Gartness

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Highlights

The interest of Gartness includes an assemblage of glacial, glaciolacustrine and marine landforms and deposits. These provide evidence for the glacial history of the Western Highland Boundary area and the associated landscape changes during the Late Devensian. Of particular note is a series of end-moraine ridges formed in a glacial lake.

Introduction

The interests at Gartness extend over an area of *c.* 10 km^2 (centred on [NS 495 875]) in the Endrick Valley to the east of Drymen. They include an assemblage of Late Devensian sediments and landforms located in the type area for the Loch Lomond Readvance. The sequence of sediments includes evidence for glaciation by the Late Devensian ice-sheet, proglacial lake formation, marine transgression, glaciation during the Loch Lomond Stadial and further proglacial lake development (Rose, 1980e, 1981). The key landforms are a series of Loch Lomond Readvance end-moraine ridges formed partly subaqueously, in a proglacial lake, and partly subaerially. The area has a long history of investigation (Jamieson, 1865, 1905; Jack, 1875; J. Geikie, 1877, 1894; Clough *et al.,* 1925; Gregory, 1928; Simpson, 1933; Sissons, 1967a; Browne and McMillan, 1989), but the most detailed modern accounts are by Rose (1980e, 1981); it has also been described by Price (1983).

Description

Early descriptions of the area (Jamieson, 1865; Jack, 1875; J. Geikie, 1877) drew attention to the occurrence of extensive deposits (about 13 km^2) of sand and gravel, sometimes interbedded with clay. These deposits, which formed a series of rounded hills resembling 'drumlins' (Jack, 1875), contained marine shells (e.g. *Arctica islandica* (L), *Mya truncata* (L), *Chlamys islandica* (Müller) and *Boreotrophon clathratus* (Strom) (Jamieson, 1865; Jack, 1875) similar in character of assemblage to that in the Clyde beds (Jamieson, 1865). According to Jack (1875), the sands and gravels were stratigraphically above the distinctive shelly till of the area (see Croftamie) and were locally overlain by till.

Additional details were given by Simpson (1933), and he included the Gartness deposits as part of the end moraine system of the Loch Lomond Readvance glacier that occupied the Loch Lomond basin.

In a comprehensive investigation, Rose (1980e, 1981) has described and mapped in detail the landforms and sediments of the Gartness area. The principal landform is an end-moraine ridge running approximately north–south from about [NS 495 895] to [NS 501 860] (Figure 13.3). The northern part of the moraine ridge comprises sand and gravel near Drumhead [NS 495 882], and till where it curves round to the west upslope [NS 495 895]. The southern part (between [NS 495 882] and [NS 501 860]) comprises deformed silts resting on a succession of earlier deposits. On the ice-distal (east) side these deposits are largely undisturbed; on the ice-proximal (west) side they are glaciotectonically deformed. These deformations have also been noted by Browne and McMillan (1989) but have not been described in detail as sections are poor due to landslipping. The deposits are best exemplified in sections in and through the moraine at [NS 498 864] and [NS 500 859]; they include the following succession:

5. Blane Valley Silts

4. Gartocharn Till

3. Clyde beds

2. Gartness Silts

1. Wilderness Till

A similar sequence was confirmed in a British Geological Survey borehole located on the end moraine (Browne and McMillan, 1989). Bed 1 is typical of the stiff, reddish-brown till deposited by the Late Devensian ice-sheet, which moved towards the north-east across the area and formed the extensive drumlins in this part of the Midland Valley, of which there are good examples to the east of the moraine ridge (Figure 13.3). This till is overlain by a lag gravel and locally by well-sorted sands, which are succeeded by laminated clays and silts with particle size range and sorting typical of diatactic varves (Sauramo, 1923) (Gartness Silts – bed 2). Over 100 couplets have been counted (Rose, 1981). Clyde beds (bed 3) (see South Loch Lomond and Geilston) overlie the laminated sediments and comprise pink and grey silt laminations with a marine microfauna and occasional shells of marine molluscs. On the ice-proximal side of the moraine the Clyde beds are glaciotectonically disturbed and mixed with glaciofiuvial sediments. Rose interpreted these deposits as a deformation facies of the Gartocharn Till (bed 4). The Blane Valley Silts (bed 5) consist of pink and brown silt laminae but become coarser and sheared towards the ice-proximal side of the moraine ridge where they merge into sand and gravel, for example at [NS 500 859]. The silts occur extensively in the Endrick and Blane valleys below an altitude of 65 m OD. To the west of the end-moraine ridge there is a series of five further moraine ridges (Figure 13.3), partly buried by Blane Valley Silts. The ridge at Drumbeg [NS 483 880], near Drymen, is associated with a large accumulation of deltaic sands and gravels seen exposed in quarry sections [NS 484 882] (Browne and McMillan, 1989).

