
ACHNASHEEN

J.E. Gordon and D.G. Sutherland

OS Grid Reference: NH160575

Highlights

The landforms and deposits at Achnasheen are outstanding examples of glaciofluvial outwash and delta terraces formed by meltwater deposition in an ice-dammed lake during the Loch Lomond Stadial. They are also important for studies of sedimentation in a glacial lake environment.

Introduction

The Achnasheen site (NH 160575) covers an area of 4 km² at the western end of Strath Bran at its junction with the through valleys leading to Strath Carron and Glen Docharty. It is important for its particularly fine suite of outwash delta terraces and ice-marginal landforms, which are related to a former ice-dammed lake and associated glacier limits in Strath Bran. It is also important in demonstrating two contrasting styles of sedimentation in the ice-dammed lake. Early accounts of the site were given by Nicol (1844), Campbell (1865), Milne Home (1878), Lucy (1886), Morrison (1888), Geikie (1901) and Peach *et al.* (1913b); more recently it has been studied by Sissons (1982a), Sutherland (1987a) and Benn (1989a). The interest of the site and the formation of the terraces is also summarised by Benn (1992).

Description

The terraces extend eastwards from Loch a'Chroisg and north-eastwards from Loch Gowan to the vicinity of Achnasheen (Figure 6.4). The most prominent features occur to the east of the Abhainn a'Chomair and between the Abhainn a'Chomair and the Abhainn Loch Chroisg (see figure 79 in Geikie, 1901; and plate 8 in Peach *et al.*, 1913b). In both areas the terraces comprise very conspicuous high-level surfaces and varying numbers of lower fragments down to the present river floodplains (Figures 6.4 and 6.5). At their maximum height the terraces are up to 25–30 m above the floodplains. Sissons (1982a) mapped and levelled the terraces in detail, showing the terrace north-east of Loch Gowan to descend from 191 m to 175 m OD over a distance of about 850 m (gradient of 19 m km⁻¹) and the terrace east of Loch a'Chroisg to fall from 185 m to 176 m OD in about 500 m (gradient of 18 m km⁻¹). Kettle holes occur on the proximal parts of the highest terraces, and the western and southern margins of those terraces near Loch a'Chroisg and Loch Gowan, respectively, are demarcated by sharply defined ice-contact slopes. Irregular drift mounds occur on the valley sides above the ice-contact features and Sissons (1982a) interpreted these as marking the margins of glaciers contemporaneous with terrace formation.

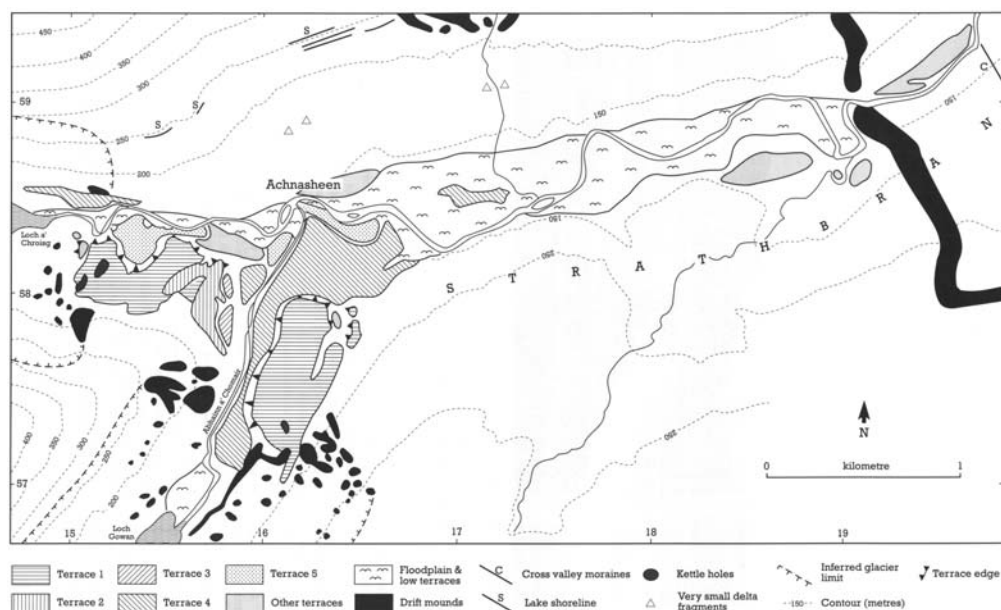


Figure 6.4: Geomorphology of the Achnasheen area (from Sissons, 1982a).



