Excursion 8 Teith valley and Strathallan

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Purpose: To illustrate glacial and postglacial landforms within the Teith valley and Strathallan, including drumlins, eskers, mounds and 'kame-and-kettle' terrain, and a notable terminal moraine at Callander; to examine exposures of glaciofluvial sand and gravel deposited during the closing stage of the last glacial cycle.

Logistics: The excursion starts at Junction 10 of the M9 just to the NW of Stirling [NS 7740 9530] and follows the A84 (signed to Crianlarich) almost to Doune (see Locality 8.1). Hard hats and other protective gear are required in working quarries. This excursion is best completed using small coaches or private cars. Walking distance is limited at each stop.

Maps: OS 1:50,000 sheets 57 Stirling & Trossachs and 58 Perth & Alloa; OS 1:25,000 sheets 366 Stirling & Ochil Hills West and 368 Crieff, Comrie & Glen Artney; BGS 1:50,000 sheets 39W Stirling and 39E Alloa; locality map (Figure 8.1).

Drumlins, glacial striae and erratics indicate that the Main Late Devensian ice-sheet flowed SE down the Teith valley, east across the low interfluve between Doune and Dunblane, then NE up Strathallan and eventually towards the Firth of Tay. Teith valley ice was deflected through Strathallan by a thicker, more-powerful flow of ice that moved through the Forth valley into the Firth of Forth (Francis *et al*., 1970).

The Dimlington Stadial ice-sheet began to retreat about 21,000 years ago and the higher ground started to become ice free some time later. In the Teith and Forth valleys, ice probably remained for a time as separate, active valley glaciers, whereas ice in Strathallan and in the valley linking Doune and Dunblane became isolated and slowly melted *in situ*. These contrasting histories of deglaciation account for some of the differences in topography. Much of the floor of the Teith valley is characterised by terraced spreads of sand and gravel that were deposited by meltwaters at, or beyond, the ice front. Much of Strathallan, however, shows 'dead ice' topography – moundy spreads of sand and gravel separated by low ground underlain by fine-grained glaciolacustrine deposits. Other differences in topography between the areas are anthropogenic. The sands and gravels of the Teith valley have been exploited extensively, providing high-grade aggregates to markets in central Scotland. In contrast, the gravel deposits in Strathallan have attracted less attention owing to the inclusion of variable proportions of Cromlix Mudstone, which renders the aggregate unsuitable for some purposes. Many of the former gravel pits in the Teith valley have been reinstated so well that it is now difficult to tell what is natural ground.

In Strathallan, the surface of the ice-sheet descended generally towards the east and glacial meltwaters were constrained to flow in that direction, away from the thicker ice that impeded southward drainage in the lower part of the strath. At an early stage in the deglaciation, meltwaters flowed north from Glen Devon into the ice at the head of Glen Eagles, where sand and gravel mounds occur. For a time, those meltwaters escaped via the Kincardine Glen spillway [NN 9450 1050], which led into Strathearn. The spillway controlled water levels within the ice occupying upper Strathallan and consequently the levels to which sand and gravel accumulated within the ice on the floor of the strath. The final disintegration of the ice mass in lower Strathallan eventually permitted southward drainage into the Forth via the present valley at Dunblane.

Ice occupying the Firth of Forth had retreated to Stirling by about 14,500 years ago. The retreat was halted for a time at Stirling by constrictions in the valley. As meltwaters returned to the oceans, relative sea level was high, about 40 m above OD. The lower reaches of the Teith valley, downstream of Kirkton [NN 7030 0270], became ice free before residual ice had melted in the valley separating Doune and Dunblane and probably also in much of Strathallan. The Late Devensian sea probably extended inland to Doune at this time. Ice in the Forth valley then retreated west and had disappeared by about 13,500 years ago, as the climate became temperate.

During the Loch Lomond Stadial from about 12,900 years ago, glaciers re-occupied the Loch Lomond basin and the upper Forth valley. A glacier also advanced down the Teith valley and formed an arcuate terminal moraine in the vicinity of Callander. Meltwaters descended the valley and formed a series of river terraces at lower elevations to those that had

formed more extensively during earlier ice-sheet deglaciation.

