The Flemington Eskers

Jon Merritt, Clive Auton and Callum Firth

The Flemington Eskers [NH 850 535] (otherwise known as the Kildrummie Kaims) form one of the best preserved braided esker systems in Britain, since they remain untouched by large-scale quarrying. The features form part of an extensive system of glaciofluvial deposits, including eskers, kames and kame terraces that occupy the low ground on the south side of the Inverness Firth stretching from the mouth of the Great Glen to near Forres (see **Easterton**) (Figs. 14 & 67). The system is aligned with the final direction of ice-flow across the flanks of Strathnairn as deduced from the orientation of glacial striae and ice-moulded landforms (Fletcher et al., 1996). The eskers were formed by glacial meltwaters draining north-eastwards whilst the ice front receded in the opposite direction towards the Great Glen. The eskers, and the ground surrounding them, have generated geological controversy since the Nineteenth Century, with several hypotheses relating the system to the history of deglaciation and relative sea-level change (Auton, 1992; Gordon and Auton, 1993).

The main system includes at least eight braided ridges (Fig. 67), 5-10 m high, with intervening kettle holes partially infilled by peat or waterlogged silt and sand (Figs. 68 & 69). The braided forms occur in three distinct groups, linked together by a single discontinuous ridge (BGS, 1997). Several eskers, separated from, but aligned with the main group, occur to the south of Tornagrain [NH 769 499]. These link with meltwater channels at the south-western end of the system, between High Wood and Blanabual [NH 776 490] (Figs. 14 & 67).

Sparse and degraded exposures in the eskers generally reveal clast-supported cobble gravel composed mainly of micaceous metasandstone, although locally including up to 30 per cent of mauve and brown sandstones, some with mudstone intraclasts. Metamudstone and granitic clasts are present in minor amounts, but no distinctive far-travelled erratics have been reported, such as ‘Inchbae’ granite-gneiss (Fig. 8) (see **Alturlie Point**). Beds and lenses of clay-bound gravel and brown sandy diamict are locally present in the ridges, notably to the east of Bemuchlye [NH 827 531], where up to 8 m of diamict apparently overlies finely interlaminated sand and silt.

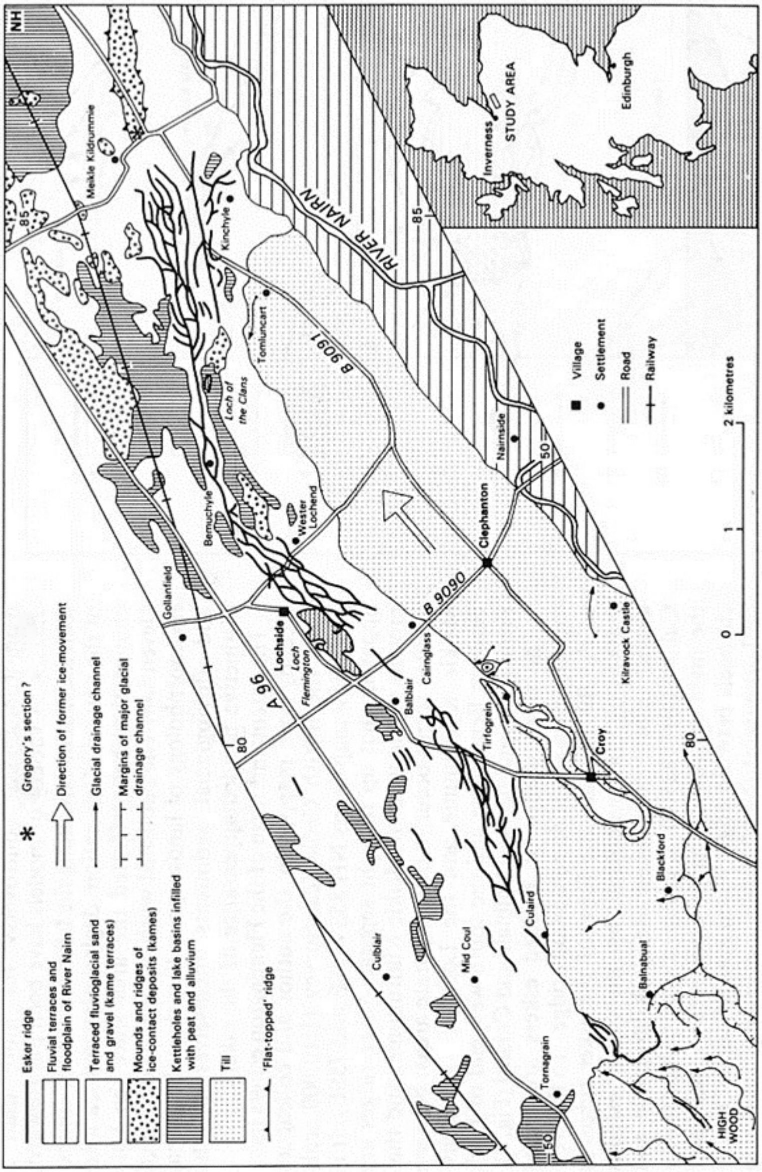

Figure 67. The Flemington Esker system between High Wood and Meikle Kildrummie (after Auton, 1992).

