Humbleton Hill and the Trows

[NT 951 275] and [NT 963 283]

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Introduction

Humbleton Hill and the Trows are two separate glacial meltwater systems, which lie 4 km west of Wooler in the eastern Cheviot Hills (Northumberland). The localities illustrate some of the best examples of subglacial meltwater erosion in the north of England. The types of channel range from the simple col channel of Humbleton Hill, with its classic, 'up-and-down' or 'humped' long profile, to the complex, anastomosing channel system of the Trows, with its perched meander loops and plunge-pool channel heads. The site is an excellent locality for demonstrating typical subglacial meltwater channel characteristics that are common throughout northern England and for illustrating how the interpretation of these types of channels has changed throughout this century.

In the northern and eastern Cheviot Hills such channel systems were first associated with glacier meltwater streams by Clough (1888) but Kendall and Muff (1901, 1903) and Smythe (1912) subsequently thought that the formation of these channels in this region was associated with overflows from ice-dammed lakes. This followed from the pioneering monograph of Kendall (1902) in the North Yorkshire Moors.

In Kendall and Muff's work they examined selected channels and ascribed them to lakelets existing at the heads of the valleys, the regional pattern being produced by a sequence of lake levels controlled by massive, impermeable ice. This work was expanded by Smythe (1912), who, on the basis of the channels and related evidence, postulated a series of retreat stages of the last ice sheet in the region. However, Carruthers *et al.* (1932) and Common (1957) suggested that many of the channels in the Cheviot Hills were eroded by ice-marginal meltwater streams. Despite this early work on the origin of the meltwater channels neither of the suggested mechanisms of lake overflow or ice-marginal channels is now considered as the likely mechanism for formation. Hence these two localities illustrate well how there has been major shifts in the interpretation of the origin of meltwater channels. Both Derbyshire (1961) and Clapperton (1968) have suggested alternatives for the erosion of these channels as sub-glacial channels.

Description

Humbleton Hill channel

This channel was one of Derbyshire's (1961) col gullies, which breached pre-existing cols in the north and east Cheviot Hills. It is cut mainly in bedrock and occupies a relatively narrow channel cutting across the south side of Humbleton Hill (channel 6 on (Figure 5.45) and (Figure 5.46). It has very steep sides and is over 30 m deep. Many of these types of channels have reversed gradients, double intakes, double outlets and interrupted long profiles. The Humbleton Hill channel shows some of these characteristics, as it rises for the first 200 m of its course and bifurcates at its lower end. Kendall and Muff (1903) had considered that the channel flowed either side of a postulated delta. However, field observations show that the final outlet of the water was by way of the Humbleton Burn valley to the west of Wooler. The slight discordance at the point of bifurcation coincides with the outcrop of a transverse dyke across the channel. There also is no field evidence for lake shorelines or a delta. Part of the channel has been infilled with post-glacial scree below the hillfort on the north side of the valley. To the west there is another channel system to the south side of Monday Clough (channel 5 in (Figure 5.45)), but this indicates meltwater transport to the north-east.

The Trows channel system

This is an intricate system of meltwater channels (Figure 5.47), (Figure 5.48), and system 4 in (Figure 5.45)), which is located in the col and slopes forming the broad head of the Humbleton Burn valley. The system consists of three main channels that join and extend part way down the small, misfit Humbleton Burn (Figure 5.47). The channel height range is between 208–320 m and the channels vary from intake furrows only 0.6 m deep to gorges over 22 m in depth. As far down-channel as point A in (Figure 5.47) the system is incised mainly in a microgranite bedrock, although a thin veneer of drift overlies the rockhead in places. Wide channels below 'A' have dissected a till plug, which is probably the 'earthy angular drift' of the early [British] Geological Survey work. Three shallow intakes to channel 1 (Figure 5.47) begin on the crest of Black Law ridge. The intakes to channel 2 begin on the south-eastern slope of the ridge just below its crest and three short feeders of channel 3 head on the col crest between Black Law and Grains Law. All the feeders begin as minor, shallow landforms, but each one suddenly expands into a plunge-pool section that varies in depth from 3 m in channel 2 to 18 m in channel 3. Shortly below these sections the feeders unite to form their respective main branches of the channel system. The system contains several abandoned loops at various levels above the main floor and this has partially isolated rocky knolls. Stream channels must have flowed side by side and were separated by only a narrow divide in several sections of the system, but eventually all meltwater was concentrated on the valley floor.