Locality 8.1 [NN 677 030] Stirling to Callander: morainic deposits

For the first 6 km from Junction 10 of the M9, the road crosses the flat-lying Carse of Stirling, which formed during the time of the highest Holocene sea (about 14 m above OD). Immediately before crossing the bridge over the River Teith at Doune, take the B8032 to Callander, signposted to Deanston [NN 7215 0120].

Initially, the road passes through relatively subdued topography that is mainly formed of typically unstratified stiff, clayey lodgement till, in which exposures are created from time to time during hedging and ditching operations. The scenery changes dramatically beyond Upper Lanrick [NN 6770 0300], where the road winds through a tract of very hummocky ground. These morainic deposits are typically composed of an angular rubble of locally derived sandstones set in a matrix of pale yellowish brown, fine-grained silty and clayey sand. Although the deposits extend to within a few kilometres of the Highland Boundary Fault, they contain very few clasts of schist and quartzite and must therefore be of very local derivation. The deposits are crudely stratified, indicating that some water sorting occurred during deposition at the ice front. A good viewpoint can be found at the turning for Mid Torrie Farm [NN 6535 0470]. From here a large mound can be seen to the north of the road, where it has been modified into an ancient fortification called the Auld Knowe. Lower in the valley, a river terrace can be seen bordering the River Teith.

Locality 8.2 [NN 6345 0745] Callander: Roman Camp Esker

Follow the B8032 to where it joins the B822 [NN 6365 0515] and continue to the traffic lights at the junction with the main street in Callander. Turn right towards Stirling and park beyond the road junction for Bracklinn Falls. Follow the footpath signposted 'Roman Camp' [NN 6325 0770], passing the Roman Camp Hotel on the right to reach the esker (2 minutes walk; (Plate 8.1)). The footpath continues along the crest of this sinuous ridge of gravel standing 4–5 m high. The esker terminates at the River Teith, where scrapes of well-rounded gravel can be found. The gravel forming the ridge, together with that underlying the terrace bordering the river, is composed mainly of quartzite and schistose gritty metasandstone, derived from the Highlands. Other eskers can be seen across the river to the SW [NN 6350 0725] (Figure 8.1). The Roman Camp and associated eskers were deposited during the Loch Lomond Stadial, by subglacial streams that issued from tunnels at the snout of a valley glacier that had terminated a short distance downstream.

Locality 8.3 [NN 6465 0697] Callander, Gart House: terminal moraine

Continue on the footpath to Geisher Road and cross the A84 at the pedestrian crossing. Follow the footpath northwards and turn right to join the path along the old railway. In a short distance, the terminal moraine associated with the Roman Camp Esker is clearly visible to the north of the path. The moraine takes the form of an arcuate ridge lying across the valley of the River Teith, stretching from here (near Drumdhu Wood [NN 6440 0740]), to a little to the NE of Braes of Greenock [NN 6310 0537] (Figure 8.1). Three distinct, concentric ridges are juxtaposed locally [NN 647 068].

Follow the track eastwards and into the woods to the south and walk along the crest of the feature, which is followed by an old stone wall (Plate 8.2). Note the marked asymmetry of this ridge compared with the esker seen previously. The NW-facing slope of the ridge is very steep and about 12–15 m high, whereas the slope on the opposite side is only 4 m high, and less steep (Figure 8.1). The steep slope formed in contact with the glacier as it ploughed into previously deposited sediments. This part of the feature may be more accurately described as a push moraine (Golledge, 2010) because there is evidence that the glacier had previously advanced a short distance across its own outwash deposits to lay down till (Gartocharn Till Formation) (Figure 8.1). The flattish ground to the SE of the moraine is mainly underlain by outwash sand and gravel that overlie glaciolacustrine deposits. However, this area has been quarried for sand and gravel (Auchenlaich Pit), so now some of the landscape is man-made. There are a few scrapes of both till and poorly sorted, clayey sand and gravel along the moraine, together with numerous angular blocks of schistose gritty metasandstone and Lower Devonian conglomerate. From coring investigations at Mollands (Figure 8.1), the oldest radiocarbon-dated organic deposits that have accumulated within the area formerly occupied by the glacier since its decay, have an age of about 10,000 years. Evidence confirming the age of the moraine comes from an important site at Torrie (Figure 8.1),

immediately downstream of the feature.

