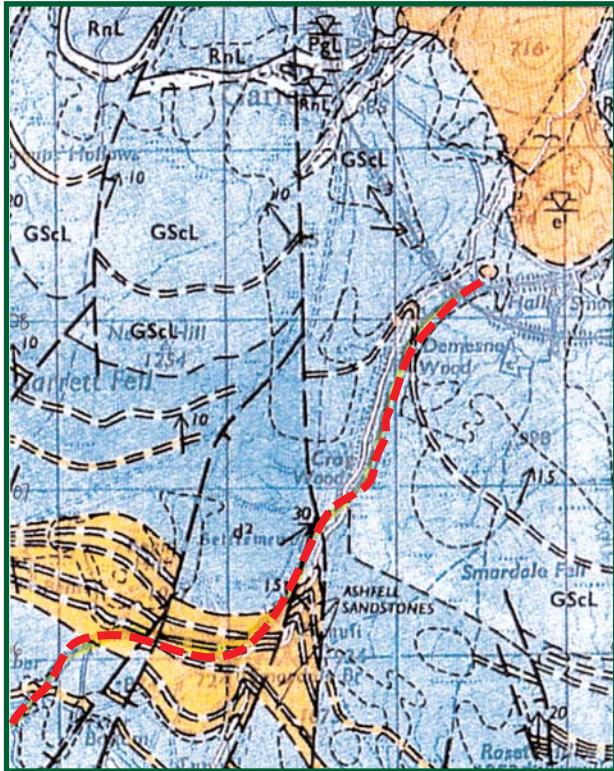


Smardale Gill

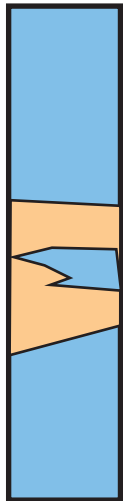
Cumbria Wildlife Trust Reserve



Smardale Gill National Nature Reserve



Geological Map Kirkby Stephen Sheet 40
SOLID 1st Edition 1972



Ashfell Limestone

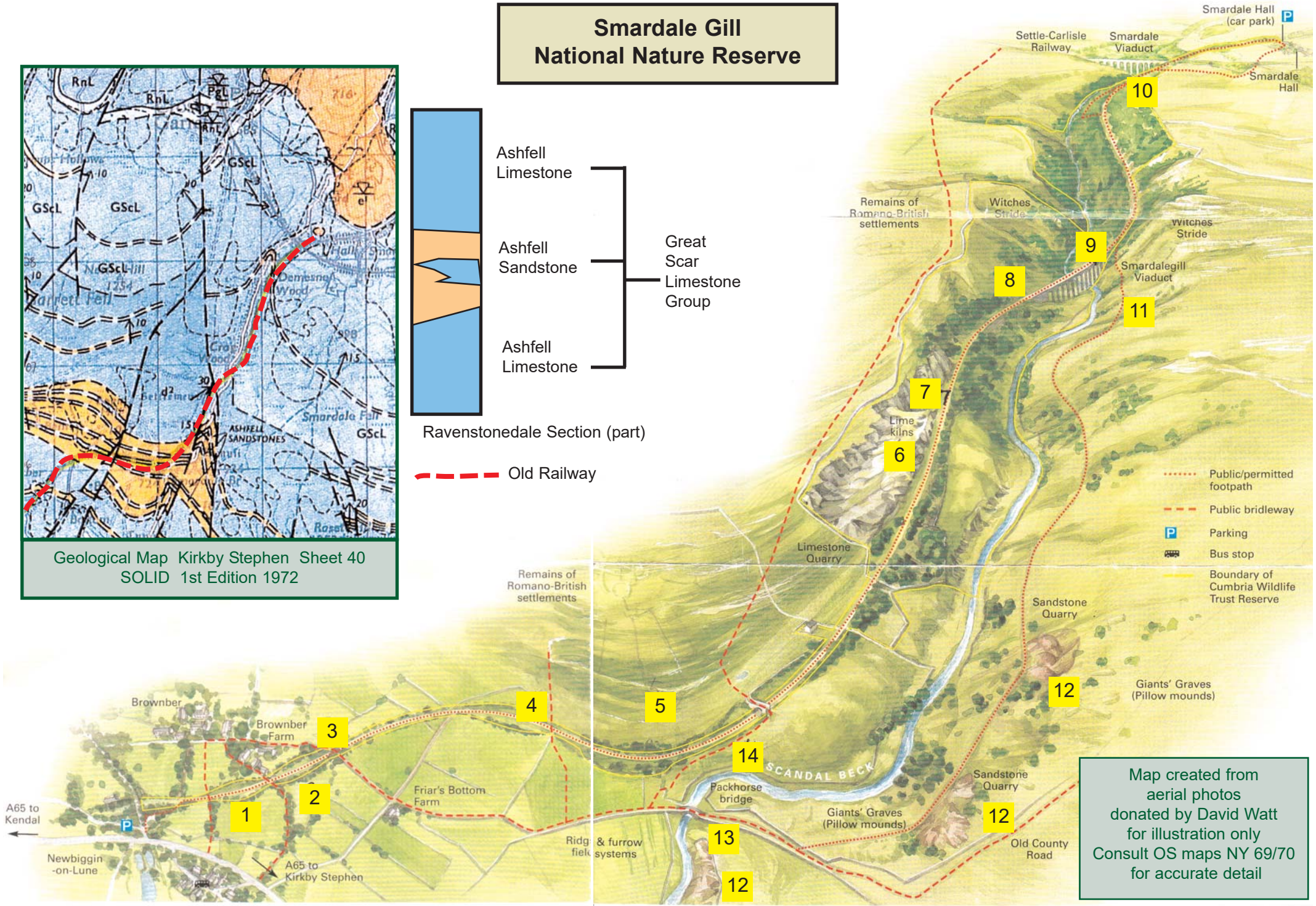
Ashfell Sandstone

Ashfell Limestone

Great Scar Limestone Group

Ravenstonedale Section (part)

Old Railway



Map created from
aerial photos
donated by David Watt
for illustration only
Consult OS maps NY 69/70
for accurate detail

Geology and Landscape of Smardale Gill

Cumbria Wildlife Trust Reserve

The walk starts at **Newbiggin-on-Lune** (703053) then follows the line of the **former Stainmore railway**, past the limestone quarry and over the Smardalegill viaduct, descending along a permissive path past the sandstone quarries and over the Smardale Bridge.

The railway ran from Tebay to Darlington, moving geological resources. It transported coal to Barrow, ores and limestone for the Teesside steel works, from 1861-1962. It is now a **Cumbria Wildlife Trust Reserve**.

Walk terrain: old railway track, permissive path is rough with ascents, descents & an awkward stile.

Distance: about 4 miles **Height gain:** little

Time: 5-6 hours at a gentle pace with time to look around

OS map: 1:25,000 OL19 *Howgill Fells
and Upper Eden valley.*

Geology map: *Kirkby Stephen Sheet 40,*
Solid and Drift 1:50,000 1997

Geology and Landscape of Smardale Gill

This walk looks at two Local Geological Sites (LGS), a limestone and a sandstone quarry, both providing excellent exposures of Carboniferous rocks, seeks evidence of ice shaped hills, searches for fault lines, and ponders the past drainage pattern of the Scandal Beck and the formation of Smardale Gill.

LGS are areas of exceptional geological interest, for both academic study and to the general public. They are designated by the Cumbria GeoConservation Group, a voluntary geological conservation group working to record and look after important geological sites in Cumbria.