Shells derived from the Clyde beds and reworked into glaciofluvial gravels exposed in the quarry at Drumbeg gave a radiocarbon date of 11,700 ± 170 BP (1–2235) (Sissons, 1967b) and plant detritus, below Blane Valley Silts and Gartocharn Till at Croftamie, has been dated at 10,560 ± 160 BP (Q–2673) (Rose *et al.,* 1988); this confirms readvance of the ice during the climatic deterioration of the Loch Lomond Stadial as previously suggested by Donner (1957).

Interpretation

Early interpretations focused on the marine aspects of the deposits at Gartness. Jamieson (1865) correlated the shelly sands and gravels with the marine clays of Aberdeenshire and assigned them to a period of submergence at the end of the main period of land ice.

Jack (1875) believed that the latter could not have survived glaciation and referred them to a great submergence during the later phases of the glacial period after the shelly till was deposited. This till was derived from marine sediments laid down during a limited interglacial submergence and represented by the shelly clay under the till at Croftamie.

J. Geikie (1877), on the other hand, considered the stratified deposits (beds 2 and 3) at Gartness to be interglacial and the till on top to be that of the last ice-sheet and not iceberg transported, as Jack had postulated. However, in the third edition of his book, Geikie (1894) argued that since all the shells were worn and could have been derived from the underlying boulder clay, the sands and gravels were probably formed in a proglacial lake, the material being washed in from the receding glacier. Clough *et al.* (1925) also followed this view, postulating a lake dammed by ice both in the Loch Lomond and Blane valleys and with an outlet to the north of Balfron station. Gregory (1928), however, still adhered to the submergence theory of Jack.

Simpson (1928) initially adopted the hypothesis of Geikie, but following further investigation of the area, reconsidered his views since there was no evidence elsewhere to substantiate the required submergence up to 65 m OD and, moreover, the whole aspect of the deposits was typically morainic (Simpson, 1933). They comprised englacial debris laid down as a moraine ridge in front of a receding glacier, partly in water and partly on land. As Renwick and Gregory (1907) had earlier done, Simpson (1928, 1929, 1933) traced the moraine almost continuously around the south end of Loch Lomond and linked it with the well-known ridge in Glen Fruin (Bell, 1891b, 1893c, 1894, 1896b; Renwick, 1895). He recognized that it represented a readvance of ice (see Aucheneck), which he called the Loch Lomond Readvance, following a period of ice-sheet recession when the sea penetrated into Loch Lomond and shelly marine sediments (Clyde beds) were deposited. The Loch Lomond moraine ridge was also contemporaneous with a similar moraine ridge in the Western Forth Valley.

Charlesworth (1956) traced the Loch Lomond moraine ridge and mapped it as part of a Lateglacial readvance which he called the 'Moraine Glaciation' or 'Stage M'. Sissons (1967a) described the damming of lakes in the Endrick and Blane valleys by ice advancing down Loch Lomond during the Loch Lomond Stadial, thick silt and clay deposits in the Blane Valley possibly representing the bottom sediments. Sissons also suggested that in the area between Killearn and Drymen considerable deposits of sands and clays were laid down in an area of stagnating ice up to a level controlled by a meltwater channel spillway to the Forth valley (see also Price, 1983).