For a guide to the Torrie site [NN 6379 0509] see Evans (2003). The site, on private ground, contains evidence of an exceptionally long late-glacial stratigraphical sequence capped by till (Gartocharn Till Formation). The till overlies outwash sand and gravel, as it does at Auchenlaich, but here organic lacustrine silts (Torrie Silts) occur below, resting on an older, presumably Main Late Devensian till. The Torrie Silts consist mainly of dark olive-grey, thinly laminated silty clay with fibrous peaty matter and compressed leaves, probably of dwarf birch. The basal part of the sequence is less organic, but does contains insect remains. The pollen record at Torrie is typical of the Windermere Interstadial (Merritt *et al*., 1990). Analyses of coleopteran (beetle) microfossils reveal a stepwise decline in temperature. Mean July temperatures were initially at least 15°C, but there followed moderate cooling, when the peaty matter was deposited in a lake surrounded by heathland and scrub. A further and rather abrupt cooling then occurred, with mean July temperatures of 10°C or lower, before the area was overridden by the re-advancing glacier. A radiocarbon date of 12,750 ± 70 BP, obtained from the Torrie Silts, proves that the moraine at Callander is of Loch Lomond Stadial age, but a considerable time lag occurred between the onset of the stadial and the arrival at the site of the valley glacier.

Locality 8.4 [NN 6565 0510] Cambusmore: moundy sand and gravel

Follow the track on the east side of the terminal moraine to the lay-by on the main road [NN 6465 0697] and return to vehicles. Continue along the A84 towards Stirling. After 2 km there is a turning on the right leading to Cambusmore gravel pit [NN 6545 0590], which is currently working terraced deposits of gravel deposited by meltwater during the advance and retreat of the Loch Lomond Stadial glacier at Callander. **Prior permission is required to enter these extensive workings and hard hats, etc. are required**. Excursion leaders will need to assess the suitability of available sections. Continue on the main road, passing moundy morainic deposits on either side. Some 250 m beyond the turning (on the left) to Cambusbeg Farm, there is limited evidence of a formerly far more-extensive esker and kame system stretching from old gravel workings [NN 6565 0510] at Cambusmore, down the valley towards Drumvaich.

Locality 8.5 [NN 715 027] Drumvaich to Doune: outwash terrace

From Drumvaich, the road continues over extensive deposits of sand and gravel. 500 m beyond the turning on the left to Lower Coilentowie [NN 6920 0330], the road enters and follows a glacial drainage channel cut into till. This channel carried meltwaters toward Burn of Cambus, where they helped to form an extensive outwash terrace stretching towards Doune. The terrace, which can be examined from the road leading to the Scottish Antiques & Arts Centre [NN 7070 0300], was graded towards the high Late Devensian sea level. This stood at about 38 m above OD in the vicinity of Doune. The sand and gravel underlying the terrace merges downstream, and oversteps glacio-estuarine deposits of silt and sand.

Locality 8.6 [NN 7327 0401] Lerrocks: glacial sand and gravel, till

At Doune, take the A820 to Dunblane [NN 7240 0175]. On leaving Doune, notice that the large area to the left lies at a lower level than the terrace you have followed all the way from Burn of Cambus and upon which the town is sited. This low-lying ground is thought to have been occupied by residual ice at the time the higher terrace was constructed. Take the first turning left, about 3 km beyond Doune, and immediately bear left again, taking the road signposted to Argaty. Follow the road through the Argaty Estate and park at the end of the public road at Lerrocks [NN 7370 0385]. This is an area traversed by major E–W-orientated glacial drainage channels. One can be seen on the left, 400 m before arriving at Lerrocks; it is shown on the BGS 1:50,000 Sheet 39E (Drift edition). Continue along the road, which follows another drainage channel parallel to the one just seen (not shown on the BGS map). Stop near a point [NN 7327 0401] about 500 m from Lerrocks and 300 m before reaching the T-junction to Mid Lundie and East Lundie. Here the road follows the Argaty Burn, which is incised into a gently undulating deposit of outwash gravel. The deposit can be examined to the north of the road, where clast-supported cobble gravel showing excellent imbrication is exposed. The elongated clasts dip north-westwards, indicating that the meltwaters responsible for depositing the gravel flowed in the opposite direction, towards the SE. The gravels consist mainly of local Lower Devonian sandstone and siltstone, some flaggy, mudstone

