# Pentland Hills

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Route: (Map 21) and (Map 22)

## Introduction

The Pentland Hills are made up of Lower Old Red Sandstone lavas and sediments with a core of Silurian rocks. The latter are generally steeply dipping and are exposed in three inliers known as the North Esk Inlier (p. 174), the Bavelaw Castle Inlier and the Loganlee–Craigenterrie Inlier. The Lower Old Red Sandstone lavas consists of ten groups of lava flows (Mykura 1960. pp. 131–155) which include olivine-basalts, andesites, trachytes, dacites and rhyolites, as well as acid and basic tuffs. They attain a thickness of over 2000 m in the north, but thin rapidly to the south. Near the southern end of their outcrop up to 600 m of Lower Old Red Sandstone conglomerate and grit are present between the lavas and the underlying Silurian strata. Upper Old Red Sandstone, composed mainly of pink sandstone, rests unconformably on an eroded and undulating land surface of the older rocks. It forms the East and West Cairn Hills in the south-western part of the range but near the northern end of the Pentlands, at Torphin Hill, it is very thin and in places completely overlapped by basal Carboniferous beds.

The present topographic pattern of the Pentland Hills was initiated in the Tertiary era, and was later modified by the Highland ice which overwhelmed the area in Pleistocene times. Thus some of the Pentland passes, such as the Cauldstane Slap and the Bore Stane, are sited on the beheaded courses of Tertiary rivers which drained to the south-east, while other major through-routes were formed as late-glacial drainage channels carrying meltwaters from the north-west slopes of the range into the Midlothian Basin.

The itinerary forms the basis for two half-day excursions from Edinburgh.

Bavelaw Castle to Loganlee Reservoir

Torphin Quarries: basalt lavas, boles, baryte veins

## Excursion A. Bavelaw Castle to Loganlee Reservoir

The object of this half-day excursion is to study the Silurian rocks of the Bavelaw Castle and Loganlee inliers, the overlying conglomerate, felsite and basic lavas of Lower Old Red Sandstone age, as well as the red sandstones ascribed to the Upper Old Red Sandstone which rest unconformably on all the older rocks. In addition, the route follows one of the major glacial melt-water channels in the Pentland Hills.

Access can be either by private transport or Eastern Scottish service bus. Using a car or private bus, travel to Balerno and thence south past Marchbank Hotel to a small car park [NT 165 637]. From there the route stays close to the public right-of-way past Bavelaw Castle to the head of Loganlee Reservoir and returns the same way. Total walking distance is 10 km; time 3 hours. Alternatively, take the service bus to Balerno and then walk 4 km to Bavelaw Castle. The homeward journey can also be made by walking down the valley of the Logan Burn past Glencorse Reservoir to Flotterstone, and thence by service bus to Edinburgh. The total walking distance is 15 km, and a time of at least 4.5 hours should be allowed.

### 1. Bavelaw Castle: Late-Glacial drainage channels

A traverse from the road-end at Bavelaw Castle to the wall on the north-west slope of Hare Hill [NT 168 623], 600 m to the south, crosses the intakes of three late-glacial drainage channels which carried meltwaters from the decaying ice just west of Hare Hill via Green Cleugh to Loganlee. The courses of the two higher channels are successively truncated by those of the lower ones.

Locality 1 forms a good viewpoint from which the following features can be observed:

1. Two small curved drainage channels contouring the low ground immediately to the south.
2. The profile of the north slope of Hare Hill, originally an evenly sloping hillside, in which the Bavelaw-Loganlee channel is now entrenched.
3. The alluvial flat extending for 1.2 km west-southwestwards from Threipmuir Reservoir, which may been part of the floor of an ice-dammed lake formed at a later stage in the retreat of the ice-sheet. The waters from this lake escaped through the gap between Black Hill and Bell\'s Hill [NT 198 643] to join the lower part of the BavelawLoganlee channel which flowed by Glencorse Reservoir to Flotterstone.
4. The flat top of East Cairn Hill (560 m) which is thought to be a residual portion of the Tertiary 600 m peneplain.

