

The Valley of Desolation

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Introduction

The Valley of Desolation is situated in the upper reaches of Posforth Gill, a north bank tributary of the River Wharfe. The Valley is approximately one mile north of Bolton Abbey village and is part of the Chatsworth Estate belonging to the Duke and Duchess of Devonshire. It is reached by following the road from the Cavendish Memorial to the Cavendish Pavilion where parking is available together with toilets, food and information. A short walk crossing the bridge and following the riverside footpath leads to Posforth Bridge, Waterfall Cottage and the Valley of Desolation.

The valley was so named after a great storm occurred over Barden Fell in 1836. Strong winds, torrential rain, lightning and flash floods caused great damage leaving many of the original oaks uprooted. Over the past 164 years, the signs of damage have disappeared as natural regeneration in part has taken place. A few decaying oak trees and rotting logs are the most obvious remains of a beautiful wooded valley which once supported oak, rowan, birch and hawthorn with hazel and alder along the wetter parts of the valley floor.

An avenue of 100 oaks leads into the Valley of Desolation but much of the area is now sheep grazing with rough grassland, some flowering plants and mosses but dominated by bracken which threatens to take over the area. To improve and safeguard the valley a programme of woodland planting will take place in 1999 and 2000 to enhance the natural beauty but also to establish an educational trail suitable for secondary schools, university students and the general public.

The planting will illustrate the natural succession of species thought likely to have developed along the valley of Posforth Gill and on the immediate fells since the end of the last Ice Age. The changing pattern of trees obviously affected the flora and fauna and it is hoped that eventually when the trees are established this will be reflected once more. Woodland clearance by man probably began in the Iron Age but reached its peak from the 12th century through to the 19th century when demand for timber dramatically increased.

The Valley of Desolation educational trail will thus illustrate the colonisation of the valley by tree species over the past 14,000 years together with the important changes created by man. However, it will also allow a study to be made of the geology and geomorphology to ensure an appreciation of the landscape processes and changes which helped create the present scenery.

Planning

A. Before a visit students should have studied

- I. Some simplified geology to appreciate rock types and formations
- II. Time scales especially of the Carboniferous period
- III. River processes
- IV. The general nature of the region
- V. Basic biogeography especially plant successions
- VI. Reasons for visiting this unique area

B. To make classroom work more beneficial, students should have

- I. Local maps – scale 1:25,000 or 1:10,000 if available
- II. Notebooks and sketching pads
- III. Drawing equipment
- IV. Magnifying lenses
- V. Identification handbooks for geology, plants, trees, etc.

C. Although footpaths are in place the area is isolated and the terrain is often steep and uneven so the following points should be noted.

- I. Suitable footwear for a 4 mile walk
- II. Suitable clothing with waterproofs for an area which has no permanent shelters and no toilets (except at the Cavendish Pavilion)
- III. First aid for cuts, blisters etc. is recommended
- IV. A supply of food and drink for a 3-4 hour period

Aims and objectives of a visit to the Valley of Desolation

The booklet aims to offer guidance to students studying geography, geology, earth science and biology on the effects of glaciation. In particular, students studying 'A' level and beyond should be able to recognise the effects of ice sheets and valley glaciers on the landscape in Craven. Glacial erosion and glacial deposition are both very evident but the replanting of the Valley of Desolation now offers students a chance to appreciate the changes in climate since about 12,000 B.C. and the types of vegetation and trees which appeared as a direct result of these changes. Within a walking distance of only 6 Kilometres, students may observe vegetation spanning some 12,000 or more years and appreciate more readily how the landscape evolved before both humans and then nature interfered with the process.

A series of questions accompanies the notes; they are designed to test observational skills, field sketching and an understanding of geomorphological processes leading onto a knowledge of biogeography. An appreciation of woodland clearance from the Iron Age through to the 19th Century is helpful. The changing pattern of woodlands over some 12,000 years has obviously affected the nature of surface vegetation, the flora and fauna of the region. Recent farming trends both in the Valley of Desolation and on the surrounding moorlands together with their effect on the landscape should also be noted.

If desired, only sections 4 to 8 may be reproduced for students or possibly 6 to 8 for more advanced candidates.

The Valley of Desolation

Simplified notes on solid and drift geology

The Valley of Desolation, together with the adjacent moorlands rising northwards to Simon's Seat, eastwards to Hazelwood Moor and westwards beyond the River Wharfe to High Hare Head are underlain by gritstones of the Upper Carboniferous period. The gritstone may form part of the Grassington Grits which date from around 315 to 300 million years ago.