Geological background

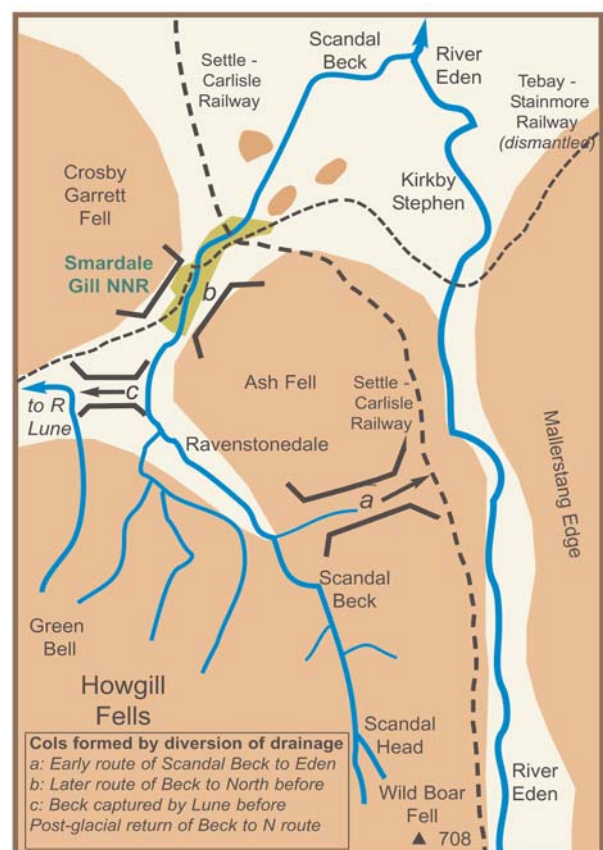
The solid rocks to be encountered on this walk are of **Carboniferous age**, of the Great Scar Limestone Group, around 350million years old. The limestone formed as a carbonate deposit, which periodically emerged from a shallow shelf platform in a tropical sea. It was deposited in troughs as the Earth's crust was stretching. Although on the northern edge of the Askrigg Block, which remained high above the Carboniferous sea, the Great Scar Limestone here (known as the Ravenstonedale Limestone) is thicker than elsewhere. The rocks of Smardale Gill are the first truly marine Carboniferous deposits in this area, but unusually for Carboniferous limestone they contain several discontinuous **sandstone** layers. Both are named after the local **Ash Fell Edge**. The sandstone may have been deposited as an alluvial fan in a semi-arid climate.

Geological naming

Carboniferous rocks have long been divided into three groups, with the 'Mountain' Limestone being the lowest. In the 1970s and 1980s more detailed divisions were established, and three of these, including the **Holkerian sub-stage** limestone, are defined from sections in Cumbria. These subdivisions are largely based on identification of key **fossil assemblages**, focussing on those fossil species which were widespread in the sea, and evolved rapidly. Initially the framework used large fossils (macrofossils), corals, brachiopods and bivalves, later using microfossils such as foraminifera.



Newbiggin-on Lune lies in the **Lune Gap**, near the source of the river Lune which flows north from Green Bell on the Howgill Fells, then west and south to Morecambe Bay. The Howgill Fells lie to the south, while to the east is **Ash Fell Edge** (a geological SSSI, the type locality for the Lower Carboniferous Ashfell sandstone and Ashfell limestone). The limestone and sandstone rocks here were of huge economic importance. Both rocks have been quarried, and the quarries are now Local Geological Sites. The area was glaciated; some ice formed on Wild Boar Fell and moved north, depositing glacial drift, in places shaped into drumlins. **Smardale** is drained by the north flowing Scandal Beck, a tributary of the **River Eden**. The present Scandal Beck rises on the slopes of Wild Boar Fell, to the south of Ravenstonedale, and flows north to join the river Eden north of Kirkby Stephen, but it didn't always do so.



Drainage development of Scandal Beck

The drainage of the Howgill Fells and upper Eden valley has been well studied. Several stages of river capture have been identified in classic research by CAM King. **The earliest north draining streams off the north slope of the Howgills to the Eden valley developed on younger rocks (Cretaceous or Tertiary) now eroded away.** The Scandal Beck was one of these north flowing streams: it has flowed through Smardale since Tertiary times. Its length and tributaries have varied due to river capture developed by **downcutting along weaker strata**, such as the Ashfell Sandstone. This breached the former watershed between the Scandal Beck and R. Eden. Glaciation in this area has been less well studied. The ice source was the high ground above 600m on Wild Boar Fell. Howgill ice is believed to have been slow moving, hemmed in by ice on each side and only thin. The ice moved north. As the ice retreated west from Ash Fell Edge, water was impounded to the west and meltwater escaped north. This cut down to divert streams back to the R. Eden, forming the 75m deep **Scandal Beck gorge**. Scandal Beck now rises at Scandal Head on the north summit of Wild Boar Fell at around 640m.

