

**Sat 11<sup>th</sup> Aug 2018**

**HGS visit to the Ailnack Gorge, leader Prof David Macdonald (University of Aberdeen).**

Purpose of Field Trip:

This excursion took us to the Ailnack Gorge which our leader noted is sometimes called "Scotland's Grand Canyon". While this, as Professor Macdonald declared, is more than a little overblown, but nevertheless is an impressive erosional feature, stretching 2-3 km and reaching depths of almost 100 m. The gorge is the product of glacio-fluvial erosion in the waning stages of the last glaciation, but more importantly it provides a window into the evolution of the landscape of the eastern Highlands. Here the Caledonian unconformity between Dalradian metasediments and Old Red Sandstone conglomerates is spectacularly displayed, and it is obvious that these later sedimentary rocks buried pre-existing relief on the unconformity surface.

The excursion's purpose was to study the unconformity, the underlying metamorphic rocks, and the overlying strata allowing the unconformity to be traced through the landscape. From the geological maps of the area it also becomes obvious that the rounded hills of Abernethy, Cromdale, and east to the Ladder Hills and The Cabrach owe their existence to the shape of the unconformity surface rather than to glaciation, implying that that ice has influenced the present land surface much less than perhaps was previously thought.

Introduction:

The geology around Tomintoul comprises a Dalradian metasedimentary basement consisting mainly of 'schist' (pelitic and psammitic) along with quartzites and metalimestones, these carrying a large Old Red Sandstone (ORS) outlier some 15 km long, one of several in the northern Grampian foothills. The Dalradian rocks were metamorphosed and uplifted during the Caledonian orogenic event with the pressure-temperature signature at present exposure level indicating several kilometres of stripping, mainly during emergence from the ocean and uplift of the Caledonian Mountains. These were probably Alpine rather than Himalayan in scale. Their feet were progressively buried in ORS deposits, draped across a rugged paleolandscape preserved as the Caledonian Unconformity. The ORS here is typically a basal conglomerate, indicating intense erosion by powerful torrents in a steep mountain landscape. However, the survival of the Tomintoul and other outliers suggests that the present hilly land surface around the Cairngorms is not far below, and locally still above, that which was evolving in the Devonian. Thus, arguably, remarkably little has happened here by way of large-scale erosion in the last 400 million years.

Field Report:

The Water of Ailnack Gorge is one of the largest and most dramatic glaciofluvial meltwater channels in Britain. It cuts the southern end of the Tomintoul Outlier for about 3 km, and together with exposures in the incised River Avon valley offers one of the finest sections through the unconformity. The gorge is 50-100 m deep, with faulting complicating the exposures. Near the mouth of the gorge, ORS is present on both sides; upstream, it reappears on the NW rim and down near to the floor for about 700 m at

NJ145152. Here, land-slipping makes a descent to the river possible and this provides the main goal of the visit.

Our first stop was 100 m south of Queen's View carpark to look at Dalradian schists exposed unconformably beneath the Devonian Delnabo Conglomerate. A roadside cutting largely covered in debris (exposure had deteriorated since David's earlier visits) illustrated the irregular nature of the unconformity at fine as well as larger scale. 100 m further south a nice fresh roadside exposure of Devonian conglomerate was visible with a variety of clast sizes ranging from boulder to pebble. Some minor faulting was present where haematite had been replaced by quartz cement giving the fault zones a pale colour. Some clasts were of rotten mica-schists but there were no visible granitic clasts.

By the bridge over River Avon we saw another exposure of ORS conglomerate, though with none of the mica-schist visible higher up the road and again no granitic clasts. One of our members pointed out imbrication suggesting a depositional flow in a northerly direction. This ORS occurrence in the present valley bottom tens of metres below the Queens View Dalradian exposure emphasise the steepness of the paleoslope (valley or scarpfoot) against which it had accumulated. This paleosurface is the Caledonian Unconformity. It was speculated that the present Avon valley may actually be exhuming a proto-valley on a similar alignment, descending northwards from a proto-Grampian divide. David argued that this divide has not shifted materially since the granite batholith was intruded late in the orogeny along the terrane axis. With high peaks of Alpine scale only 12 km to the south, the valley would have been a major ravine experiencing torrential floods.

Walking up the initial steep track above Delnabo House, David pointed out the mouth of the Ailnack Gorge, at this location incised into ORS conglomerate. He envisaged the gorge being cut as a single catastrophic event during deglaciation. Once up on the moor, we gained the rim of the gorge and could see a transition on the far side from ORS to Dalradian, indicating that the gorge roughly follows the unconformity (the near side remaining ORS to the end of the Tomintoul Outlier). Here, a large slice of the gorge rim has slipped away creating a mid-level terrace; similar though smaller rock slope failures (RSFs) were spotted on both sides further upstream.

Walking up the moor we encountered a small trackside quarry exposing a section of fluvio-glacial sediments lying parallel to the gorge and extending around 100-200 m from the gorge edge. The exposure was relatively fresh, with its top few metres showing a small channel with fine cross bedding indicating low current speeds. Some pebbles were imbricated suggesting flow was parallel to the gorge. The feature stretched for 400 m or so, bounded inland by a steep bank around 5 m high, with similar depths exposed on both gorge rims, a possible matching feature extending opposite. Explanation of the feature ranged from it being an esker with David Jarman speculating as to whether it was an overbank deposit resulting from a large flood outburst due either to a second meltwater event or perhaps due to a blockage of the gorge by a RSF and the bursting of a landslide dam. Disappointingly these features are not clearly visible when looking at Google Earth although the quarry itself can be seen.