Features of interest seen looking west from here are (left to right): Corston Hill [NT 095 635], composed of mugearite and olivine-basalt lavas of basal Oil-Shale Group (Arthur\'s Seat Volcanic Rocks) age; Dalmahoy Hill [NT 135 779], a sill of teschenitic dolerite containing the rare mineral chlorophaeite; and Ratho Hill [NT 128 714], a sill of quartz-dolerite.

### 2 and 3. Bavelaw Castle: Silurian

Silurian rocks of the Bavelaw Castle inlier are exposed in two small quarries south and west of Bavelaw Castle. The strata are nearly vertical and consist of grey-green mudstones with silty laminae. They are poorly fossiliferous but some of the genera recorded are: the brachiopods Lissatrypa and Lingula, the trilobites *Leonaspis lothiana* and *Acernaspis* sp, the gastropod (?)*Liospira*, bivalves, (?)*Ctenodonta* and orthocone cephalopods. The beds of the Bavelaw Castle inlier were for a long time thought to be of Wenlock age, but Lamont (1947) has shown that they are of Upper Llandovery age and may belong to the oldest Silurian rocks exposed in the Pentland Hills. In both the quarries the sediments are intruded by dykes of finegrained andesine-dolerite. There are five dykes varying in thickness from 0.9 m to 3.4 m in the northern quarry and two, respectively 1 m and 7.5 m thick, in the southern. Most of the dykes are slightly transgressive to the bedding of the sediments.

### 4. North of Hare Hill: dykes

A large swarm of highly decomposed basic dykes is exposed on the slopes of the glacial melt-water channel between 500 m and 550 m south-east of Bavelaw Castle, most westerly of these dykes may be up to 45 m thick and all are so highly decomposed that they are easily mistaken for grit.

### 5 and 6. North of Hare Hill: glacial melt-water channels

The gentle gradient of the floor of the channel remains constant as far as a point 600 m south-east of Bavelaw Castle (5). Beyond this point it steepens slightly and the valley floor loses some of the characteristic flatness of a drainage channel.

The north bank of the original east-west channel is breached 750 m south-east of Bavelaw Castle (6), and a secondary channel leads off northwards. This branch channel has the shape of a typical glacial drainage channel for the first 130 m of its course, but beyond this it deteriorates into a normal stream valley. It appears to have been initiated during a late stage in the decay of the ice-sheet that covered the north-west slope of the Pentland Hills. At first the ice in this area formed a continuous sheet and the only escape for the glacial meltwater was eastward, probably in a tunnel beneath the ice or along a crevasse in the ice, via the valley of the Logan Burn into the North Esk valley, which had become ice-free by then. As the climate became progressively warmer the local ice would become thinner and the crevasses would widen. The meltwater would eventually find a way along one of these crevasses and flow directly downhill towards the valley now occupied by Threipmuir Reservoir. Eventually all the meltwater would pass through this more steeply inclined northern channel. This led to the downcutting of the floor of the original channel on either side of the new outlet, the limit

of back-cutting being marked by knick-points.

Up to 400 m farther east several small streamlets, which have cut gullies into the north slope of Hare Hill, have deposited small alluvial cones on the flat bottom of the main channel. One of these now forms the watershed in the channel and is thus an example of a delta-watershed or corrom.

### 7 and 8. North-east of Hare Hill: Silurian, Old Red Sandstone and felsite

The westerly of the two big gullies (7) cut in the south bank of the channel exposes sparsely fossilferous, steeply inclined Silurian strata, which consist of purplish-grey siltstones and mudstones with thin ochre-coloured f1aggy ribs. The fossils recorded from this locality include: *Ungula*. the graptolites *Monograptus* and *Retiolites*, the problematic organism *Dictyocaris*, rare bivalves and orthocone cephalopods.