1. Upper Scandal Beck

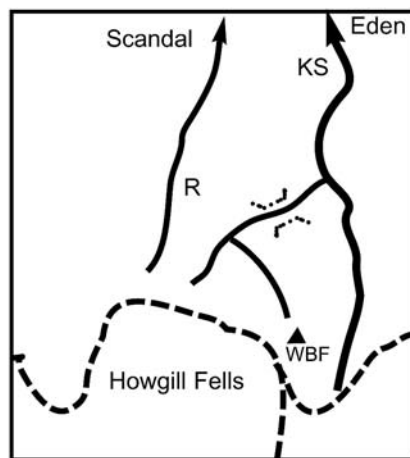
used to flow east into the R. Eden, south of Ravenstonedale, while a stream from the northern slopes of the Howgill Fells flowed north through Ravenstonedale to Smardale.

2. R. Eden headwaters were captured by a stream from Wild Boar Fell, leaving Col A, with the Scandal Beck having several additional tributaries, enabling it to cut a deeper valley.

3. Pre-glacial river capture to the west by the upper R. Lune left Col B, (which is now Smardale Gill) without a stream, with a much shorter Scandal Beck, whose headwaters were now north of Ravenstonedale. The last Ice Age then completely upset the drainage pattern with glaciers forming and melting.

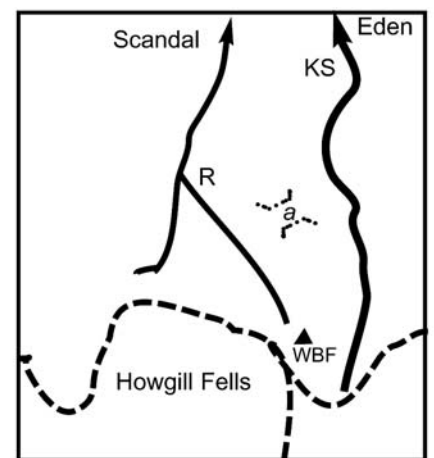
4. Glacial meltwater re-established the pre-glacial drainage pattern, and flowed north through Col B, leaving Col C to Newbiggin, (which is the low route now used by the road and railways), and cut down Smardale Gill even deeper. So the **Scandal Beck is a post glacial river gorge**.

DRAINAGE DEVELOPMENT OF SCANDAL BECK



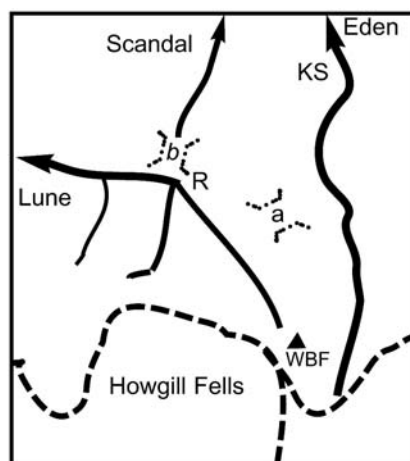
Stage 1: Tertiary Period

--- Watershed R: Ravenstonedale
KS: Kirkby Stephen WBF: Wild Boar Fell



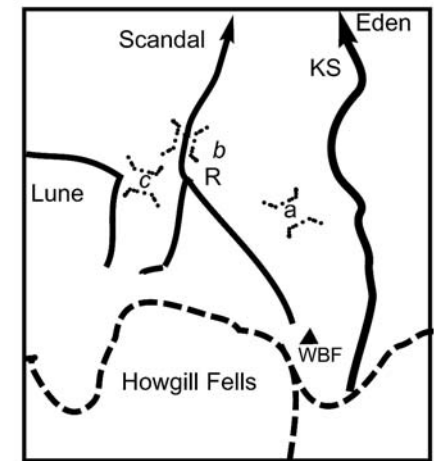
Stage 2: River capture

Col at a - former course to the Eden



Stage 3: Pre-glacial

Col at b - capture by upper Lune



Stage 4: Post-glacial

Col at c - capture by upper Lune
Scandal Gill is post-glacial river gorge

1. A View of the Howgill Fells (NY 704055)



To the south, in the distance, past the village of Newbiggin, the hills have a smooth skyline. The flat top of Wild Boar Fell, over 600m, built up a small snowfield and glacier in the Ice Age, while the rounded Howgill Fells were shaped by ice moving over them. In the fields in the foreground glacial drift covers the solid rocks. A small dry valley to the north gives a clue to the underlying limestone rock.