Within the Valley of Desolation, the grits are clearly exposed at the lower falls called Posforth Force. Individual grains are of a medium size but with occasional large quartz pebbles. Generally, the rock is massive with no apparent current bedding, but a number of bedding planes varying from 0.5 metres to over 1.0 metre apart can be detected. It seems likely that these rocks were deposited in deeper deltaic waters by rivers flowing southwards into the Craven Basin from the Caledonian continent which stretched across what is now Central and Northern Scotland. At the upper falls some 400 metres upstream, the rocks exhibit a much coarser structure with more frequent quartz pebbles and some current bedding. This suggests shallower deltaic conditions and rapidly changing river channels. A similar pattern is repeated on the outcrops of North Nab which rises to the east of the valley, once more pointing to a general shallowing of sea conditions over the delta during a 10 – 15 million period of years.

The underlying bedrock is thus gritstone but the surface has been covered by glacial till which is very variable in thickness, partly due to erosion but also landslips on the steeper slopes. There appears to be evidence of two or maybe more landslips between the North and South Nab creating a large spur of hummocky land crossed by the footpath leading northwards from Waterfall Cottage. The till continues to move westwards towards Posforth Gill after heavy and prolonged periods of rainfall and recent landslips are evident on the valley side. Here the nature of the till can be examined in the exposures, generally it is a mix of gritstone pebbles and gritstone rocks in a sandy rather than heavy clay matrix. There are some limestone pebbles and rocks which may have originated from the Great Scar limestones near Appletreewick and Burnsall. A few larger erratic limestone rocks are apparent in the Valley of Desolation, one immediately upstream of the wooden footbridge but perhaps the best example is located in the stream bed 50 metres south of the upper falls. These limestone rocks have been severely affected by the acidic waters of Posforth Gill (flowing from gritstone and peaty uplands) producing a scalloped effect.

The till cover was produced by ice sheets which lasted for perhaps one million years during the Quaternary ice Age. At their maximum extent they covered most of the high Pennines over Craven. The ice cover fluctuated but eventually began a major retreat about 8000 B.C. as the climate ameliorated significantly. While ice sheets covered the uplands, a valley glacier extended southwards through Upper Wharfedale. Its effects are clearly seen a few miles to the north at Kilnsey Crag where the valley side is both eroded and undercut. Only three miles away at Drebley, morainic material spreads across the valley suggesting a recessional moraine while at Litton a lateral moraine helped create a glacial lake. Near Bolton Abbey the glacier was relatively small and shallow but still sufficient to widen and overdeepen the valley at

Posforth Bridge. The River Wharfe now occupies the valley but tributaries such as Posforth Gill were originally at a higher elevation (hanging valleys) when they resumed flowing after the Ice Age. Posforth Gill has five major tributaries from an extensive catchment basin and consequently discharges a large volume of water during snow melt or storms. It can readily erode and over the past 10,000 years, two major waterfalls have retreated upstream about 1.0 Kilometres and 1.5 Kilometres respectively as knickpoints from the Posforth Bridge region. Erosion has thus created a very deep and steep sided valley with a narrow valley floor, especially south of Posforth Force where a thick layer of till overlaid the solid gritstone.

Generally, the glacial till has a low clay content and with a relatively heavy rainfall exceeding 1000mm per year there is strong leaching of any surface humus. Soils tend to be poor, especially those from Posforth Beck eastwards onto North Nab although they may have been far better when a forest cover was in place. Today bracken tends to dominate where the land has not been reclaimed for more intensive grazing.

N.B. It should be noted that the older beds belonging to the Carboniferous period such as limestone do not outcrop along the Valley of Desolation but they appear in the bed and banks of the overdeepened River Wharfe valley near to the Cavendish Pavilion
see location 2

Climatic variations and vegetational successions

(1) The Craven ice sheets and glaciers probably began their slow decline and subsequent 'retreat' from 12,000 B.C. leaving the Valley of Desolation area under tundra type conditions about 8000 B.C. A cold and generally dry climate created conditions of permafrost suitable for willow scrub, dwarf birch, junipers and vaccinium. *See location 7*