Figure 6.5: Glaciofluvial terraces at Achnasheen. (British Geological Survey photograph B915.)

There are few good contemporary sections in the terraces. Small exposures at NH 159577 show rhythmically bedded silts and clays, and recent stream erosion at NH 156581 has revealed a section with horizontally bedded sands at the bottom overlain by well-sorted sands and gravels dipping eastwards in foreset-type bedding (Benn, 1989a). Former sections described by Lucy (1886) and Peach *et al.* (1913b) showed similar composition and bedding.

About 2.5 km east of Achnasheen an impressive drift limit crosses Strath Bran (Figure 6.4). On its west side the drift margin is up to 20 m high and is continued eastwards on the south side of the valley by a ridge and mounds (Sissons, 1982a). To the east of the limit in the valley bottom, there are two further asymmetric cross-valley moraine ridges (Figure 6.4). Benn (1989a) described the facies geometry of sediments in three exposures at the former ice limit,

noting the presence of alternating diamictic and laminated associations. The former comprise laminated, matrix-supported diamicton with thin sand interbeds, laminated silts with dispersed clasts, and clast-supported diamicton, while the latter comprise multiple sand-silt couplets and rippled sands. Overlying these sediments is a much coarser deposit of coarse diamicton with a sand-rich matrix, poorly sorted gravel and deformed sand with abundant clasts. Numerous small exposures of laminated lake-floor sediments with occasional drop stones occur in the valley between Achnasheen and the Strath Bran drift limit. Further evidence for a former ice-dammed lake is the presence of shoreline fragments identified by Sissons (1982a) at 255 m, 245 m and 237 m OD on the side of the valley north of Achnasheen (Figure 6.4) and overflow channels along the southern margin of the Strath Bran ice lobe (Sissons, 1982a).

Interpretation

On account of their striking landscape form, the Achnasheen terraces have been noted in the scientific literature for about 140 years. In early accounts, debate centred on whether they were of fluvial, marine or glaciolacustrine origin. In one of the first descriptions of the site Nicol (1844) considered that the terraces were formed by a great river flowing from the west. Campbell (1865), however, thought them to be of marine origin, a view supported by Milne Home (1878). Lucy (1886) proposed a lacustrine theory in which glacier-transported debris blocked the outlets of Lochs Gowan and Chroisg. Outflow of water from these dammed lakes then cut down into the barriers and levelled the terraces. He envisaged three separate episodes of damming and overspill to cut the three main terraces.

Morrison (1888) explained the terraces as the beaches of a former lake in Strath Bran, formed at a time when vast quantities of meltwater were released on to low ground by melting glaciers. Geikie (1901, p. 294) developed this interpretation of what he described as a "remarkable group of ancient lake terraces" (p. 508), suggesting that they were formed in a lake ponded in Strath Bran by the build up of snow and ice to the east. Peach *et al.* (1913b) concluded that the finer-grained deposits in the lower part of the sequence were laid down as a lake delta (an explanation which they acknowledge was first proposed by A. Penck on a visit to the site in 1895), then subsequently covered by coarse glaciofluvial gravels. The lake in Strath Bran was impounded to the east by a lobe of ice from the Fannich mountains which extended west into the valley. The valleys to the west (now occupied by Lochs Gowan and Chroisg) were also occupied by glaciers, which acted as sediment sources for the terraces, initially providing fine-grained material at the advancing delta fronts, then coarser glaciofluvial gravels.

In a detailed study, Sissons (1982a) has confirmed and amplified the conclusions of Peach *et al.* (1913b). He mapped moraines and meltwater features that defined the margin of the large lobe of ice from the Fannich mountains, which produced the ice-dammed lake. The lake had a maximum depth of at least 125 m adjacent to the ice lobe. Sissons (1982a) also identified a moraine related to a small glacier that descended the northern side of Strath Bran, as well as the glaciers west and south-east of Achnasheen, at the margins of which the large outwash terraces formed. The height relationships of the terraces and the lake shorelines indicated that the terraces formed during deglaciation as the lake level fell to about 175 m OD, this level being controlled by a meltwater channel identified farther down Strath Bran (Sissons, 1982a). Sissons noted that minor deltas occur beside various side streams at this altitude. Subsequently, the lake level fell rapidly to about 140 m OD, the major proglacial terraces were dissected and the terraces close to the valley bottom formed.