and conglomerate, together with andesite, porphyritic igneous rocks and some far-travelled Highland crystalline rock types. There is evidence that the Argaty Burn has cut through the gravel deposit into the underlying till, but the actual contact is not always visible. There is a poorly exposed 2 m-high section [NN 7325 0400] in the right bank of the burn close to a wooden fence leading up the bank from the road, although access is rather difficult. The till consists of stones in very stiff greyish red sandy clay. The stones (up to boulder size) are matrix-supported and mainly comprise local sandstone and siltstone, some flaggy. The latter are commonly 'flat-iron' in shape and finely scratched, both features being diagnostic of glacial abrasion. Overall this section is typical of lodgement tills in the area.

In order to better appreciate the overall geological setting, continue up the road, turning right at the T-junction past East Lundie to a spot [NN 7320 0445] on the track leading to the old Argaty Quarry. From here, looking ESE along another glacial drainage channel, this feature can be seen leading towards a ridge of gravel in the distance above Lerrocks. Meltwaters initially flowed ESE, forming channels and locally depositing sand and gravel. As deglaciation continued, the meltwaters took new, lower routes to the south, eventually taking the path of the present valley of the Argaty Burn, where they formed the deposits described at the next locality.

Locality 8.7 [NN 7410 0270] Argaty: the Argaty Esker

Driving southwards from Lerrocks, the Argaty Esker is first seen just to the left of the road, beyond the walled garden and immediately before a sharp left-hand bend in the road. The road follows the esker southwards. The feature can be examined by parking at the turning on the left [NN 7410 0270], signposted Glenwhilk. Walk south along the 4–5 m-high feature, which is flanked by a late-stage glacial drainage channel to the east. The esker continues southwards into a complex of ridges and mounds, but these are now largely quarried away.

Locality 8.8 [NN 7790 0200] Laighhills Park: moundy sand and gravel

Continue to Dunblane and park in the centre. Walk upstream along the east bank of the Allan Water northwards to Laighhills Park, noting exposures of the Scone Sandstone Formation in the river and in small cliffs. Follow any obvious path in the park northwards to a prominent meander bend in the river, at [NN 7790 0200], where a major semipermanent section in glaciofluvial sand and gravel is exposed by the eroding floodwaters of the Allan (Plate 8.3). The grade of the material varies from boulder to pebble gravel to gravelly sand and sand. This exposure can be viewed with care from the top of the bank, or with more difficulty can be accessed along the river bank from upstream. **Beware of active landslips**.

Locality 8.9 [NN 7910 0536] Cromlix Bridge: moundy sand and gravel

From the park, return to vehicles and drive northwards on the B8033, signposted to Braco. North of the former Barbush Quarry at Ashfield, remnants of the former landscape may be seen at [NN 7880 0380]. Stop in the lay-by on the left-hand side of the road, immediately before crossing the double-arched Cromlix Bridge at [NN 7910 0536]. Sandstone can be seen cropping out at the base of the bridge. A stile on the opposite side of the road gives access to high grass-covered mounds, which afford an excellent viewpoint [NN 7912 0533]. The mounds, which are formed of sandy gravel overlying sand, almost block the valley at this point and indeed they once formed part of a barrier, behind which lakes were ponded for a time after deglaciation. Thick, laminated glaciolacustrine deposits occur at depth beneath the floodplain of the Allan Water, both upstream and downstream of this point. Looking north-eastwards, the low-lying floodplain is seen to be flanked on the left by a steep-sided, 20–25 m-high ridge of sand and gravel. This feature has been called a 'beaded' esker because of its irregular height and width. The low-lying ground was occupied by residual ice at the time the sand and gravel was deposited and became a glacial lake. The sides of the feature, which can be inspected at the next stop, are ice-contact slopes.