Interpretation

Derbyshire (1961) considered the evidence for the lake overflow hypothesis for the meltwater channel systems in the north and east Cheviot Hills and argued that lake-bottom sediments were entirely absent, that there are no undoubted shorelines and that there was a complete absence of true deltaic landforms. He therefore came to the conclusion that the lake-overflow hypothesis for the origin for the col gully channels was untenable. He suggested that the frequent reverse gradients within channels, accordant tributary development and inconsistent topographical relationships cast doubt on the then accepted ideas related to ice meltwater drainage in this area. He thought that as glacial till was found in the majority of such channels deposition of such sediment took place after erosion of the channels subglacially. He called these types of channels 'subglacial col gullies'. Clapperton (1968), however, cast doubt on some of Derbyshire's (1961) field evidence, such as the frequent reverse gradients and presence of till. The Humbleton Hill channel was used to illustrate some of these doubts as no evidence of till is apparent, but there is much post-glacial accumulation of slope deposits on the valley floor subsequent to its formation, so that any till deposits that might have been deposited originally would now be completely hidden. To Derbyshire (1961) the evidence from the col gullies suggested subglacial erosion, which represented the flow of meltwater under hydrostatic pressure at a level within the ice that was at, or above, the melting point. Below such channels the ice was compact and impermeable. Where col gullies occur at decreasing altitudes in the same topographical area they can be dated relatively to one another. He thought that subglacial waters in the early phases of deglaciation tended to flow outwards to areas of thinner ice and therefore the direction of flow of these channels is a good indicator of regional ice thickness.

The Trows channel system, which is an accordant system, strongly suggested to Derbyshire (1961) that the stream valleys were used as major gutters for subglacial drainage. He considered that a marginal origin for the system was difficult to reconcile with the situation of their intake only 5–40 m above the present streams. Such a thin and restricted ice mass was thought not to be sufficiently impermeable to retain drainage at the surface during the later stages of deglaciation. Derbyshire (1961) considered that this type of system represented a stage of glaciofluvial erosion marked by the formation of subglacial channel systems that showed no control by ice. The abandoned loops suggested a subglacial origin, especially the most peculiar abandoned section, which is the largest loop (point 'r' in (Figure 5.47)) and which climbs *c.* 12 m to a point where it resumes a course parallel to the main channel. The volume of water that cut this loop was sufficient to erode a narrow, bedrock gorge, which deepens from 6 m to 22 m along this section of the system. The main channel is here nearly 31 m deep and is rejoined after 460 m by loop r descending with a steep profile. The hydrostatic head of water pressure must have forced water out of the main channel at right angles to form loop r.

Clapperton (1968) refined the subglacial model for these channels systems by suggesting that the meltwater associated with ice down-wasting over the Cheviot area became subglacial mainly by the superimposition of englacial meltwater streams in submarginal zones of the downwasting ice mass. As the meltstreams were aligned across the trend of spurs and valleys it was inevitable that when these stream systems became superimposed on to the underlying topography that many of the streams eroded channels across the spurs and in some valley heads. Clapperton (1968) argued persuasively that the various complexities of the channel systems needed ice during their formation and that meltwater associated with this ice must have flowed in tunnels beneath the ice. As the largest and most complex channel systems were consistently located in pre-existing cols and valley heads, and are all located in areas of broken and considerable relief, the superimposition of englacial streams explains most satisfactorily how the eroding meltwater became subglacial. Pre-existing valleys and spurs radiate from the north-east to east of the Cheviot Hills and were orientated approximately at right angles to the direction of ice movement and subsequently to that of meltwater flow upon deglaciation. If a system of englacial streams were superimposed on to a topography of short deep valleys, separated by spurs with well-developed cols in their crests, then the following events would be expected: streams that are superimposed on to the steep slopes of narrow cols and spur ends would be likely to slip laterally downwards eroding mainly in the ice at the ice–ground contact rather than into the steep hillside. In the meantime, adjacent streams located over the site of col floors would probably cut down more quickly through the ice. If connections existed between such adjacent streams and those over the col floors then the lower streams may be expected to tap the waters of those at higher levels, thereby concentrating the flow of meltwater more and more over the sites of the col floors. Eventually, incision into the col floor may be made with the combined volume of a previously spread-out englacial channel system.