Rose (1980e, 1981) interpreted the fining-upwards sequence of gravels, sands and Gartness Silts (bed 2) as freshwater lake sediments deposited in a proglacial lake as the Late Devensian ice-sheet, which deposited the Wilderness Till (bed 1), retreated westwards. The Clyde beds (bed 3) indicate extension of the sea into the area during the Lateglacial Interstadial. The characteristics of the Gartocharn Till (bed 4) reflect the incorporation of Clyde beds into the moraine ridge by the glacier that crossed the area from the north-west during the Loch Lomond Stadial. The Blane Valley Silts represent proglacial lake sediments deposited in an ice-dammed lake in the Blane and Endrick valleys (cf. Price, 1983), occupying this locality both before the moraine ridge was being formed and after the ice had receded (see also Croftamie). The level of the lake and the upper level of sedimentation were controlled by a meltwater channel at 65 m OD across the lowest col on the Endrick–Blane watershed at Ballat [NS 528 907]. The water drained northwards and into a contemporaneous glacier in the Forth valley. The southern part of the moraine ridge was formed subaqueously by the deposition and subsequent deformation of lake sediments at the ice margin. Where the ice grounded above the lake level, the moraine ridge was formed of sand and gravel or till. As the glacier retreated from its maximum extent, five further moraine ridges were formed, also partly subaqueously, and deltaic sediments were deposited in the proglacial lake. Rose (1980e, 1981) considered that each ridge represented an oscillation or standstill of the ice margin in an environment of rapid sedimentation of large volumes of unconsolidated material.

The significance of Gartness is that it demonstrates an exceptional assemblage of landforms and sediments in the type area for the Loch Lomond Stadial. It provides clear geomorphological and stratigraphic evidence for the Loch Lomond Readvance in the form of a sequence of deposits including non-glacial marine sediments interbedded between till deposited by the Late Devensian ice-sheet and till formed during the Loch Lomond Stadial. It is of considerable sedimentological interest, demonstrating a succession of glacial, lacustrine and marine events, and of considerable geomorphological interest for a series of sublacustrine moraines and associated proglacial lake deposits. The site has significant research potential for detailed studies of the lake sediments, the glaciotectonic deformations and the processes of sublacustrine moraine formation. Stratigraphically, the site complements the interest at Croftamie, including Gartness gravels, sands, silts and laminated clays; geomorphologically, that at Aucheneck, demonstrating moraine ridges formed in a glacial lake and glaciotectonic deformation.