Figure 68. The Flemington Eskers as seen from the recommended viewpoint [NH 853 537], near Meikle Kildrummie, looking south-westwards.

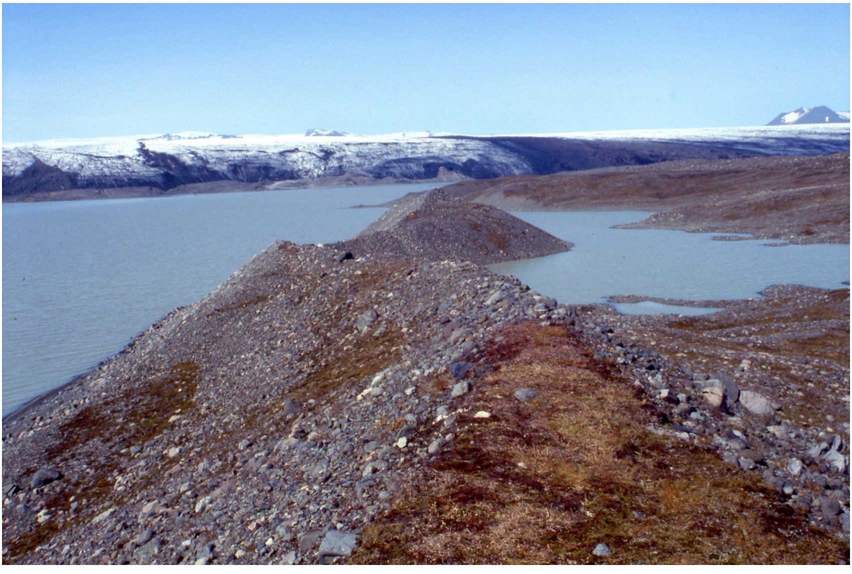

Figure 69. A modern example of an esker near Breiðamerkurjökull, Iceland, taken in 1991, showing how the Flemington Eskers may have looked from the recommended viewpoint [NH 853 537], near Meikle Kildrummie.

The main esker system terminates in a broad, flat-topped and steep-sided ridge to the south-east of Meikle Kildrummie [NH 856 539]. This feature, which has come to be known as the 'flat-topped ridge' slopes towards the east-north-east from c. 38 m OD and is pitted by small kettleholes. It has been interpreted either as a glaciomarine delta laid down at the mouth of a subglacial channel as it emerged from the retreating ice front (Synge, 1977a), or as a large subaerial crevasse-fill unmodified by marine processes (Firth, 1989a). The gradient of the feature is too steep for it to represent a raised shoreline (Firth, 1990b). Most agree that the ridge was initially contiguous with the esker system to the west, but has been separated from it by subsequent glaciofluvial erosion.

Debate has also ensued over the origin of another kettled, flat-topped feature in the area, the 'Delnies Ridge', which stretches 4 km east-north-eastwards from the vicinity of Blackcastle [NH 829 541] towards Nairn (Fig. 14). In a pit at Moss-side [NH 863 552], Synge (1977a) recorded "horizontally bedded glacial outwash gravels punctured by kettleholes filled to the brim with gravel". He considered the 'gravel fill' to have resulted from wave action and the ridge to represent a raised shoreline fragment at 30.5 m OD. However, kettleholes on the ridge are mostly infilled with silt and fine sand displaying soft-sediment deformation structures, as at **Alturlie Point**; exposures in the vicinity of Moss-side revealed large-scale foresets dipping towards the north-east and overlying both planar and trough cross-bedded fine-grained sand (Fletcher et al., 1996). Former exposures in Drumdivan Pit [NH 840 547] (Fig. 14 D) revealed clast-supported gravel with tabular cross-bedding, pronounced bimodal sorting and imbrication of clasts; coarsening-upward sequences were commonly developed. The foreset bedding and general coarsening-upward nature of the sequence suggests that the sands and gravels were laid down as fan-delta deposits without modification by subsequent marine activity. However, Merritt et al. (1995) proposed that much of the sand and gravel forming the 'flat-topped' Denies ridges accumulated in ice-walled chasms that opened into the sea, similar to deposits that form the wave-washed kame plateau in the vicinity of Balnagowan [NH 800 551], towards **Ardersier Peninsula**

(Firth, 1990). The three chasms opened up sequentially whilst relative sea level fell (Fig. 15).