Locality 8.10 [NN 7970 0640] Cambushinnie: beaded esker

Continue towards Braco over Cromlix Bridge. The road passes initially between the esker and lower, irregular-shaped mounds of sand and gravel to the west. Stop at the entrance [NN 7970 0640] to a small gravel pit on the right, 1.2 km

beyond the bridge. Unlike most eskers, which are narrow and sharply pointed, this one tends to be flat-topped and relatively broad. The sand and gravel forming the feature is better sorted and less coarse than most; the deposits also generally coarsen upwards, which is less usual. A small section may be examined in an old pit about 400 m to the SW, adjacent to the road [NN 7940 0610]. It is almost impossible to park at this location, so great care must be exercised when walking along the road. Here the gravel comprises siltstone, sandstone, porphyritic andesite and other porphyritic igneous rocks in addition to local Cromlix Mudstone, which makes the deposit clayey overall. Although not currently seen, cross-stratification indicated fluvial transport towards the SSW. The sand and gravel forming the Cambushinnie Esker was probably deposited by meltwaters flowing southwards within an open, ice-walled channel.

Locality 8.11 [NN 8390 0990] Braco: kame-and-kettle terrain

Continue on the B8033 to Braco, crossing several NW–SE-orientated glacial drainage channels. Parking is first on the right, entering the village [NN 8340 0960]. The local bedrock, of Scone Sandstone Formation, may be seen to the north of Bridge of Keir, just to the west of the village [NN 8332 0950]. To the south of the bridge, the glaciofluvial sand and gravel landform has been modified into the Iron Age, Grinnan Hill Fort.

Return to vehicles, turn left in the village onto the A822 and cross the River Knaik, just north of which parking is available on the left if you wish to visit the impressive Ardoch Roman Fort, described as one of the best preserved in the Roman Empire.

Locality 8.12 [NN 8700 1065] Orchill, Seathaugh: glaciofluvial landscape

From Ardoch, turn right onto a minor road signposted to Seathaugh. This road first crosses an undulating plain of outwash sand and gravel that was deposited by meltwaters entering Strathallan from the valley of the River Knaik, to the NW. Continuing eastwards, the plain becomes increasingly pitted by irregularly shaped, poorly drained hollows called kettleholes, indicating that deposition occurred whilst some ice remained in the area. Follow this road for 3 km to Orchill. Here the sand and gravel has largely been worked out, but tracks around the commercial fishery may show small sections in the deposit. Continue for another kilometre, before turning right towards Panholes and Blackford. Beyond this turn-off the road passes through spectacularly developed kame-and-kettle topography, dissected by some deep, winding, drainage channels.

There is a public footpath [NN 8945 0964] leading to Blackford some 600 m beyond the turning on the right to Milton of Panholes. Park on the verge just beyond the end of the path. There are deep kettleholes on both sides of the road. Follow the path towards the railway and Blackford. Exposures of sand and gravel can be examined in the escarpment overlooking Blackford, which is probably an original ice-contact slope. The gravels comprise local sandstone, conglomerate, porphyritic andesite and other porphyritic igneous rocks, together with rare Highland crystalline rock types. Follow the escarpment westwards to gain a good vantage point looking down Strathallan. Flat-topped kames, demonstrating a consistent upper surface, can be seen bordering the Holocene alluvial plain of the Allan Water. Looking north-eastwards, the skyline coincides with a series of bracken-covered eskers, now forming part of the Gleneagles Golf Course complex.