The western bank of the second gully (8) shows Silurian strata which dip steeply to the west-south-west and have yielded the trilobite *Leonaspis*, *brachiopods* such as *Lissatrypa*, bivalves and orthocone cephalopods. The east bank of this gully is cut in Upper Old Red Sandstone, which consists of pink sandstone with layers full of small sub-angular pebbles of quartzite and Pentland lavas. The sandstone has been faulted down against the Silurian to the west. For a short distance east of the gully, Upper Old Red Sandstone appears to rest directly on Silurian, but about 30 m east of the small sandstone cliff an exposure in a small water-scoop shows Upper Old Red Sandstone resting on weathered felsite.

Felsite is exposed for a considerable distance on both sides of Green Cleugh, and the accumulation of its platy scree has here obliterated the original cross-section of the glacial drainage channel. The felsite, which forms Black Hill, has in thin-section the characteristics of microgranite, and is a distinctive rock as it contains porphyritic crystals of micro-pegmatite, a graphic intergrowth of quartz and feldspar. Near Habbies Howe the felsite on the south slope of Black Hill is unconformably overlain by a thin cap of Lower Old Red Sandstone conglomerate which dips at up to 25° to the south-south-west.

### 9–11. Logan Water: Lower Old Red Sandstone Conglomerate, glacial features

Lower Old Red Sandstone conglomerate is well exposed in the gorge of the Logan Water between localities 9 and 11. It is a fluvial conglomerate with rounded pebbles of greywacke. jasperised basic lava and radiolarian chert, which were probably derived from the south. Blocks of Silurian limestone which have yielded corals and other fossils, are found 90 m to 140 m upstream from the lowest waterfall (10). Near the waterfall the conglomerate passes down into a brownish pebbly grit which contains, in addition to the rounded pebbles mentioned above, some smaller angular pebbles of igneous rocks. The latter are mainly trachytes and more basic lavas, but a number are composed of felsite containing phenocrysts identical to those in the B1uck Hill felsite. Such felsitic fragments are well seen in some loose blocks of conglomerate lying just east of the stream at the point where it emerges from its gorge on to the flat bottom of the glacial drainage channel. The conglomerate, both in the gorge and in the cliff to the east, is cut by irregular sills and dykes of Black Hill felsite and there is also a sill of andesine-dolerite which crosses the lowest waterfall.

There is a marked change in the character of the valley of the Logan Burn at a point 250 m upstream from the waterfall (11). Above this, the stream flows in a fairly wide valley which is largely floored by boulder clay: below, it passes into a post-glacial rock gorge. The pre-glacial course of the Logan Burn appears to run to the south of Habbies Howe cliff to join the present course of the stream about 400 m south-west of Loganlee.

### 12. South-west of Loganlee Reservoir: Black Hill felsite and Silurian

The vertical junction between the Black Hill felsite and the Silurian strata of the Loganlee-Craigenterrie inlier is exposed just north of the path 450 m south-west of Loganlee Reservoir. Slightly higher up the hillside the felsite is said to spread out horizontally in places over the truncated edges of the Silurian sediments, but the evidence for this cannot be conclusively demonstrated from present-day exposures. Steeply inclined Silurian strata are exposed on the truck for a distance of 200 m down the valley. They consist of grey shales and mudstones and have in the past yielded several species of graptolites. Thin beds of fine-grained turbidite sandstone with load and flute casts on their bottom surfaces can

be seen. The bottom structures indicate that the beds young to the west-north-west.