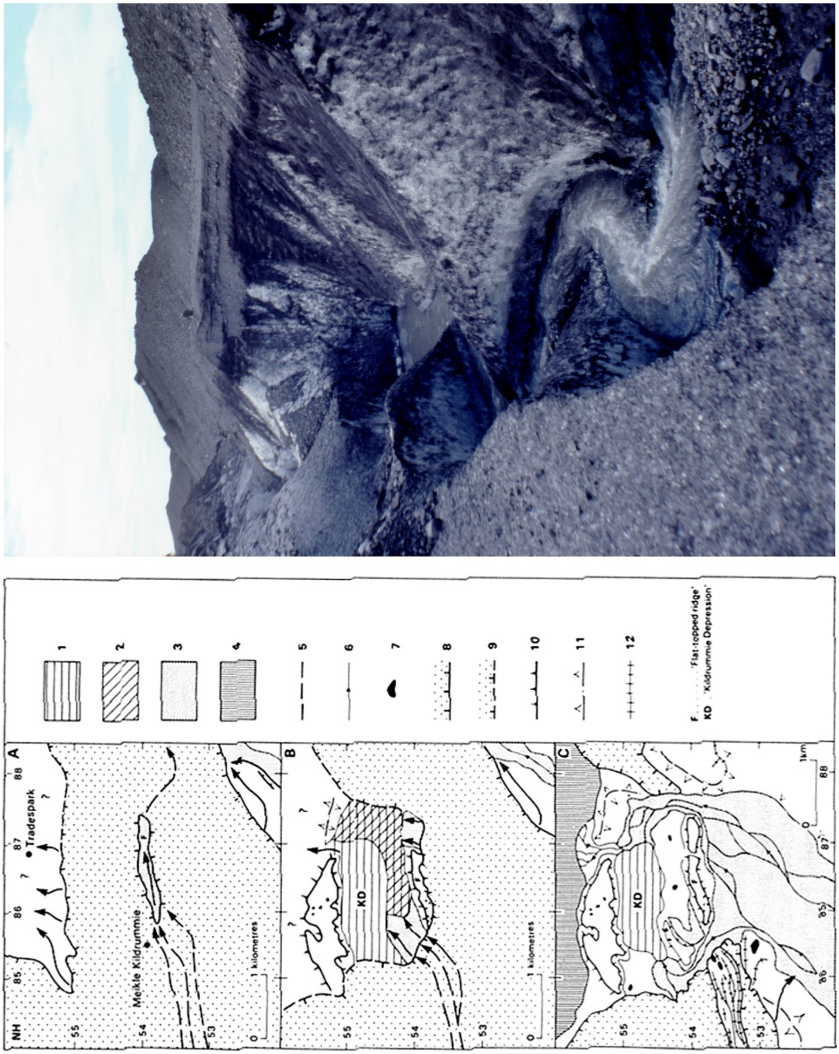

Figure 70. (A) Schematic maps showing the sequential deglaciation of the Kildrummie area (from Firth, 1984). 1, proglacial lake; 2, ground underlain by stagnant ice; 3, outwash terrace; 4, sea; 5, direction of subglacial drainage; 6, subaerial meltwater channel; 7, kettlehole; 8, former ice-margin; 9, former ice-margin; 10, steep slope; 11, generalised slope; 12, esker. (B) Subglacial drainage flowing away from the camera into an ice-walled chasm at Svinafellsjökull, Iceland, in 1991. Note person in distance for scale above where water re-enters a subglacial tunnel.

Glaciofluvial terraces that bisect the eastern end of the eskers near Meikle Kildrummie descend northwards towards a low-lying area of marshy ground known as the 'Kildrummie Depression' (Fig. 70). An ephemeral ice-dammed lake probably occupied the basin during deglaciation, draining via an overflow channel south of Tradespark [NH 869 568] towards the highest recognised marine shoreline in the area, at 23 m OD (Firth, 1984). Firth (1984) correlated this shoreline with an ice front at Kessock (Figs. 16 & 17), suggesting that meltwater was still draining through the system when, following the Ardersier Oscillation, ice within the coastal zone had retreated to the mouth of the Beauly Firth.

The Flemington Eskers and related features offer significant potential for further research on subglacial hydrology and controls on meltwater routes and sedimentation. The gravel forming the anastomosing ridges might have been deposited subglacially (Auton, 1992), possibly during subglacial flood events, or alternatively within subaerial channels on an ice-cored fan surface developed in front of a receding ice margin (Fig. 70 B). These braided eskers, one of the best examples in Scotland, together with others to the north-east around **Easterton**, are associated with transverse ridges (Fig. 14) (**see Upper Strathnairn**) and appear to have formed sequentially, possibly along the suture or 'shear margin' which separated stagnating (Monadhliath) ice within Strathnairn from more active ice that issued from the Great Glen during deglaciation.