolate hues. Whereas some bands are hard and occasionally calcareous, others are poorly lithified and disintegrate easily. The full thickness is difficult to estimate and, while Dinham's (1920) figure of 30 feet (9.1 m) is most probably too low, Read's estimate (in Francis *et al.,* 1970) of 200 feet (61 m) may be rather large.

Above the Kirkwood Formation and resting on 1.4 m of shales and marls at the base of the Lawmuir Formation is the Productus Limestone (Bannock Limestone G). This hard, grey, biomicritic limestone (1 m) includes bands containing gigantoproductids (*Gigantoproductus, Latiproductus* cf. *latissimus*; see Francis *et al.,* 1970) which are often disarticulated and usually orientated convex up. In addition, both solitary and compound (*Siphonodendron funceum, Diphyphyllum fasciculatum*) corals occur in bands at the base and towards the top of the limestone. The Productus Limestone is separated from a higher limestone (the Goniatite–Lingula Limestone) by about 12 m of strata which are not completely exposed (Figure 2.25). The exposed beds are shales and light-coloured marls some of which appear to contain fine material derived from weathered lava.

The Goniatite–Lingula Limestone (Bannock Limestone E and F) is a bedded, dark argillaceous limestone (1.1 m) which contains abundant goniatite fragments, orthoceratids, bivalves (*Edmondia, Nucula*)*, Lingula squamiformis* and other brachiopod fragments and plant remains. Currie (1954) identified the goniatites as *Beyrichoceratoides truncatum var.* H and *Dimotphoceras.* The molluscan shells are typically pyritized. There are also two thin crinoidal bands within the limestone. Above the limestone, a thin shale (0.5 m) containing *Lingula* is sharply overlain by a thick greenish-grey calcareous mudrock (7.5 m), which may be reworked from weathered volcanic material. The mudrock contains horizons of carbonate nodules (Figure 2.25), and towards the base, some of the nodules have a botryoidal appearance and septarian cracks with two stages of calcite infill. Above this mudstone are black pyritous shales (10 m thick). These contain a marine fauna at the base and top but a non-marine fauna of bivalves and *Euestheria in* the middle (Francis *et al.,* 1970). Towards the centre of the shales there is a contorted zone. The basal shale, whose fauna includes *Euphemites urii, Sanguinolites* spp., *Myalina* and *Eomarginifera,* contains calcareous and pyritic bands and nodules. The pyrite nodules often show a compound structure and a wide range of crystal forms and textures. Pyrite also occurs disseminated throughout the shale and in small finely crystalline granules.

These dark shales underlie the Murrayshall Limestone (Bannock Limestone D, at the base of the Lower Limestone Formation), which has been extensively worked both at the surface (Figure 2.26) and in pillar and stall workings which extend to the south-east under Sauchie Crag. The limestone, which is thought to have been about 1.5 m thick, is no longer exposed but a sample, recovered from the underground workings, was a very dark, pyritous biomicrite containing small crinoid ossicles and brachiopod fragments.

The Murrayshall Limestone is overlain by shales, of which only the top 3 m can be seen. These pass up into siltstone and flaggy yellow sandstones (6 m) with rootlets. Above these and below the junction with the sill there is an incomplete section (3.2 m) of shales and a limestone. This limestone (Bannock Limestone C) has been baked by the sill and is a pyritous micritic limestone with colonies of *Siphonodendron.*

