**EXCURSION**

# Monsal Dale, Derbyshire

Sunday 13 August 2017

Leader: Vanessa Banks

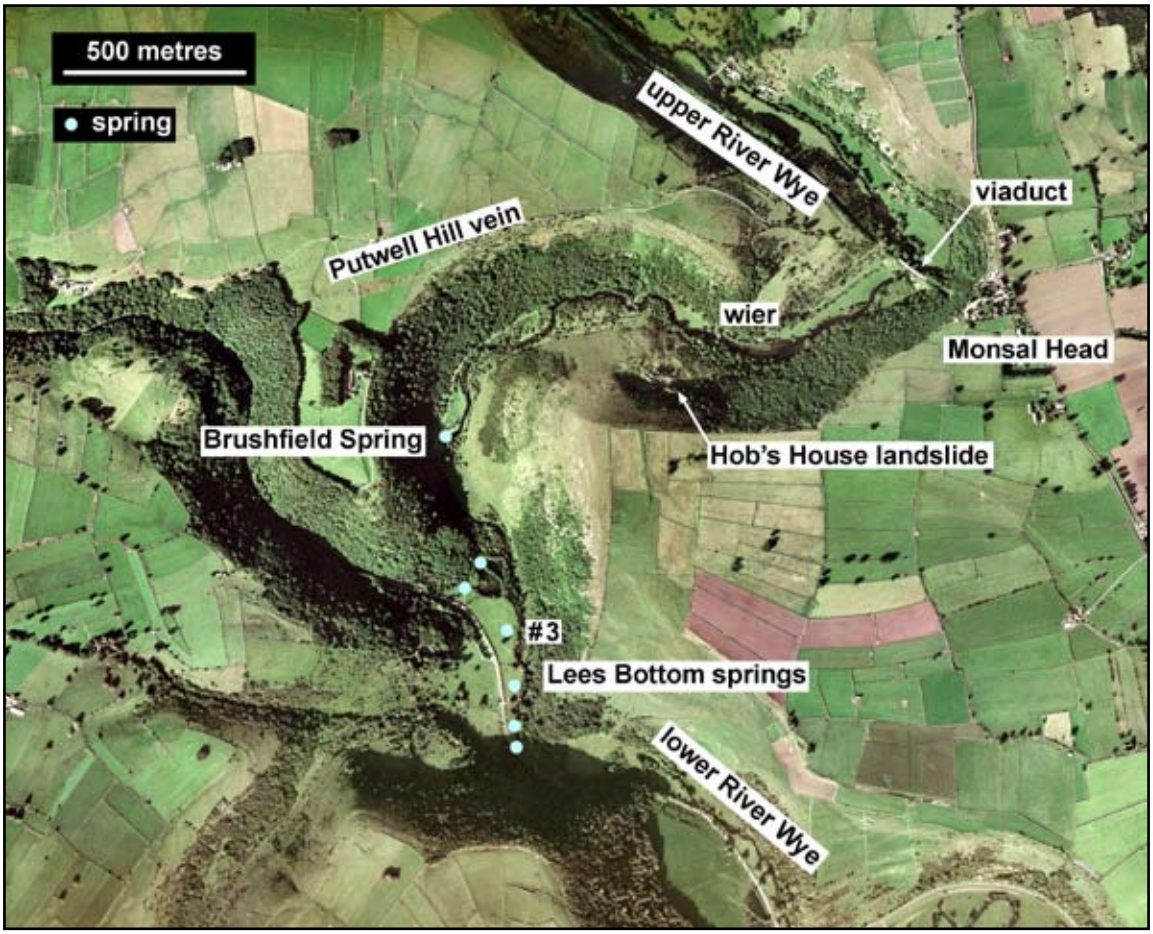
For a joint meeting with the North Staffs Group of the Geologists' Association, 25 people assembled in the Monsal Head car park on a bright morning. All were invited to consider a number of geological issues that would be confronted during the day. How has the River Wye achieved such a degree of incision, and what was the origin of the large meander from Upperdale into Monsal Dale? What processes were active to produce the landslide at Hob's House? What was the source of the silica that preserved the fossils of the Hob's House Coral Band? And why are there such extensive tufa deposits in Monsal Dale?

Our first objective was the landslipped feature of Hob's House, not easily reached across steep scree. The celebrated eponymous coral band is about a metre thick, with a lower leaf rich in small colonial forms (*Diphyphyllum* and *Lithostrotion*) and an upper leaf presenting large solitary forms (especially species of *Dibunophyllum*). Differential weathering between the limestone and silicified fossils leaves their morphological features standing proud, locally preserving fine detail; brachiopod beds are also prominent.

Silicification is likely to be associated with formation of the widespread cherts within the Monsal Dale Limestone. This chert is important enough to have been the basis of a local industry in times past, supplying the Potteries with suitable material with which to grind the clay-mixes. It is believed that cherts formed both during early diagenesis and after lithification. An early mineralisation would favour the detailed preservation of the fossils seen at Hob's House.

Lunch was taken at the weir, where bedrock exposed in the bed of the river confirmed the gentle ESE dip of the limestones. Shortly downstream a small outcrop of remarkably well indurated tufa triggered discussion on the age of this and other such deposits in the area. Reference was made to the well-known tufa cones on the Via Gellia, which are believed to have been influenced by minewater discharge in historical times, but many of the local tufas are dated to within the Holocene, perhaps extending back to the Ipswichian interglacial.

Emerging out on to the valley floor, the party crossed to the foot of the northern valley slope, noting that it, too, was entirely composed of overgrown screes at the same angle of repose as those on the southern side. It therefore appears that aspect was not a conditioning factor in the development of these talus deposits, but that the depth of incision has been more instrumental in their development. It was suggested that this in turn related to pre-Devensian glacial scouring developed further during the Devensian by periglacial processes.