Benn (1989a) drew attention to the contrasting landform and sediment associations related to, on the one hand, the Strath Bran glacier lobe in the east and, on the other hand, to the ice tongues in the valleys of Loch a'Chroisg and Loch Gowan to the west. The Strath Bran glacier produced a large, asymmetric drift ridge and drift limit, with cross-valley moraines on its proximal side. The latter have been interpreted as sublacustrine in origin (Sissons, 1982a), possibly associated with a floating ice ramp (Benn, 1989a). Outwash terraces and deltas, however, are absent. From the sediment characteristics and facies variations, Benn (1989a) inferred gravity-flow sedimentation at the ice margin, including deformation and remobilization of previously deposited materials. In contrast, the western glacier margins are marked by the large ice-contact terraces described above, which formed as prograding deltas built out into the lake. Benn (1989a) considered three factors, which together could explain the observed contrast between the "glacier-contact" glaciolacustrine sedimentation of the Bran ice lobe and

the "glacier-fed" glaciolacustrine sedimentation at the western glacier margins: variations in ice thickness and water depth, meltwater discharge and glacier fluctuations. He concluded from both field evidence and glaciological theory that the contrast reflected relatively high meltwater discharge at relatively stable, grounded ice margins in the west, compared with lower meltwater discharge at a fluctuating and periodically calving margin of the Bran ice lobe which directly controlled the level of the ice-dammed lake.

The age of the Achnasheen landforms and sediments is not firmly established. Clapperton (1977, p. 31) reproduced a map of the terraces by A.M.D. Gemmell and suggested that they might mark the limits of "the local ice cap during the Late-glacial". However, Robinson (1977) and Sissons (1977a) mapped the limits of the Loch Lomond Readvance some distance to the west suggesting an earlier age for the events at Achnasheen (*cf.* Sutherland, 1984a). Subsequently, Sissons (1982a) was unable to locate any evidence that would refute the hypothesis that the Achnasheen ice limits and terraces were related to the Loch Lomond Readvance. Similarly, Ballantyne *et al.* (1987) concluded that there was no evidence to discount a Loch Lomond Stadial age for the deposits; of particular relevance was the apparent absence of Lateglacial Interstadial deposits within the ice limits.

The Achnasheen terraces are the best known example of a suite of outwash delta terraces in Scotland. They are one of the classic landform localities in the country (*cf.* Benn, 1992) and are important from both educational and scientific viewpoints in demonstrating terrace morphology and sedimentology. Achnasheen is also notable for a wider assemblage of glacial and glaciolacustrine landforms and sediments represented in a relatively compact area. These include end moraines, drift limits, cross-valley moraines, lake shorelines, ice-contact slopes and kettle holes. Recent work has further highlighted the value of the area for studies of glaciolacustrine sedimentation; two quite distinctive styles are represented and these provide a valuable opportunity to demonstrate and evaluate their relationships to reconstructed glacier, meltwater and lake-level controls. Achnasheen is therefore a key locality for glacial lake landforms and sediments.

The interests of Achnasheen complement those at several other sites in Scotland. The most comparable glacial lake outwash deltas are in Glen Spean (see Glen Roy and the Parallel Roads of Lochaber), but the terrace forms there are less clearly displayed than at Achnasheen, and the sediments have not been studied in detail; the origin of the terraces in Glen Roy (e.g. at Glen Turret) is currently a matter of debate (see below). Detailed sedimentological studies and comparisons between the features at Achnasheen, in Lochaber and at Gartness (see below) would contribute towards a better understanding of glacial lake sedimentary environments in Scotland. In some cases individual landforms are equally or better developed elsewhere (for example, lake shorelines at Glen Roy, cross-valley moraines at Coire Dho), but Achnasheen is outstanding first, for the quality of its delta terraces; second, for a clear demonstration of some of the controls on glaciolacustrine sedimentation; and third, for the range of landforms and deposits developed in a relatively compact area. In their glacial lake associations, the Achnasheen landforms also differ genetically from the subaerial or marine-related terrace systems, for example, at Moss of Achnacree, Glen Feshie, Corran Ferry, Port a'Chuilin, Gruinard Bay, Glen Einich and Kilmartin Valley.

Conclusions

Achnasheen is a classic locality for a series of impressive outwash and delta terraces formed by glacial meltwater rivers that flowed into a lake dammed by glaciers in Strath Bran and adjacent valleys, probably during the Loch Lomond Stadial (about 11,000–10,000 years ago). The deposits are also significant for sedimentological studies, in particular for reconstructing the patterns and processes of sedimentation in glacial lakes and the factors that control them.

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