*Fluvio-glacial deposit on moorland beside the Ailnack Gorge*

Once on the higher part of the moor the wider landscape became visible. Tomintoul lies in a shallow bowl surrounded by low lying hills, many with “Tom” names (Gaelic, small rounded hill) Tom Trumper, Tom na Bat, Tom Buirich etc. David argued that these “Toms” are part of the ancient landscape (around 400 Ma old) cut into the Dalradian schists as the Caledonian Mountains were reduced down from Alpine peaks to more subdued relief. They are draped with remnants of once much thicker ORS cover. Most of these ORS outliers occur around 200-600 m elevation, suggesting a ‘window’ of relative protection from long-term exposure to both higher-mountain erosion and marine trimming when sea levels were higher. Quaternary glaciation has probably trimmed the outliers where their edges thin out.

David explained the finer points of the Caledonian Unconformity. Rather than a simple view of an extensive erosional surface preserved in a single depositional event or episode over a short geological period of time, it is time-transgressive, with the outer parts being oldest and the contact point migrating inland and uphill as burial progresses. When looked at in detail we see a very complex landform.

After lunch on the rim of the gorge we continued over a brow at 440 m elevation. From here we could see across a shallow bowl to the conspicuous notch (‘The Castle’) where the Water of Ailnack cuts through a ridge in a 100 m deep gorge. Above this notch, it is named Water of Caiplich, and meanders through an upland basin. When the natural outlet from this basin east into the River Avon was blocked by ice during deglaciation, meltwaters dammed then overflowed, cutting the notch and the 6 km-long Ailnack gorge. The former Caiplich valley now continues as Glen Loin.

We admired the tor-dotted skyline above the notch - Ben Avon (1171m). David remarked that the tors have been dated to several hundred thousand years old, and have thus survived glaciation. Some nearer Cairn Gorm have been dislodged or stripped by ice, but the cover was generally thin and not very erosive. Indeed the idea that glaciation has given us our smooth rolling Highland landscapes is a myth (as evident in the spiky Western Highlands where ice was much thicker). The landscape of NE Scotland is basically a very old surface - despite being exposed to erosion for 400 million years, it has still not been reduced to a peneplain! Erosion by weathering and the action of ice has merely smoothed and slightly modified the ancient surface. The valleys are quite narrow and deep, mainly fluvial with some glacial shaping and straightening. The survival of ORS even in the floors attests to their not having cut deeply into the ancient surface. NB: rates of ice flow are governed by the amount of precipitation, as well as temperature.

The Ailnack Gorge itself is a spectacular glacial meltwater channel cutting through a high part of the moor. From this brow, David Jarman pointed out the former course of the Ailnack which had flowed NW to the Burn of Brown. Con Gillen (University of Edinburgh) observed that the shallow bowl had a flat floor suggesting a temporary ice-dammed lake, as is common all along the Cairngorms front to the Spey ice-stream. If this lake overflowed at the brow, it would cut (or recut) the outer Ailnack gorge, which has raw walls much sharper than the more subdued and vegetated ones up to the Caiplich notch. Such an outburst flood event, charged with reworked debris, could have briefly exceeded the capacity of the earlier outer valley/gorge and spewed out the overbank deposit we had just studied.

Most of the group elected to descend cautiously to the bottom of the gorge where we could view the Caledonian Unconformity. The Devonian made up the upper half of the NW side of the gorge with the Dalradian semi-pelites comprising the SE side of the gorge. Looking downstream, we could plainly see the irregular step-like nature of the unconformity. Also evident were small exposures of Dalradian limestone, with associated tufa deposits lining the rocks below the exposures. The Dalradian semi-pelites included layers of garnet mica schists with some kyanite present. David and Stewart pointed out many fascinating rocks in the riverbed, including a rare boulder of Dalradian conglomerate, and another blurred purple with amethyst. David borrowed a lighter but could not ignite a suspected bituminous sliver adhering to a boulder.

A few smallish well-rounded granite boulders attested to their transport at least 8 km by ice and meltwater flood. The continuing absence of granite clasts in the ORS conglomerate confirms that the pluton had not yet been unroofed, although David argued that it must have been getting close, as it must be not far above present land surface. The intrusion of this large elongated batholith has contributed to the long-term buoyancy of the Grampian Highlands - you can't keep a good mountain down!

David now devoted attention to gradations in breccia-conglomerate clast size, roundness and structure, with land-slipped blocks of ORS in the floor being coarsest, and exposures higher up progressively finer.

The group having spent half a midge infested hour in the gorge then scrambled to the top in the hope that a breeze might disperse our unwanted friends.



*Group viewing the Ailnack Gorge unconformity, Devonian (upper left) and Dalradian (right)*

In the mean-time, David had given Ann the task of receiving the gentler lower slopes of Carn Tuadhan to the west of the gorge, to look for possible small exposures of Devonian rock: no outliers were found. However, absence of evidence isn't evidence of absence, a good point to remember!

The group then met up at the Delnabo carpark where David gave a resume of what had been an enjoyable and interesting field trip looking at spectacular features with more than a little food for thought thrown in.