2. Railway cutting and Bridge (NY 707056)



Rock exposures are now rare in the first railway cutting encountered. However, on the north side, there are signs of small outcrops of thin, near horizontal layers of Great Scar Limestone and Ashfell Sandstone. At the end of the cutting go down the steps to look at the railway bridge over the footpath. Two sets of building stone can be distinguished, each a slightly different colour. One rock is coarser, feeling rough, with some pebbles and the other finer, with many masons' marks. Some blocks show graded bedding, where the particles get fine further up. The dressed sandstone may be the local Ashfell Sandstone.

3. Small outcrop of Brownber 'Pebble Beds' (NY 709058)

Below a tree an exposure of Brownber Formation shows 2 metres of sandstone, in thin layers, with some cross bedding. It is pebbly below becoming finer grained higher up. Ashfell Sandstone can be seen in the adjacent barn. It is a red sandstone, well cemented with silica and has good load bearing properties. It makes a strong building stone.



Along the next section of the railway line there are good views of **drumlins**, here showing ice movement from west to east. Continuing along, a small outcrop of Ashfell Limestone may be glimpsed on the hillside to the north.



4. Sandy Bank signal box and cutting (NY 715062)

The railway line cuts through a drumlin, and as the glacial drift is liable to slumping, the cutting has been strengthened by a stone wall, using both the Ashfell Sandstone and Ashfell Limestone blocks. Good examples of fossil corals & brachiopods may be seen in the limestone blocks in the wall, together with chert (silica) nodules.



There is a striking difference in weathering effects on the north and southern sides of the cutting, with a more recent (August 2015) sandstone wall over an arc-shaped landslip scar on the north facing side. (photo19 &27) Look for mud clasts in the blocks of this new wall.



5. A 'Sandwich' on the hillside (NY 718061)



Beyond the cutting, the hillside to the north shows a series of benches, reflecting layers of limestone with a layer of reddish Ashfell Sandstone between. (photo20) There is soon the first view, looking south-east, of the Smardale Bridge sandstone quarry, and Smardale Beck, flowing north from Wild Boar Fell, and then through Smardale Gill. (photo 03?). Pause at the viewpoint. In winter you can see a debris flow from the sandstone quarry opposite (photo21)



6. The Lime kilns, a Grade II Listed Building.

The lime kilns used the limestone quarried adjacent, which was smelted using coal transported by rail. The limestone blocks of the kilns appear to be covered in a tufa-like deposit, which was perhaps blown out of the kilns while they were working.



7. Smardale Gill Limestone Quarry Local Geological Site (NY 725065) (photo 41)



There is much of interest here: a good place to pause, but please do not collect any fossils. Please be aware that the area is a National Nature Reserve. The limestone scree at the base of the quarry is a rare habitat, important for orchids and other plants. Try to keep to paths, or the base of the quarry face, when examining the rocks. Take care if you go up into the upper quarry; there are steep and unstable slopes. Keep away from the top of the lime kilns.