The shape and origin of the Black Hill felsite mass has been a matter for some speculation. Geikie suggested that the felsite forms a vertical sheet intruded along the bedding of the Silurian strata, while Peach described it as a laccolith intruded along the plane of unconformity between the Silurian and Old Red Sandstone sediments. More recently it was realised that angular blocks of felsite occur near the base of the overlying conglomerate, that the felsite on the north-west side of Black Hill is locally vesicular, and that certain dyke-like bodies of felsite intrusion-breccia with a markedly scoriaceous matrix occur within the outcrop. A theory which could satisfactorily explain all the observed field relationships, is that the felsite may have been extruded in early Old Red Sandstone times to form a cumulo-dome, or mamelon, on the Silurian land surface. This dome was soon covered by greywacke-gravel in which some of the felsite scree forming around the base of the dome was incorporated. The sills and dykes of felsite found in the Lower Old Red Sandstone conglomerate overlying the felsite are attributed to a later intrusive phase of activity of the felsite magma.

### 13. Loganlee: Old Red Sandstone lavas

The Silurian inlier of Loganlee is bounded on the east by a fault with a large easterly downthrow. This is exposed on the north bank of the stream 240 m south-west of Loganlee Reservoir, where a layer of purple basaltic tuff, intercalated with lavas of the Carnethy group, abuts against the Silurian.

Along the road to Glencorse Reservoir numerous exposures of this tuff, locally interbedded with tuffaceous sandstone, and of the Carnethy basalt and basic andesite lavas can be examined. A good section of these rocks, including some porphyritic flows of basalt, is also exposed in a southern tributary which enters the Logan Burn at Lovers' Loup, 500 m south-west of Loganlee Reservoir.

If this excursion is combined with the Torphin Quarry-Bonaly Tower excursion (p. 169), the path leading from Glencorse Reservoir to Bonaly Tower should be taken. It is then most convenient to reverse the order of localities in the latter itinerary. Alternatively, good exposures in the rhyolite of Bell's Hill and Castlelaw Hill and the biotite-dacite of Capelaw Hill, are easily accessible from Glencorse Reservoir. Sections of auto-brecciated olivine-basalt flows of the Carnethy Group are exposed along the road to Flotterstone.

## Excursion B. Torphin Quarry–White Hill–Bonaly Tower

The excursion is concerned with the Lower Old Red Sandstone basalt, andesite and trachyte lavas and intercalated sedimentary rocks which form the Pentland Hills. It also provides an opportunity to collect a number of vein minerals, particularly baryte.

Access is by Lothian Region Transport bus to Torphin Golf Club, and then 500 m walk to Torphin Quarry. Cars and private buses can be taken to the quarry entrance, where parking space is available. It is advisable to get permission from the quarry operators to enter Torphin Quarry. At the time of writing the faces in the working quarry are loose and dangerous, and special care should be taken at all times. Walking distance is 6 km; time 3 hours.

### 1. Torphin: conglomerates

The road to Torphin Quarry passes to the north of a grassed escarpment with poor exposures of pink calcareous conglomerates containing subangular pebbles of various Pentland lavas, as well as quartz and quartzite. The age of this conglomerate has been taken as Upper Old Red Sandstone, but a temporary exposure 360 m to the south-east has shown that typical Lower Carboniferous sediments occur very close to the post-Lower Old Red Sandstone unconformity in this area. It is therefore quite likely that the conglomerate is of Lower Carboniferous age, and that the lavas of Torphin Hill and White Hill may have formed an ’island’ above the plain of deposition until well into Carboniferous times.

### 2. Torphin Quarries: basalt lavas, boles, baryte veins

The lavas of Torphin Quarries form part of the Warklaw Hill group of olivine-basalts. This is the lowest group in the known portion of the Pentland Hills succession and can itself be divided into four distinctive groups of flows (a-d, of route-map). The basalts exposed in the quarry belong mainly to group b, with some flows of group c near the top of the south-east face.