(2) **Boreal** stage 8000 B.C. to 5500 B.C.
An increase in temperature from about 8000 B.C. to 7500 B.C. allowed birch to spread into the region followed by a few scots pine with some hazel, elm, alder and a few oaks. Gradually the scots pine became increasingly dominant and together with the birch spread onto the more exposed and cooler uplands such as High Park.
See Location 6

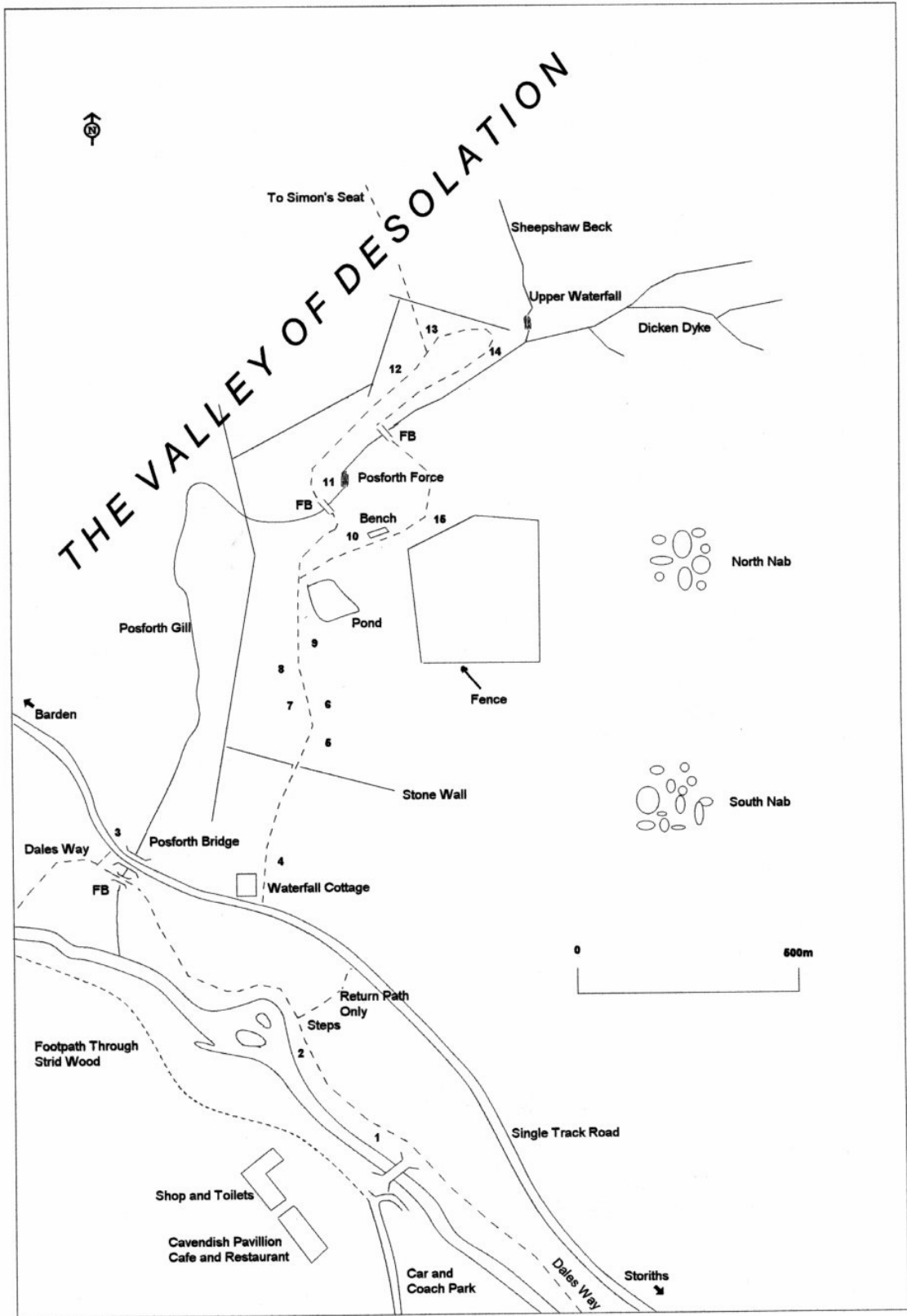
(3) Milder conditions from 7500 B.C. to 5500 B.C. allowed pine forests to dominate but oak and elm formed isolated pockets. Hazel reached its maximum distribution during the early part of this period spreading to the extreme north of Scotland.