The rock exposed in the quarry is the **Ashfell Limestone Formation**, near the base of the Lower Carboniferous in this district on the Askrigg Block. It is now believed to lie above the 80m thick Ravenstonedale Limestone Group, and to comprise the oldest truly marine strata in the district. The rock is evenly bedded with siltstone partings. It was deposited in a warm clear shallow sea, rich in life, which is now preserved as fossil corals



(Lithostrotion occurs both as fragments and in its living position), Productid brachiopod shells and Fenestella, a bryozoan, also occur. There are also layers of quartz and nodules of chert, which may be stromatolite **algal mounds**. The fossils are silicified, making them stand out clearly from the weathered rock surfaces. The topmost beds are said to show a shallowing of the sea, to estuarine conditions, with a cherty porcellaneous limestone, carbonaceous mudstones and iron stained shell beds. (photos 11, 12, 13). The rocks were later tilted

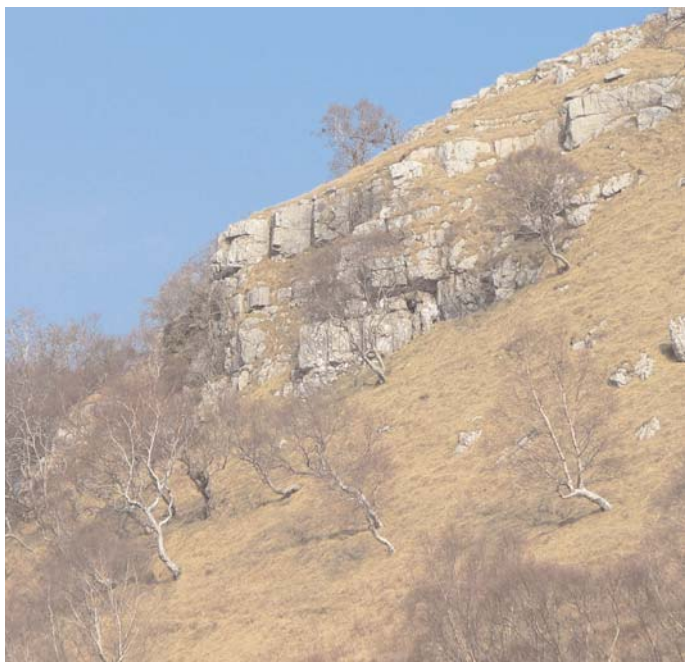


At NY 726068 the limestone is disturbed by a number of **faults**, trending mostly north to south, which have caused some gullying (air photo). The valley of the Scandal Beck south from here may also be fault guided. The view ahead shows dipping layers of limestone, known as the 'Witches Stride', on either side of Smardale. (photo30)

8. Ashfell Limestone Formation: fault guided gullies (NY 726068)



Further along the railway line the Ashfell Limestone is dipping about 30° to the NE, and a few thin siltstone partings can be seen. (photo 07)These represent pauses in the deposition of the limestone.



9. Smardalegill viaduct (NY 727069)



The 80 foot high viaduct, now maintained by the Northern Viaduct Trust, was built from Ashfell Sandstone quarried further south, up the valley. Over 60,000 tons were said to have been used. The viaduct took 5 years to construct and opened in 1875. The arch quoins are of Millstone Grit. The large sandstone blocks forming the present edge of the viaduct were added in the late 1990s as a safety measure, and are not local rocks. The valley sides are steep and are still slipping down under gravity. Looking down from the viaduct the steep sides of the valley give an insight into the power of postglacial meltwater streams which deepened the river gorge of Smardale Gill. As you walk further east along the old railway line, the Scandal Beck is in a deep valley is flowing north, from its source at Scandal Head on the slopes of Wild Boar Fell, through Ravenstonedale, into the River Eden. Further along limestone layers, of the overlying Potts Beck Limestone, can be seen in the railway cutting (photo 03)



10. Smardale viaduct on Settle- Carlisle railway (NY 734082)

Pause here to examine the **viaduct's construction**, of large blocks of light grey limestone, called 'freestone' by quarrymen. A protruding layer and the edges of the arches are made of Millstone Grit, tough sandstone which feels like emery paper.



Look closely for fossils in the limestone blocks. You should see a shell like brachiopod, and coiled gastropods, now replaced by harder quartz (SiO₂), so they are more resistant to weathering, and protrude slightly from the rock surface. It is not possible to say if these building stones are of local origin. (Photos 1&2).



Return to Smardalegill viaduct and take the permissive path to the sandstone quarries on the west side of the valley. Take care along this path.