The basalts of group b are black and fine-grained, with small reddish phenocrysts of olivine pseudomorphed by iron oxide and iddingsite. In thin-section their groundmass contains much alkaline feldspar and they have a trachytic texture. The characteristic feature of the group is the thickness of its two lowest flows. The lowest, which rests on a band of tuff, is up to 18 m thick and is locally flow-brecciated near its top. The second flow which is the flow principally worked in the quarry, attains a thickness of nearly 30 m and is non-vesicular throughout. It is overlain by a prominent bed of waterlain tuff, composed largely of small rounded clasts of weathered basalt. The higher lava flows, seen in the upper face of the quarry, are much thinner and have weathered tops which pass upward into pebble-beds of weathered lava debris. This suggests that these flows were undergoing rapid weathering and some active erosion shortly after their formation. The flows of group c. which are best examined near the summit of Warklaw Hill, are highly vesicular and are composed of macroporphyritic basalt with phenocrysts of altered olivine and feldspar in roughly equal numbers. Note: part of the northern quarry is now filled in, and the lower part of the original section is no longer exposed.

The faces of Torphin Quarry are cut by a number of small faults and joints. Some of these are lined with coarsely crystalline baryte and calcite. Good specimens of platy baryte, including cockscombe spar are to be found. Many lava blocks lying in the quarry are highly amygdaloidal and some amygdales contain chalcedony and agate.

### 3. Torduff Reservoir: basalt lavas of Lower Old Red Sandstone, glacial features

The highest flows of the Warklaw Group (group d) are well exposed on the roadside on the west bank of Torduff Reservoir. They are usually 3 to 4 m thick and highly amygdaloidal throughout. The purplish-grey basalts are macroporphyritic, with phenocrysts of altered feldspar measuring up to 5 mm predominating over the smaller altered ferro-magnesian phenocrysts. In the road-cutting 45 m west of the waterman’s cottage a number of veins and irregular masses of siltstone and mudstone are found near the top of a flow; these appear to be filling cracks and cavities in the lava.

Torduff Reservoir lies in the valley formed by a north-east trending fault. In late glacial times this valley formed part of a drainage channel which was cut during the final stage in the northward retreat of the ice-sheet from the Pentland Hills.

### 4. Clubbiedean Reservoir: Upper Old Red Sandstone sediments

The unconformity between Lower and Upper Old Red Sandstone lies close to the south end of Torphin Reservoir. Sections of Upper Old Red Sandstone are seen in the burn between the two reservoirs and also close to the road. The sandstone contains a number of thin cornstone (caliche) horizons, which represent fossil soils (pedocals) developed during long periods of reduced deposition in a tropical climate. Outcrops of cornstone occur on the hillside south-east of the track, but the area is fenced off from the public.

### 5. Torduff Hill: trachyte lava of Lower Old Red Sandstone

Torduff Hill is formed of pale-grey fine-grained trachyte, which closely resembles the trachyte of the Braid Hills near Edinburgh. It is locally flow-banded and there are a number of well-defined belts which have been brecciated in a manner suggesting flow-brecciation. The field evidence suggests that this trachyte is separated from the lava groups on either side by faults, and it seems likely, though not certain, that Torduff Hill forms a structural horst.

### 6. White Hill: basalt and andesite of Lower Old Red Sandstone

The lavas forming the crags of White Hill belong to the Bonaly group, which consists of feldspar-phyric olivine-basalts and pyroxene-andesites in its lower part, and of non-porphyritic andesites with one thin flow of trachyte in its upper part. The lower olivine-basalts and andesites are well exposed in the Dean Burn. The upper non-porphyritic flows are seen on