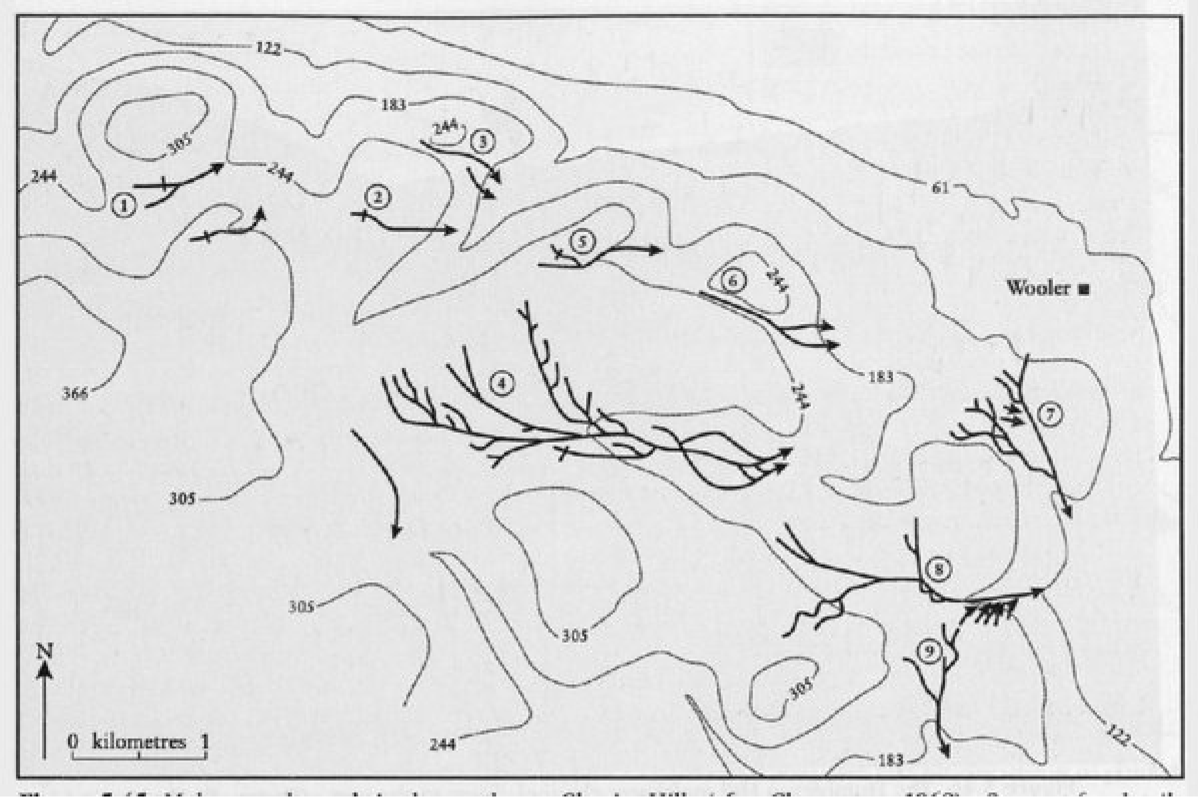
The Trows channel system suggested to Clapperton (1968) that a broad shallow embayment type of valley head allowed latitude for the superimposition of englacial streams more as a complex system with many branches. Here several streams became deeply incised independently before uniting as the valley narrowed downstream. Frequent abandoned channel loops on the sides of, and above, the main branches testify to the continual concentration of meltwater into a subglacial position at the lowest available route.