11. View of the Smardalegill viaduct: Glacial drift (NY 727068) (photo35)

The path was once the track taking sandstone blocks, by horse and cart, to the viaduct: some have been left beside the path. Along the path small exposures can be seen of the thin cover of **glacial drift**, which here is dominantly reddish and sandy, suggesting that the ice eroded the local Ashfell Sandstone. Some if it contains rounded pebbles, suggesting deposition by meltwater streams, and a fluvio-glacial origin. The path is nearly along the junction of the Ashfell Limestone above and the conformable well-cemented Ashfell Sandstone below, the contact being often revealed as a **spring line**. An ancient mudflow, after 1862, left an arcuate scar up the hillside, and covered the track with a lobe of liquefied mud. The path is often wet here.

12. Smardale Bridge Local Geological Site (NY 726063)

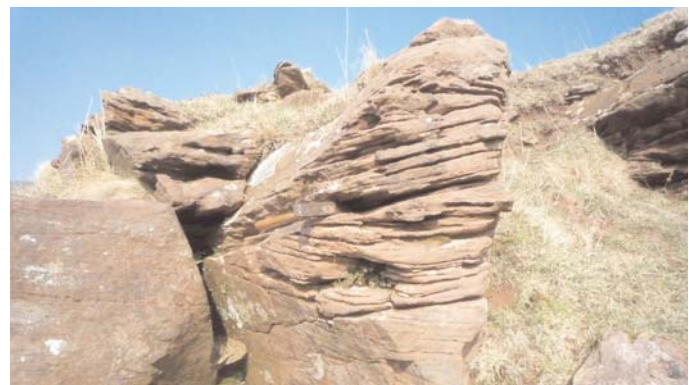
The LGS includes several sandstone quarries with good sections through the **Ashfell Sandstone**. It is a well bedded massive sandstone, reddish in colour, due to a high iron content. A mixture of part-cut sandstone blocks can be seen, some of which may have been brought from elsewhere to be cut here. One loose block shows current ripples, indicating it was deposited in a high energy environment. (photo 17) Its red colour suggests it was deposited near to an arid area, probably a shoreline where periodic storms generated rivers which deposited the sediment.



In the lower quarry, a closer examination shows solution holes where lime has dissolved out. Tufa has been deposited from lime rich water percolating down from the limestone above, and trace fossils may be seen.



The sandstone lies conformably below the Ashfell Limestone, forming lenses and layers, lower in the succession. The sandstone formed at the beginning of Carboniferous marine deposition here, when rivers from the north east intermittently emptied land-derived deltaic deposits into the ancient sea.



From the quarries a view across the valley shows an **alluvial fan**, probably formed by post glacial meltwater channels. Downslope movements under gravity are exposing reddish material, derived from the Ashfell Sandstone. Below the quarries a mass of quarry waste has been tipped into the stream bed. Examination of the **stone walls** and gate posts reveals both Ashfell sandstone and limestone, coral colonies, brachiopods, chert nodules and erratics, together with firebricks from the former inn at Smardale Bridge.

Just alongside the footpath to Ravenstonedale is the main **Smardale Bridge Local Geological Site (NY 722058)**.

Several small quarries operated in the 1860-70s, extracting the local **Ashfell Sandstone Formation** for building stone. The LGS designation describes the rock as 'rusty red fine-grained sandstone, well bedded with strong cross bedding. The sandstone is well cemented with secondary silica, making a strong building stone'. A rock fall showed bright red unweathered sandstone blocks in March 2015, but by August 2015 was already weathered to a duller colour.



13. Smardale Bridge – a Grade II listed structure (NY 721059)

This old packhorse bridge was probably constructed of rock from the smaller sandstone quarry just to the west of the bridge. Various other types of sandstone have been used later to strengthen its parapet. The ground is wetter here as the Ashfell Sandstone is well cemented and does not let water in. The river's course south from here may also be fault guided.



14. The stone walls



Return along the railway line, pondering the evolution of this remarkable meltwater channel



Return to the railway line along the Coast to Coast path. At NY 721061 stop for a view along the Scandal Beck. The stone wall is worth a look for good examples of coral colonies, chert nodules, brachiopods, an erratic from Wild Boar Fell and firebricks. (photos 31,32).