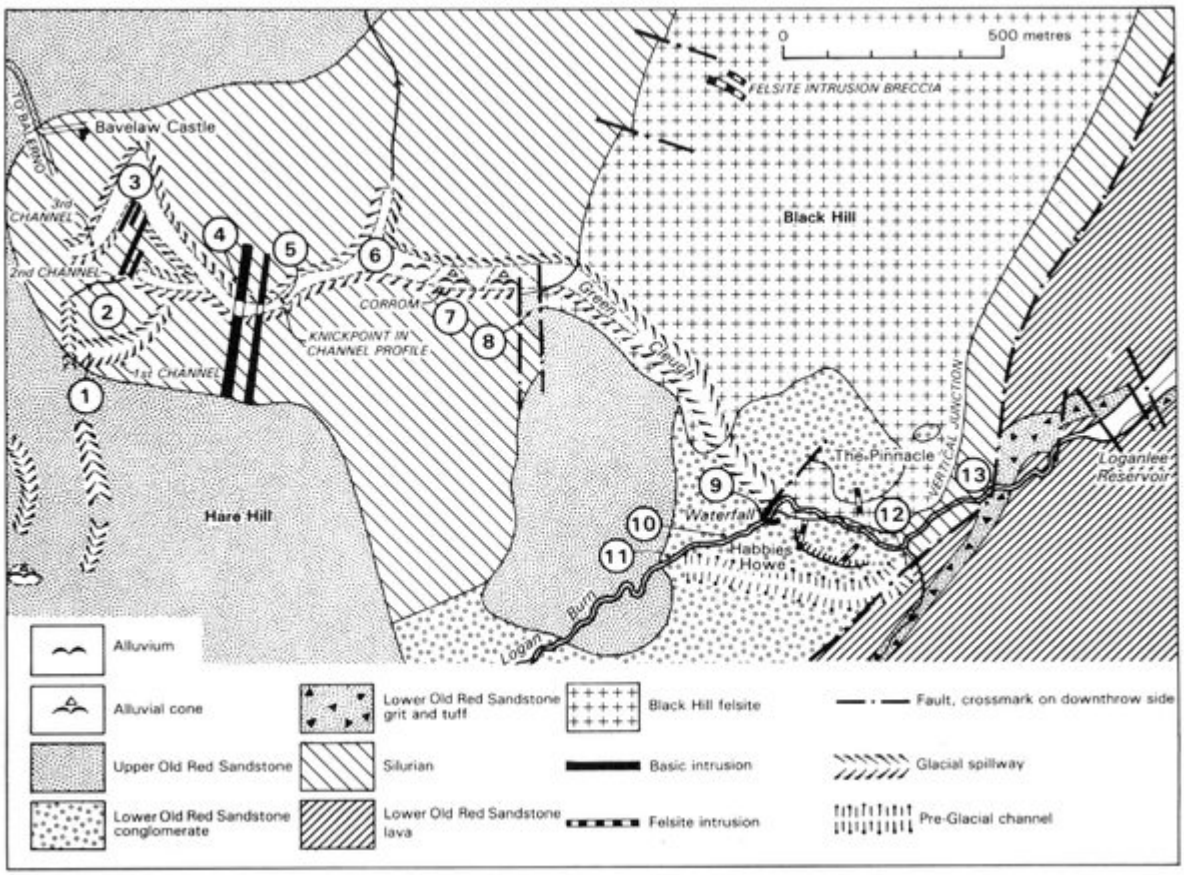
White Hill, where they form prominent trap-features, slightly modified by glacial scour.