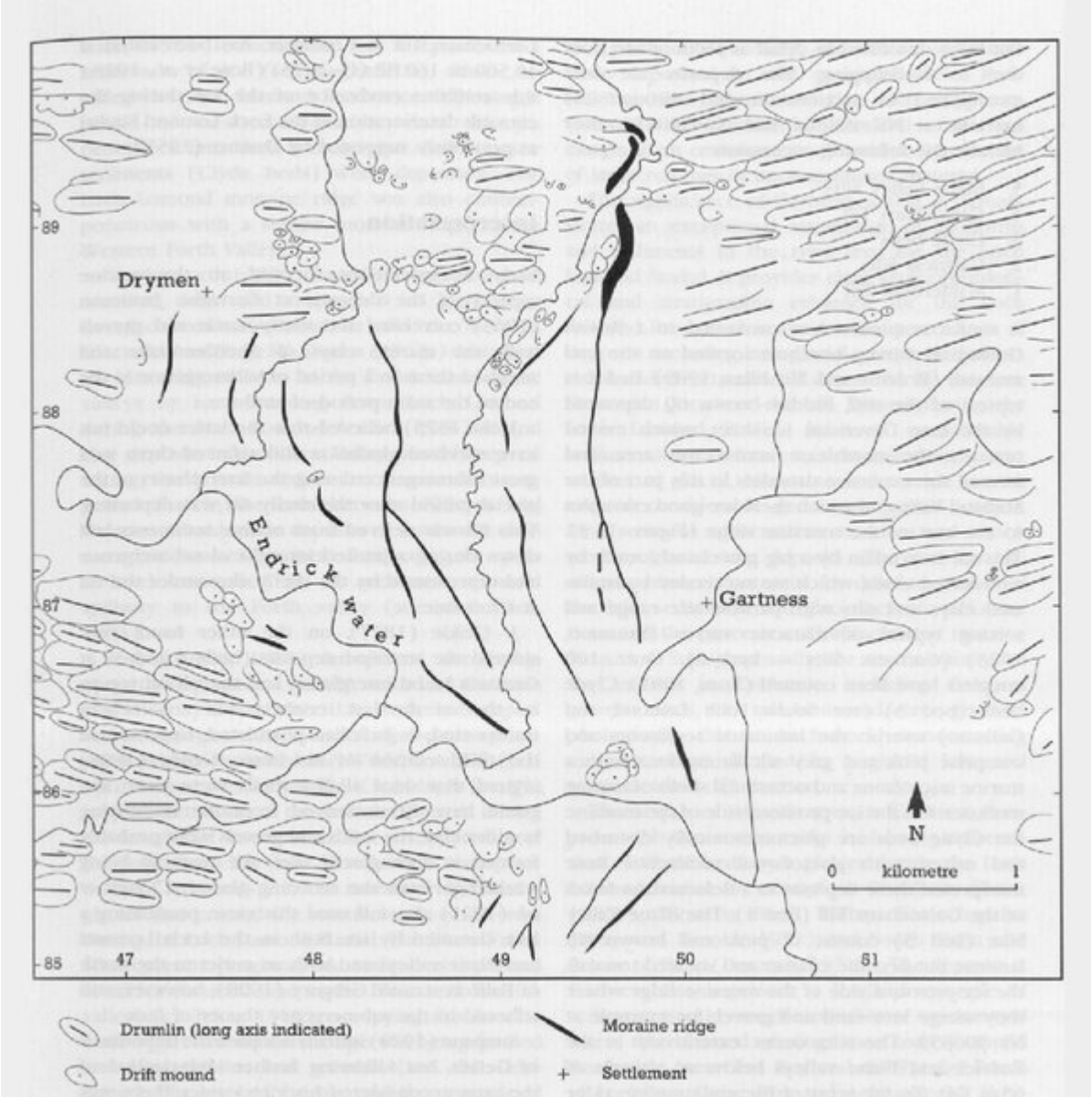
The sequence of sediments at Gartness compares with that at other sites in showing deformation of Clyde beds by a glacier during the Loch Lomond Stadial; for example at Rhu Point (Rose, 1980c), Western Forth Valley, Kinlochspelve (Gray and Brooks, 1972) and South Shian and Balure of Shian (Peacock, 1971b). The deposits at Gartness also represent a lowland example of sedimentation in one of a number of ice-dammed lakes that formed during the Loch Lomond Readvance (see Glen Roy and the Parallel Roads of Lochaber, Coire Dho and Achnasheen). However, apart from Achnasheen (Benn, 1989a) and parts of Glen Roy (Peacock, 1986), there have been no detailed sedimentological studies. In addition to Gartness, sublacustrine moraine ridges of Loch Lomond Stadial age are also reported from Coire Dho (Sissons, 1977b), Glen Spean (Sissons, 1979c) (see Glen Roy and the Parallel Roads of Lochaber) and Achnasheen (Sissons, 1982a). Together these sites provide a range of sedimentary environments that merit further detailed, comparative study of sedimentation in glacial lakes.

Conclusion

The landforms and deposits at Gartness demonstrate the sequence of landscape changes that occurred in the Loch Lomond area during the Late Devensian. The sediments provide evidence for ice-sheet glaciation (approximately 18,000 years ago), the formation of a proglacial lake, invasion by the sea, then renewed glaciation during the Loch Lomond Stadial (approximately 11,000–10,000 years ago) with contemporary glacial lake formation. The principal landforms are a series of end-moraine ridges that formed in the later ice-dammed lake. Gartness is important for interpreting key facets of

the geomorphological changes that occurred during the Late Devensian in the type area for the Loch Lomond Stadial and the Loch Lomond Readvance.

References



(Figure 13.3) Landforms and deposits associated with the Loch Lomond Readvance ice limit at Gartness (from Rose, 1980e, 1981).