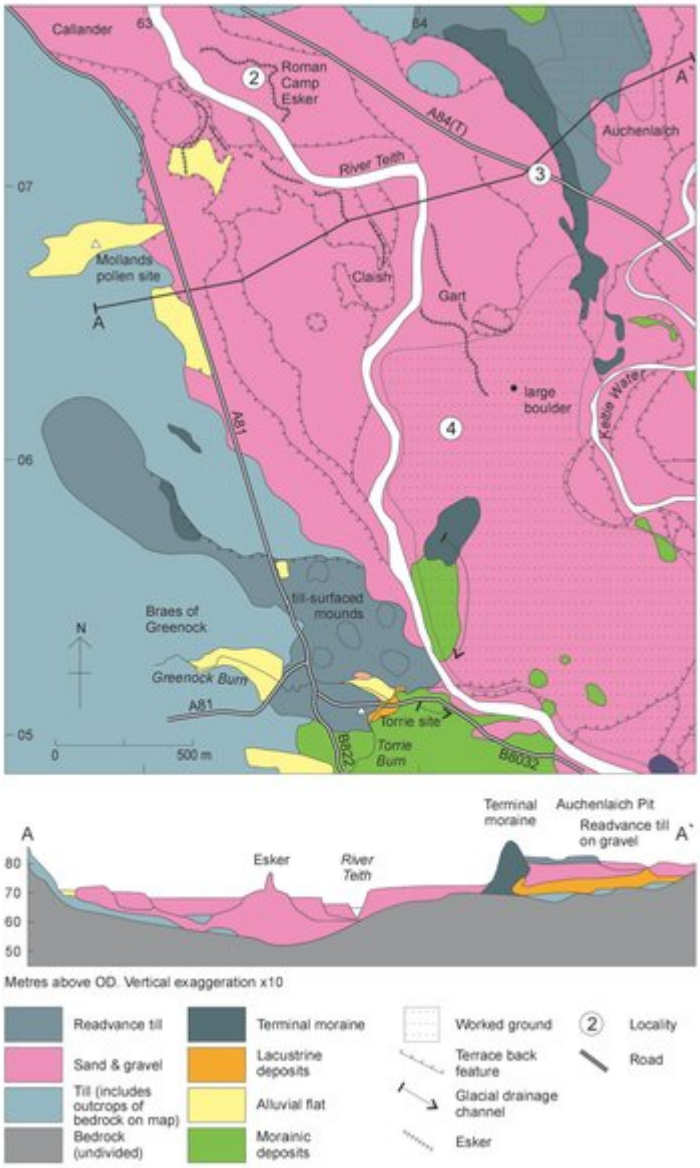
Locality 8.13 [NN 9250 1000] and [NN 9300 0940] Gleneagles: esker and glacial spillway

Continue on the road to Blackford, joining the by-pass heading towards Perth and turn left at the first junction towards Gleneagles Golf Course.

There is a small access strip [NN 9250 1000] just to the north of the slip road leading from the dual carriageway, at the junction with the A823. Park here in order to gain access to the wood covering a hillock, which is part of an esker that was modified into an ancient hill fort. Follow the ridge northwards to the edge of the wood, where there are fine landscape views (Plate 8.4). The ridge is one of a swarm that continues intermittently WNW from near Kincardine Glen across the Gleneagles Golf Course towards Kaims Castle. Kincardine Glen can be seen towards the east. This was a major glacial spillway during the deglaciation of upper Strathallan. It operated whilst the lower part of the valley remained

blocked by ice. The height of the spillway controlled the level of the glaciofluvial regime in upper Strathallan, particularly during the period of formation of the kame terraces seen at the previous locality. If wished, the Kincardine spillway can be seen from the bridge on the A823 near Gleneagles Castle [NN 9300 0940].

References



(Figure 8.1) Quaternary geological map and cross-section of the Teith valley south of Callander.

(Plate 8.1) Locality 8.2. Roman Camp Esker, Loch Lomond Stadial age, Callander.

(Plate 8.2) Locality 8.3. Drumdhu Wood terminal moraine, Loch Lomond Stadial age. (Photo: M. Hawkins)

(Plate 8.3) Locality 8.8. Glaciofluvial gravels, Late Devensian age, Laighhills Park, Dunblane.

(Plate 8.4) Locality 8.13. Glen Eagles U-shaped valley, looking south.