Interpretation

The sections in the Bannock Burn at Touchadam are on the western side of the Stirling Basin and provide important information about the transition between the basin and the structural high to the west formed by the extrusive rocks of the Clyde Plateau Volcanic Formation of the Campsie and Touch Hills. Although not fully exposed, the beds of the Kirkwood Formation are thicker at Touchadam than at the nearby sections at Todholes (see GCR site report, this chapter). These beds are very largely made up from transported and degraded volcanic material. After the cessation of volcanic activity there was a long period of weathering and erosion, during which the deposits of the Kirkwood Formation were deposited as a unit of variable thickness, which, at least in the Bannock Burn area, thickens markedly eastwards. Regionally, the boundary between the Kirkwood Formation and Lawmuir Formation is markedly diachronous (Browne *et* al., 1999) and at Touchadam the earliest beds of the Lawmuir Formation are considerably younger than the earliest beds of this formation in the Paisley area (Hinxman *et al.,* 1920; Macgregor *et al.,* 1925). Although the lava landmass appears to have been largely overstepped by the Lawmuir Formation, weathered volcanic material is incorporated into this formation indicating some persistence or intermittent rejuvenation of the volcanic landmass.

The two marine limestone units of the Lawmuir Formation show features of significance to the palaeogeography of the area. The lower of these, the Productus Limestone (Bannock Limestone G), is markedly thicker than at Todholes where it thins markedly before dying out completely in the most westerly exposures. With its fauna of corals and gigantoproductid brachiopods this limestone is similar in character to, and correlated with, the Hollybush Limestone of the Paisley area (Hinxman *et al.,* 1920; Dinham and Haldane, 1932; Francis *et al.,* 1970). The upper horizon, the Goniatite-Lingula Limestone, is very different in character from the corresponding limestone (Bannock Limestone E and F) at Todholes, which has a shelly fauna dominated by brachiopods and bryozoans. The thinner development at Touchadam is interpreted as a deeper-water facies and it is significant that goniatites have been found in the most easterly exposures of this horizon at Todholes, which are also the closest to Touchadam (Read, 1959; Francis *et al.,* 1970). This horizon has been correlated with the Blackbyre Limestone of the Paisley district (Hinxman *et al.,* 1920; Macgregor *et al.,* 1925; Dinham and Haldane, 1932). The character of the Blackbyre Limestone is more similar to the facies developed at Todholes than that at Touchadam but it is interesting to note that 'a thin limestone of Pendleside type' was formerly recorded in it at one locality (Hinxman *et al.,* 1920).