(4) Considerably warmer and also wetter conditions during the **Atlantic** phase, allowed widespread changes to occur. Deciduous woodlands of elm, oak and lime were able to develop along sheltered valleys such as Posforth Gill but pine and birch would continue to dominate surrounding uplands (*see location 11 and 15*). Probably much of High Park and Barden Fell became woodland areas at this time.

(5) From 2500 B.C. to 700 B.C. (**Sub Boreal** phase), the climate fluctuated, initially mild and drier, then cooler and wetter especially around 700 – 550 B.C. (**Sub-Atlantic** phase). This may have been a sufficiently wet period to begin the creation of peat bogs on the moorlands at the expense of the birch and pine forests while rowan, oak, juniper, blackthorn and holly may have spread into the valley floor.
See between locations 11 and 14

(6) From 550 B.C. the climate has fluctuated through to the present day but the main factor affecting woodland has been the activities of man. Woodland clearance for farming probably occurred from about the 8th century in the Craven area. The increasing use of wood to build houses, to make farm equipment and for use in wooden ships all led to the more mature trees being extracted without any replanting occurring. Thus the Valley of Desolation may have already had clearings and some local felling before the great storm created devastation. (Areas along the Valley of Desolation will show some glades and clearings to help recreate this situation).

(7) During the permafrost period from about 10,000 B.C. to 7,000 B.C. surface water collected in natural hollows creating lakes especially in the 'summer' months allowing the eventual appearance of trees such as willow and alder on their margins. The natural hollow at the entrance to the Valley of Desolation is fed by springs from the North Nab. This hollow has been enhanced to help recreate such conditions.
See location 9



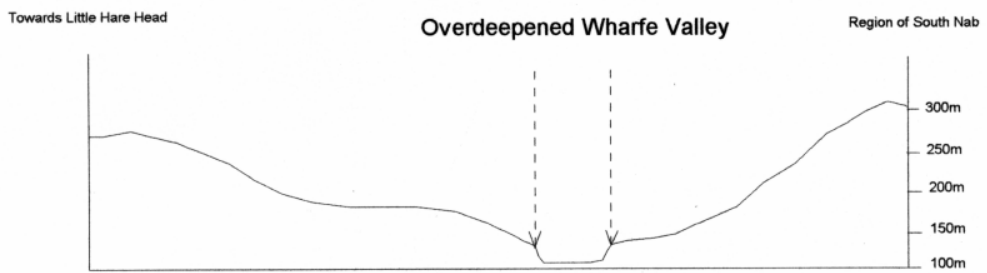


Figure 1 . A generalised cross-section from near Little Hare Head towards South Nab

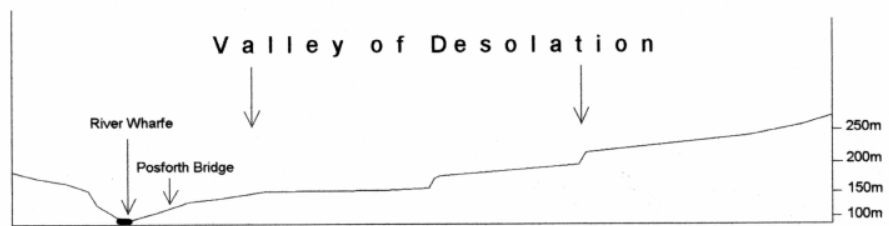


Figure 2. The long profile of Posforth Gill from Barden Moor to confluence with the River Wharfe

The Hartington Trail (Cavendish Pavilion to Valley of Desolation and return)

Leave Cavendish car park, cross the wooden bridge over the River Wharfe and turn left (north) onto the Dales Way, signposted to Valley of Desolation. Proceed for 35 metres to the old tree stump where there are clear views across the valley.

Location 1

- (a) Using the following information, draw a cross-section west to east across the River Wharfe's valley. Choose suitable horizontal/vertical scales.

Flat valley floor by Cavendish Shop and toilets is 30 metres wide (108m.O.D).

River Wharfe is 40 metres wide. The riverbed is at 105m O.D.

Eastern valley floor occupied by field is 50 metres wide. (108m O.D.)

Each visible bank rises to 120m high.