The importance of such meltwater channels in interpreting the deglaciation pattern in the east Cheviot area has been discussed by Clapperton (1970), where he identified four main phases of meltwater drainage. The channels in this GCR site resulted from an ice-directed drainage in the first phase of deglaciation. In a later paper, Clapperton (1971b) discussed the location and origin of glacial meltwater phenomena in the east Cheviot Hills, which included not only the meltwater channels, but also the origin of the associated sands and gravels in the later stages of deglaciation. The orientation of meltwater channels also was used by Clapperton (1968), along with much other evidence, such as glacial striations, erratics, moraines and features of glacial erosion, to support the concept that the Cheviot massif acted as an independent ice dispersion centre during the last glacial. Glacier ice flowed radially from the core of the Cheviot massif and from the higher summits in the Cheviot Hills ((Figure 5.4)a).

Conclusions

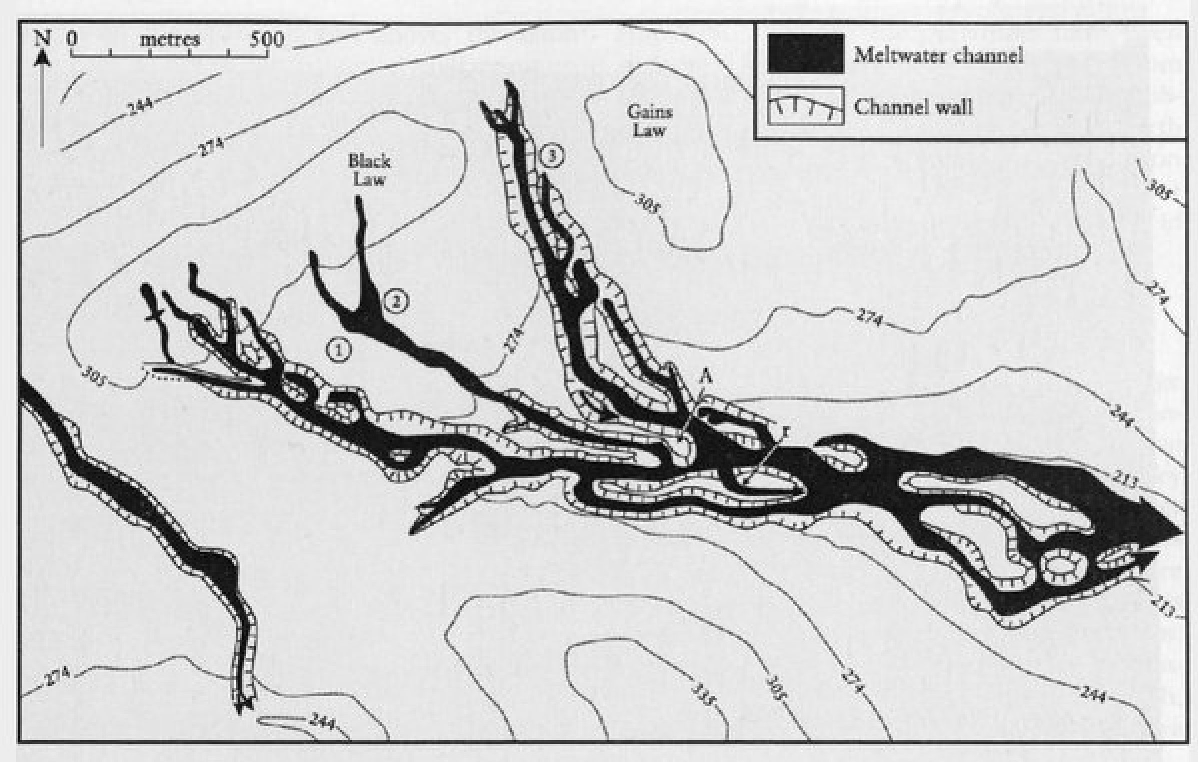
The importance of this GCR site is that it shows two excellent examples of meltwater channel systems that have been interpreted in different ways over the last century. These have ranged from origins as lake overflow channels, through marginal channels to subglacial meltwater systems. It is now considered that they have been formed from the superimposition of englacial stream systems on to the underlying topography, eventually to form as subglacial channels. They are important in that they have helped us understand the mode and pattern of deglaciation and the condition of the ice during this melting. Their orientation, along with other lines of evidence, has helped establish an independent Cheviot ice cap during the last glacial.