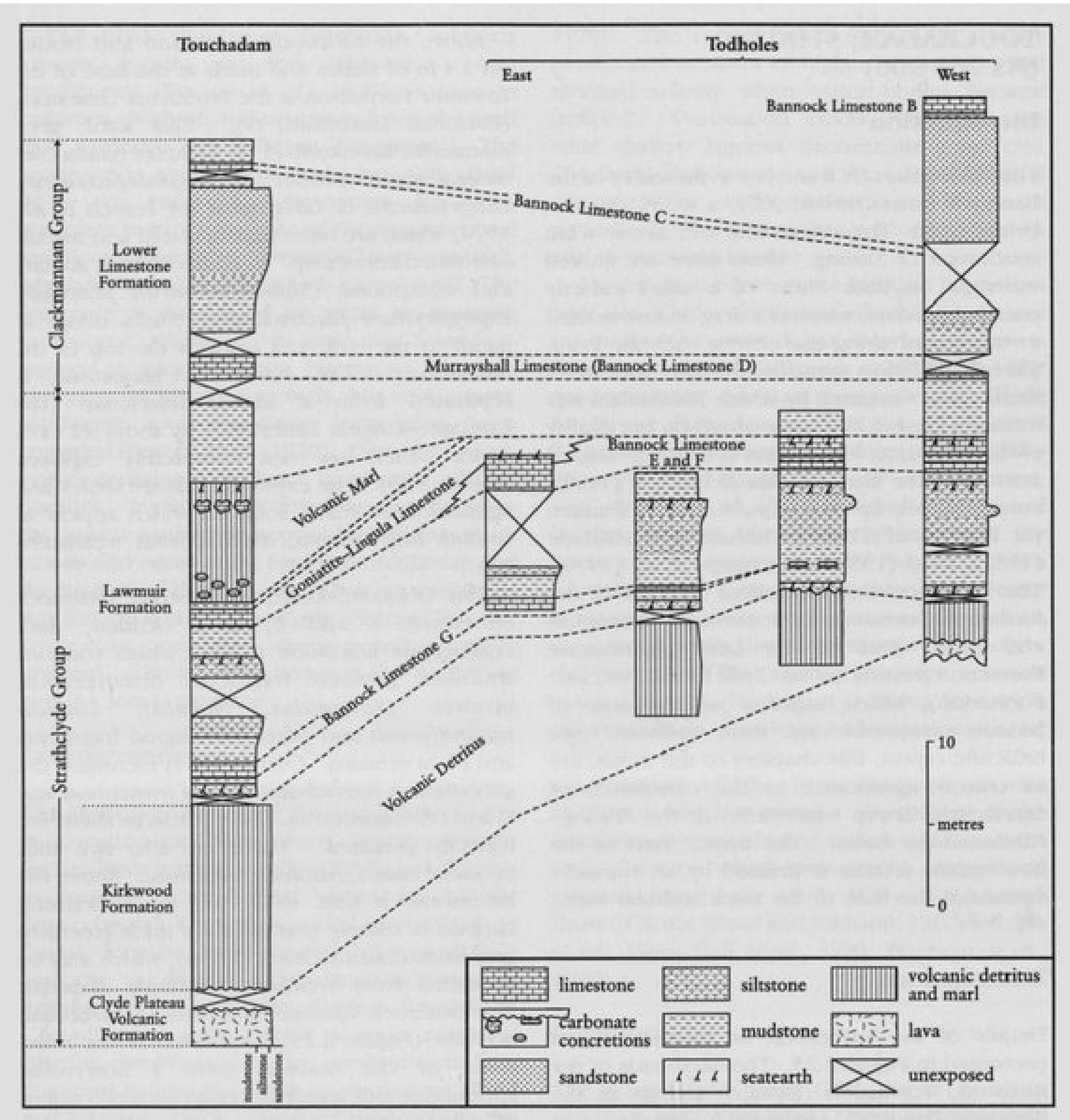
There is no development in the Gonatite-Lingula Limestone at Touchadam of the palaeosol features that are so markedly superimposed on the Bannock Limestone E at Todholes and which mark the position of a disconformity prior to the shales and limestone of the Hurlet (Murrayshall Limestone) Transgression. In the past, the thick 'ashy' mudstone at Touchadam has been inferred to equate with or replace Bannock Limestone E (Dinham and Haldane, 1932; Francis *et al.,* 1970). The 'ashy' mudstone is, however, a product of the disconformity and associated rejuvenation of the volcanic landmass. It thus overlies the surface of disconfor-mity and cannot be equated with any part of the Bannock Limestone E and F sequence, which pre-date the disconformity. Some of its carbonate nodules in the 'ashy' mudstone may be pedogenic and related in time to the processes that modified the upper parts of the limestone at Todholes. A distinctive dark calcite cement in some of these nodules also occurs in Bannock Limestone E at Todholes.

The Murrayshall Limestone is the local representative of the Hurlet Limestone (Dinham and Haldane, 1932; Francis *et al.*, 1970) and its base marks the local base of the Lower Limestone Formation (Browne *et al.,* 1999; and see (Figure 2.4)). The fauna of the underlying shales (Francis *et al.,* 1970) includes elements of the Macnair Fauna, which is widely distributed at this horizon (Wilson, 1989). Bannock Limestone C is correlated with the Shields Bed of Campsie (Dinham and Haldane, 1932; Francis *et al.,* 1970) but has no equivalent in the Paisley region (Macgregor *et al.,* 1925). The development of this horizon at Touchadam thus provides valuable data for establishing its distribution and palaeogeographical significance (Wilson, 1989).