- (b) From your information, cross section and observation of the valley, describe carefully this area of the River Wharfe valley.
- (c) The 110 metres contour crosses the valley floor approximately 1500metres away to the north.
- Calculate the gradient of the riverbed.
 - Look carefully to see if the river is eroding or depositing at this point.
 - Suggest the 'stage' reached by the river (e.g. old)?
- (d)
- To what extent does the 'stage' of the River Wharfe correspond with an expected valley shape at this location?
 - Suggest reasons for your answer to (d) i.

Follow the Dales Way north across the field to a point 40 metres before the stone steps by a small enclosed area of sand and pebbles.

Note. The River Wharfe is deep and great care should be taken on the shoreline.

Location 2

- (a) Examine the rock outcrops along the bank.
- Describe the two main rock types in terms of colour, bedding, fissility, cleavage, jointing, possible fossil content and resistance to weathering.
 - Suggest the types of rock exposed.
- (b) Check the angle of dip and its direction in a few localities marking these onto a sketch diagram of the outcrop. Geologists should use dip and strike.
- (c) Determine the type of structure found in this exposure.

- (d) What may have happened to these rocks before new sediments (seen along the Valley of Desolation) were deposited?

Follow the Dales Way along the valley of the River Wharfe to the footbridge (alongside the road bridge), cross the footbridge over Posforth Gill and continue 40 metres, cross the minor road to the 6 bar gate (no access). Examine the valley cross-section of Posforth Gill.

Location 3

- (a) Describe the valley shape; floor, sides, steepness etc of Posforth Gill. Then walk along the minor road back to Posforth Bridge to examine the stream. **Take Care** of cycles and cars along this minor road.
- (b)
- i. The bed of the stream has rocks the same as on the bridge parapet. Are they same or different to those at location 2? Describe the rocks carefully; grain size, composition, banding etc.
 - ii. Suggest the type of rock crossed by Posforth Gill.
- (c)
- i. Consider the flow and gradient of Posforth Gill. Is this flow and valley profile consistent with a tributary stream about to join the River Wharfe?
 - ii. Suggest a reason for your answer.

From Posforth Bridge follow the minor road up the hill towards the Valley of Desolation (see signs by the bridge). The ascent along the valley side is steep (as on your cross-section) and leads to Waterfall Cottage and access onto the field through the gate.

Location 4

Before crossing the field, consider the information gathered and suggest what may have happened to the valley of the River Wharfe to create its present shape. Figure 1 may also be of help in formulating your answer.

Follow the defined track across the field passing by very old oak trees; some of these may have been growing well before the damaging storm of 1836. Pass through the gate and follow the track to the information board and viewpoint northwards into the main Valley of Desolation area. An avenue of oak trees, planted in 1980 flanks the track.

Location 5

To the east is the outcrop of South Nab. To the north-east (front right) is North Nab outcrop. Between the two nabs is a ridge which it is thought was once continuous at about 270 metres O.D. giving a level skyline. Remembering that this area was once covered by stagnating ice sheets.

Suggest:

- (a)
 - i. The type of material likely to be deposited in the area.
 - ii. What may have happened since the Ice Age in order to create both the pronounced col between the Nabs and the area around you.
- (b) The avenue of oak trees was planted in 1980. Assess their speed of growth and suggest how long these hardwoods may take to attain maturity.

N.B. The replanting of the Valley of Desolation is long term and 'visible results' may take some decades to be achieved.

Follow the track to the fenced area (which is to the east of the track) about 50 metres distant.

Location 6

- (a) Look carefully at the type of plants and identify them.
- (b) Suggest:
 - i. when these plants may have been dominant in this landscape.
 - ii. why they were dwarf in nature
 - iii. why they seldom developed vertically for more than 15cm but were able to grow horizontally over many metres.
 - iv. with the help of information already presented, which other FLORA and FAUNA, may have existed during the same period.

Follow the track northwards to a fenced area (left of the track) in about 100 metres.

Location 7

- (a) Identify the main trees within this area and suggest a likely phase from the past 14000 years when they were likely to develop.
- (b) Which trees may have been most dominant among those identified and suggest reasons.

Only a few metres away and to the east of the track lies a second fenced area.

Location 8

- (a) Identify the main species of trees present within this fenced area.

(b) Suggest:

- i. how they differ from the trees seen at location 6.
 - ii. the climatic phase during which these trees were dominant.
- (c) Why was it possible for these trees to gradually replace many of the trees which occurred in location 6 and become dominant?