*The large and deeply incised meander of the River Wye through Monsal Dale, with localities visited on the excursion (base image from Google Earth).*

*Some large rotated blocks of limestone within the landslide mass of Hob's House indicate that it is a more complex feature than a simple translational slide (photo: Peter Jones).*

This was also a suitable vantage point from which to observe the nature of the Hob's House landslip. Two main types of landslip movement were considered: rotational failure did not appear to fit observations, and translational failure was the preferred style of movement, triggered by fluvial undercutting at a time of elevated water levels and porewater pressures. Further downstream the bedrock geology includes volcanic horizons, and it is possible that thin clay wayboards, affect permeability and thus slope stability. Discussion also invited comment on the rate of slippage, to which there was no firm answer. The general feeling was that this particular landslip developed in stages, each being small but 'sudden' by geological standards.

Having walked round the large meander of the River Wye, it was appropriate to relate the two main theories that have been advanced to explain its development. Both ideas recognise the presence of the Ashford intra-shelf basin and its importance in controlling facies distribution around Monsal Head. One view suggests that strike-streams were originally developed on a Namurian shale cover and then superimposed on the limestone. Accordingly, there may have been two pre-glacial streams (the Wye and a Lower Wye) flowing southeastwards, which had already begun to conform to structures in the limestone. In due course the Lower Wye captured the upper Wye through headward erosion by a tributary, resulting in a sharp change of direction, since smoothed out into the shape of the present meander.

The alternative view is based on the existence of two glacial terraces in the area. The higher Pilsley Terrace at some 180-195 m OD broadly coincides with the level of the Ashford Basin, and both overlie a lower Hathersage Terrace, which forms a surface at 158-177m OD overlain by till. This could suggest glacial diversion of the River Wye to produce the sharp change in the river's course around the imposing mass of Fin Cop.

Further along the footpath through the woodland, a small exposure at the foot of the talus slope reveals angular scree with clasts imbricate to the slope. Contrasts with the well-known screes at Ecton Hill were drawn, the latter being more chaotic. The commonly held view that the Ecton screes are strongly cemented is apparently true only along a specific seepage level, so a weakly cemented character is the case both at Ecton and in Monsal Dale.

The woodland path then descends to river level, where the remains of several artificial weir-boards are visible. These were once put in place by fisheries to increase aeration of the water and so improve the fish stocks. The margin of the flood plain can also be seen to consist of distinct terrace-like features. These consist of tufaceous spreads described as barrage deposits, formed when water levels and flow regimes were higher. They are mainly associated with the outcrop of the Monsal

*Silicified fossils of the rugose coral Dibunophyllum standing proud of the limestone matrix that has been reduced by surface dissolution; in the upper leaf of the Hob's House coral band; the coin is 23 mm across (photo: Peter Jones).*

*Monsal Dale and its distictive old railway viaduct, as it was in the 1970s, with the limestone blocks and the head scar of the Hob's House landslide clearly visible on the hillside (photo: Tony Waltham).*

*And as it is today, with the structure and detail of the Hob's House landslide gradually being obscured by unconstrained growth of trees and shrubs; the viaduct is still in place, but is out of sight in this view (photo: Peter Jones).*

Dale Limestone, reflecting the greater degree of super-saturation achieved by a more-closed flow-path within thinner bedded lithologies. Precipitation of lime due to degassing of carbon dioxide was also promoted by turbulence from the Brushfield Spring. This is from a sough driven into the valley side to drain mine workings associated with the Putwell Hill vein, which was worked along the top of the hill, yielding lead and zinc ores with a gangue of barytes and calcite.

The woodland footpath passes an exposure of the chert-bearing Monsal Dale Limestone. The belief is that much of the silicification was early diagenetic, and its particular abundance in the Bakewell area might sensibly be attributed to volcanic activity; such an inorganic source would contrast the biological source that is likely for the analogous flints in the Chalk. The presence of chert, either as bands or nodules, also influences the passage of fluids through the rock mass, and thus the bulk permeability. Stylolites are also exposed in this limestone outcrop. They originate through pressure solution during burial of impure limestones, and also influence the hydrological properties of the limestone as they concentrate clay residues along defined surfaces within the rock mass, much like clay partings within the typical layered sequence.

The main valley at Lees Bottom houses small springs, some with associated tufa deposits. Water temperatures, composition and flow characteristics vary between the springs, indicating different origins controlled particularly by depth of groundwater source and flow paths. Massive limestones in the Peak District give rise to fewer springs of high discharge, whereas more thinly bedded limestones (such as the Monsal Dale Limestone in this area) give rise to more springs each with lower discharges. Furthermore, the presence of different lithologies, such as localised volcanic rocks, can create perched water tables of small extent. At one point a rich soil is associated with the weathering of the Lees Bottom Lava, which itself is not exposed. The wall alongside the A6 provides the only physical evidence of volcanic material in the vicinity (assuming a local provenance), with cobbles probably derived from the more widespread outcrop of the younger Shacklow Wood Lava. The presence of lavas might explain why one nearby perennial spring, Lees Bottom 3, shows weakly thermal associations and has a composition noticeably different from others nearby. Such a confined groundwater source emerges from a fault-controlled upward flow path, unlike the more usual unconfined seasonal springs in the area.

The party then returned to Monsal Head by way of the viaduct, arriving just after the cafe had closed for the day, whereupon the ice-cream van in the car park benefitted from a surge in business.

*Vanessa Banks and Mike Allen*