Conclusions

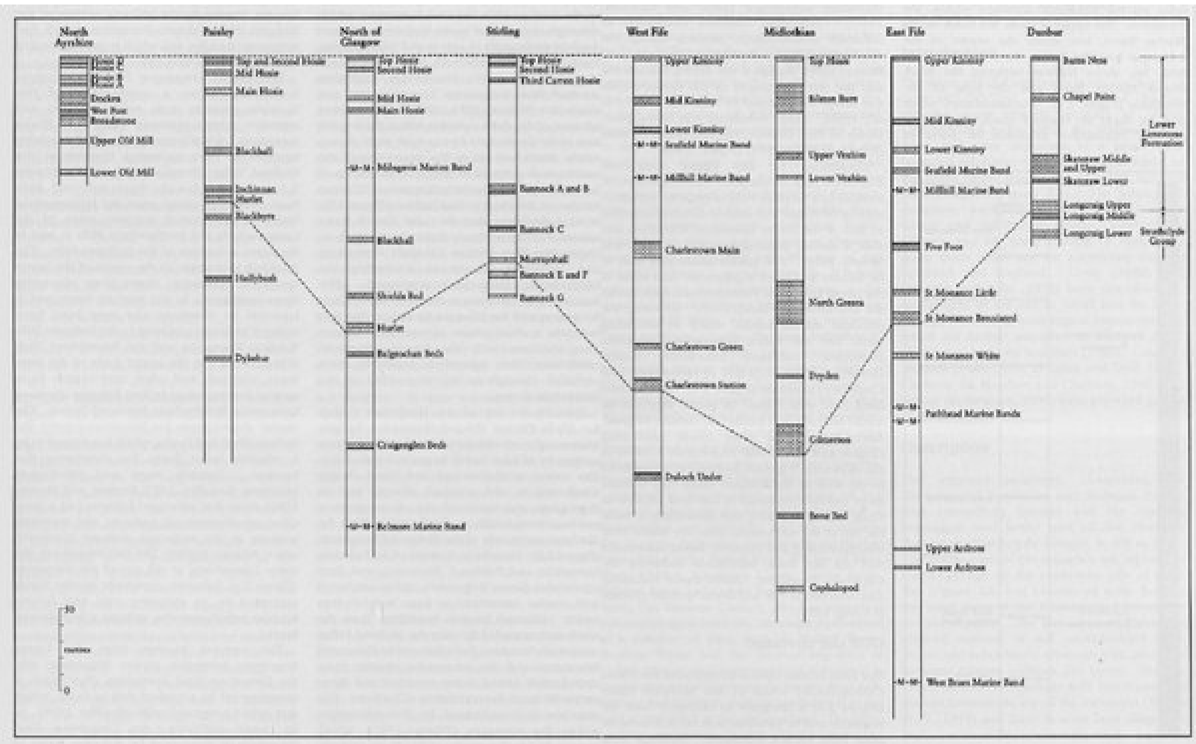
Situated on the western margin of the Stirling–Clackmannan Basin, this stratigraphically and palaeogeographically significant site provides vital reference sections of the Lawmuir Formation and Kirkwood Formation (Strathclyde Group) which overlap the Clyde Plateau Volcanic Formation, and, in conjunction with the neighbouring GCR site at Todholes, is an outstanding locality for the investigation of Lower Carboniferous facies relationships. The remarkable lateral facies changes demonstrated between the Touchadam and Todholes sites and the unique development of facies associated with the stratigraphical discontinuity below the Murrayshall Limestone at Touchadam demonstrate very well the influence of a major structural high (formed by the extrusive rocks of the Clyde Plateau Volcanic Formation) on the development of Brigantian successions in this part of the basin.

[References](#)



(Figure 2.25) Comparative sections of strata at the Touchadam and Todholes GCR sites showing the correlation of the principal lithostratigraphical units. Note that the sections at Todholes are each approximately 100 m apart and some 3 km to the south of Touchadam. Based on various sources and including information from Francis et al. (1970).

(Figure 2.26) General view of the quarry at Touchadam, where the Murrayshall (Hurlet) Limestone (Lower Limestone Formation, Brigantian) was formerly worked. (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).