Alongside the track and close to location 8 is a large, shallow pond.

Location 9

Consider the answers to the questions at location 5 and location 7 on soil types, plants and climatic conditions at the end of the Ice Age.

- (a) Suggest why some natural hollows, such as this, may have developed.
- (b) Which plants would initially colonise the pond as the climate ameliorated?
- (c) Describe the subsequent development of plants and trees naming this type of feature.
- (d) Examine the type of trees flourishing along the pond margins. Suggest why these tend to dominate wetlands.
- (e) Why are ponds always ephemeral features of any landscape?

Follow the track to the wooden bench that overlooks the Valley of Desolation and offers a view of Posforth Gill Waterfall and the general nature of the valley sides. Examine figure 2 that shows the long profile of Posforth Gill.

Location 10

Using information gathered about the shape of the River Wharfe Valley, the shape of Posforth Gill Valley together with the long profile provided, suggest:

- (a) why Posforth Force has developed
- (b) a suitable term for this geomorphological feature.

Return back along the track for 70 metres and descend along the valley side, follow the footpath to the point where it crosses the new bridge onto the western bank. In a few metres you rise to a point with an excellent view of Posforth Force.

Location 11

- (a) Draw a field sketch of Posforth Force and its plunge pool region. On your sketch show:
- i. the bedding planes, marking in approximate distance apart.
 - ii. possible dips and appropriate angles. (strikes also)
 - iii. the position of the falls and plunge pool.
- (b) There is no apparent current bedding in the rocks at the falls (some may exist on boulders in the rock bed downstream). Under what conditions might this massive sand and grit deposit have accumulated?
- (c) Carefully examine the boulders and rounded rocks in the streambed to see if they are predominantly one type. Are any other rock types present, if so try to identify them. This examination can be continued wherever the footpath is close to Posforth Gill.

Follow the footpath northwards through the Valley of Desolation noting the new planting which eventually will create a similar landscape to pre-1836. You will see a series of glades and clearings most of which were man-made, possibly from the 8th century onwards although Iron Age man is known to have cut down small sections of woodland.

Location 12

Stop where the path divides and consider the following questions.

- (a) Why might some small clearings have been a feature of the Posforth Gill valley from the 8th century onwards?
- (b) Suggest why oak trees may have been felled along the Posforth Gill Valley
- i. for use by monks at Bolton Priory.
 - ii. during the development of the Bolton Abbey Estate.
- (c) Local industry (especially linked to farming and textiles) required timber for certain machinery. Establish which tree species were used in farm wagons, wooden wheels, shuttles, bobbins, wooden handles etc. Would these trees have been present along Posforth Gill Valley prior to 1836?

Location 13

Continue along the footpath to this small area containing trees likely to be seen in commercial forestry within the United Kingdom.

- (a) Identify the main species and their county of origin.

- (b) Suggest why these species dominate the commercial forest industry. A number of reasons should be developed.

Walk up to the northern end of the valley to view the second waterfall, then return some 50 metres to a point where a large grey- white boulder dominates the other rocks in the stream bed.

Location 14

- (a) What has caused the scalloped effect on the rock surface?
- (b)
- i. Name the rock type.
 - ii. Is it older or younger than the bedrock?
- (c) Suggest how this rock may have been transported to this location and its probable original outcrop.
- (d) What geographical term may suitably describe this rock?

Retrace your walk along the footpath leaving the Valley of Desolation along the path which climbs the eastern bank and emerge onto the footpath which leads back towards Waterfall Cottage. A very large fenced area has been planted on the flanks of North Nab. This forms location 15.

Location 15

- (a) This area was originally forested. Suggest reasons why the area may have become cleared over a period of perhaps 3000 years.
- (b) After clearance, bracken gradually took over and dominated all other vegetation. Suggest why present landowners spend considerable amounts of money trying to reduce the presence of bracken on moorland.
- (c) Prior to planting, bracken on this area was poisoned but a few small patches may still exist on the margins. Why will it eventually decrease in importance as the new trees grow?
- (d) Look carefully at the new planting, identify the tree types and suggest why various trees dominate at different points within the fenced area.
- (e) During which climatic phase would these trees have dominated the upland regions of Craven?

Follow the path to Waterfall Cottage, turn left along the minor road for 100 metres and then take the path back towards the river and the Cavendish Pavilion to complete the Hartington Trail.