### 7 and 8. White Hill Plantation: rhyolite and conglomerate of Lower Old Red Sandstone

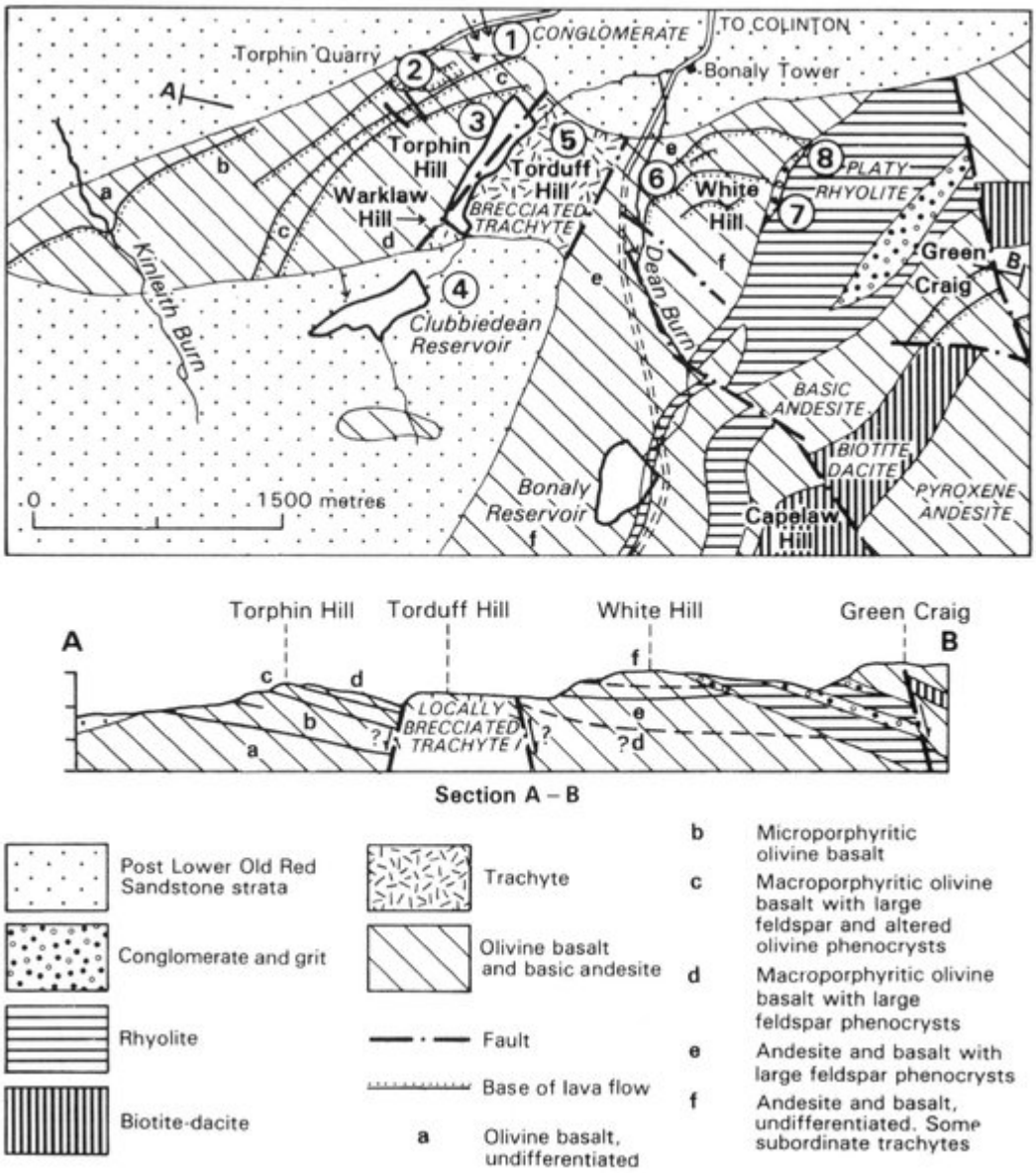
The Bonaly basalts are overlain by the rhyolites of the Bell\'s Hill and Howden Burn group. On the north-east slope of White Hill a thin conglomerate with pebbles of greywacke, chert and some basic lavas separates these two groups (7). This conglomerate, as well as the overlying rhyolite, can be traced by several outcrops north-eastwards downhill through White Hill plantation (8). It can here be demonstrated that the conglomerate rests on the truncated edges of the higher flows of the Bonaly group. It is not suggested that a period of earth movement intervened between the eruption of the andesites and the overlying rhyolite: a period of erosion with steep valleys cut into the latest lava flows can be the cause of an angular unconformity of this type.

Return by Bonaly Castle to Colinton.

**References**




*(Map 21) Bavelaw Castle to Loganlee.*




*(Map 22) Torphin to Bonaly Tower.*