FALLS OF CLYDE

L.J. McEwen and A. Werritty

OS Grid Reference: NS885406

Highlights

This site is selected for an excellent example of the glacial diversion of drainage. The present route of the River Clyde occupies a bedrock gorge which was cut following the infilling of its former course by glacial deposits.

Introduction

The Falls of Clyde (NS 885406 to NS 882421), 3 km south of Lanark, provide a notable example of glacial disruption of drainage. TheFalls of Clyde serve as the local base-level for the upper River Clyde, effectively isolating the upper part of the river from its lower reaches. This is the result of glacial deposits blocking the original channel of the Clyde, forcing the river to cut a new bedrock channel. The origin of the falls has been considered byRoss (1927), George (1958), Linton (1963), Sissons (1976b) and Whittow (1977).

Description

The Falls of Clyde are located to the south of Lanark at a point where the River Clyde abruptly changes in both character and direction. Whereas 3 km upstream it is an alluvial, meandering channel flowing south-west through a wide valley, 5 km south-east of Lanark it becomes a relatively straight, narrow, rock-controlled channel flowing to the north-west. Within the designated site the river drops 55 m within 1.8 km. In contrast, the long profile of the Clyde upstream of the site is graded to a base-level at about 183 m O.D. and requires 32 km to register a comparable descent (George, 1958). The gorge itself which contains the site is 7 km long overall and locally up to 50 m deep. The gorge is incised into a pre-glacial surface cut across gently-dipping greywackes of the Lower Old Red Sandstone (Whittow, 1977).

The site consists of two major waterfalls, Bonnington Linn and Cora Linn, separated from each other by a slot gorge. Cora Linn, the larger of the two falls (27 m high), comprises a series of cascades over benches formed from the near horizontally bedded and more resistant sandstone units within the greywackes. The angle made by the top of the falls is oblique to the flow of the main channel indicating that the falls have retreated asymmetrically upstream leaving an enlarged section immediately downstream which now forms the plunge pool. Thus Cora Linn provides a very good example of a waterfall whose configuration is controlled by the detailed stratigraphy and relative resistance of the underlying bedrock. The upper of the two falls, Bonnington Linn, is wider than Cora Linn but not so high. It consists of a single cascade segmented into three parts with large rocky "islands' separating the individual units. As with the lower falls, the angle is oblique to the main flow of the river.

The shales within the Lower Old Red Sandstone (which dip downstream very gently) provide the risers of the "staircase' into which the falls are incised. At low flows, it is clear at Cora Linn that there is minimal development of an inner channel within each riser, and very little bedload is at present being transported through the whole rock controlled section. As a result, the edges of the more massive sandstone units exposed in the bed of the falls have undergone minimal abrasion and rounding.

Between the lower falls at Cora Linn and the upper falls at Bonnington Linn the river descends steeply in a series of rapids over bedrock steps masked by occasional bouldery deposits which, because of their lithology and minimal rounding, are clearly recent and local in origin. The resulting "step-pool system' is controlled in terms of its detailed morphology (height of "steps' and dimensions of "pools') by the spacing of the local joint systems and variation in the relative resistance of the constituent strata. This 1 km long gorge separating Bonnington Linn and Cora Linn is relatively straight, has near vertical side-walls 25 m high and displays a well developed set of rapids over a very bouldery bed. The local sandstone here is virtually flat-bedded,

permitting only a limited development of potholes. However, some have developed at the margins of the gorge in response to abrasion and selective exploitation of joint planes.

The current flow over the falls is regulated to some extent by extraction of water at Bonnington Linn for hydro-electric power. Under normal flow conditions this represents only a small proportion of the total.

Interpretation

The explanation for this dramatic change in river level and river character has been attributed to a number of causes. George (1958) described the gorge as an outstanding example of rejuvenation related to a Tertiary lowering of sea levels. Linton (1963), on the other hand, explained the gorge as a product of lowered base level where the river descended into an "ice-cut trough' which Sissons (1976b) subsequently claimed was scoured by a Highlands ice stream which flowed up this part of the Clyde Valley. A third, but less plausible, explanation is that offered by Whittow (1977) who argued that the gorge was the result of rejuvenation caused by tectonic uplift. However, construction of the hydro-electric power station at Bonnington revealed a buried former channel of the Clyde to the east of the present river course (Ross, 1927), and McLellan (1969) mapped the full extent of an area of glacial deposits blocking this channel. Upstream of these deposits a former lake existed in which abundant silts, sands and clays were deposited (Laxton and Nickless, 1980). This former lake basin explains the low river gradient upstream of the falls. The latter were cut upon deglaciation, the Clyde eroding a new channel in bedrock before regaining its original course at the mouth of the gorge.

Disruption of pre-existing river courses has occurred in the Highlands due to glacial erosion of cols and valley heads and the production of glacial breaches (Linton, 1949a, 1951a, 1963) (see also the Cairngorms). The Falls of Clyde, however, provide the most dramatic example in Scotland of disruption of a major river course resulting from glacial deposition in the original river channel and therefore differs from other sites such as Corrieshalloch Gorge (see above). The individual landforms demonstrate specific geological controls on the form and configuration of the waterfalls, rapids and slot gorge which collectively comprise the site.

Conclusions

The Falls of Clyde provide a particularly striking example of the effects of glacial disruption of drainage. The original channel of the Clyde was infilled with glacial deposits, forcing the river to adopt a new course. The latter takes the form of a bedrock gorge and is distinguished by the presence of two waterfalls. The site is important in illustrating some of the indirect, but nevertheless significant, effects of glaciation on the landscape.

Reference list

George, T.N. (1958) The geology and geomorphology of the Glasgow district. In *The Glasgow Region* (eds R. Miller and J. Tivy). Handbook prepared for the meeting of the British Association, Glasgow. Edinburgh, T and A. Constable, 17–61.

Laxton, J.L. and Nickless, E.F.P. (1980) The sand and gravel resources of the country around Lanark, Strathclyde Region. Description of 1:25,000 sheet NS 94 and part of NS 84. *Mineral Assessment Report*, *Institute of Geological Sciences*, No. 49, 144pp.

Linton, D.L. (1949a) Some Scottish river captives re-examined. *Scottish Geographical Magazine*, **65**, 123–32.

Linton, D.L. (1951a) Watershed breaching by ice in Scotland. *Transactions of the Institute of British Geographers*, **15**, 1–15.

Linton, D.L. (1963) The forms of glacial erosion. *Transactions of the Institute of British Geographers*, **33**, 1–28.

McLellan, A.G. (1969) The last glaciation and deglaciation of central Lanarkshire. *Scottish Journal of Geology*, **5**, 248–68.

Ross, G. (1927) The superficial deposits in the Clyde Valley at Bonnington, 1.1/2 miles S. of Lanark. Geological Survey of Great Britain. Summary of Progress of the Geological Survey of Great Britain and the Museum of Practical Geology for the year of 1926. London, HMSO,

158–60.

Sissons, J.B. (1976b) *The Geomorphology of the British Isles*: *Scotland*. London, Methuen, 150pp.

Whittow, J.B. (1977) *Geology and Scenery in Scotland*. Harmondsworth, Penguin Books, 362pp.