[References](#)



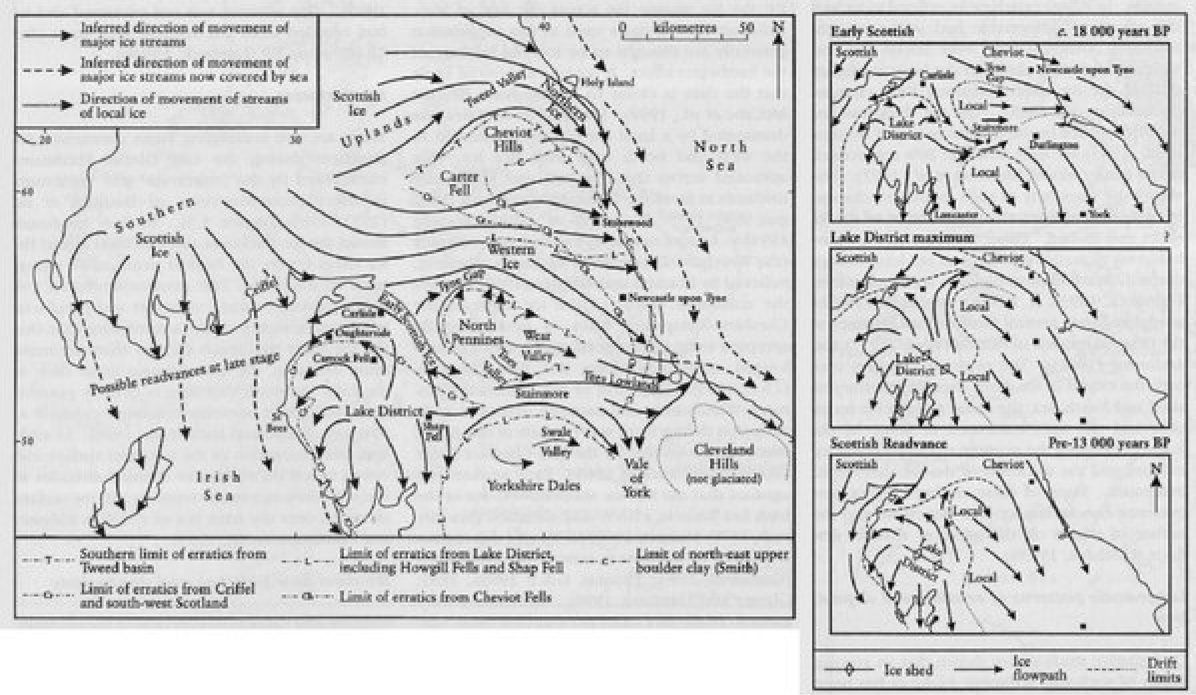
(Figure 5.45) Meltwater channels in the north-east Cheviot Hills (after Clapperton, 1968). See text for details of channel/channel systems 1 to 9.

(Figure 5.46) The Humbleton Hill meltwater channel. View to the east. (Photo: D. Huddart.)



(Figure 5.47) The Trows meltwater channel system (after Clapperton, 1968). See text for discussion of point A and loop r and channels 1 to 3.

(Figure 5.48) The Trows meltwater channel system. View to the north-west. (Photo: D. Huddart.)



(Figure 5.4)a. Suggested Late Devensian ice movements in northern England (after Taylor et al., 1971). b. Suggested Late Devensian ice movements in northern England: generalized movements at various time periods after Letzer (1981). Note that the Early Scottish could be Early Devensian or Wolstonian and that the ice movement directions for the Scottish Readvance are incorrect (see Huddart, 1970, 1991, 1994, 1997).