

A PRELIMINARY STUDY OF THE EMPLACEMENT OF LIMESTONE ERRATIC BOULDERS ON LOWLAND LIMESTONE LANDSCAPES AT HOLME PARK FELL AND SUMMERHOUSE HILL, NW ENGLAND

PETER STANDING

Field notes on limestone erratic boulders (glacially transported boulders) at Holme Park Fell and Summerhouse Hill in northwest England.

INTRODUCTION

The term “erratic” is usually applied to glacially transported boulders whose lithologies differ from the bedrock of their depositional site. Thus, at Norber Scar, Silurian Greywackes rest upon Carboniferous Limestone (Fig. 1, left). However, ice can quarry rocks of one lithology and move them to new locations that are still part of the same outcrop such as the limestone boulders on Scales Moor.



FIGURE 1. Silurian erratic at Norber Scar (left) and limestone erratic at Scales Moor (right).

Hughes (1886) was the first to record the fine assemblage of limestone erratics at Holme Park Fell, south of Farleton Knott, which with Summerhouse Hill, Yealand Conyers, provides the setting for this preliminary study on the emplacement of limestone erratic boulders in lowland karst. The bedrock at both sites is Lower Carboniferous Urswick Limestone and the SSW trajectory of Devensian ice flow across the area can be traced from the orientations of Quaternary erosional and depositional features such as glacial grooves, drumlins and erratic trails. This work forms part of a Masters dissertation on the chronology of karren formation on lowland pavements (Standing, 2013) and follows earlier research on the emplacement of erratics into the grikes of these pavements (Standing, 2010, 2012).

Summerhouse Hill has an elevation of around 120 m and late Devensian ice is likely to have retreated contemporaneously with nearby Warton Crag where optically stimulated luminescence tests of exhumed loess from dolines gave dates of 19.3 ka \pm 2.6 ka (Telfer *et al.*, 2009). With a higher elevation of 150-265 m, glacial retreat at Holme Park would have occurred later, perhaps around 18 ka. These lowland areas were not re-glaciated during the Younger Dryas or Loch Lomond Stadial (12.8-11.7 ka BP) although periglacial conditions would have provided powerful freeze thaw erosion.

Whatever their lithology, erratics offer some protection from erosion to underlying bedrock, sometimes leading to well-defined pedestals of uneroded limestone. These have been used as a proxy for postglacial surface lowering rates with Goldie (2005) projecting rates of 3-13 mm ka⁻¹, not too dissimilar from the 12.4-25.1 mm ka⁻¹ figure

derived by Wilson *et al.* (2012) from cosmogenic dating at Moughton Scar. Both authors emphasise that dissolution is not the only cause of pedestal erosion and that concurrent mechanical erosion principally from freeze-thaw is important too and Wilson prefers absolute surface lowering since deglaciation which in his study was 22-45 cm over 17.9 ka, the latter figure reliant on cosmogenic emplacement dates for the Norber erratics.



FIGURE 2. Some eccentrically orientated limestone erratic boulders at Holme Park.

Field observation of erratic limestone boulders shows that some have eccentric orientations that differ from their preglacially quarried orientations (Fig. 2). Providing that these new positions have not changed since deposition, such boulders should demonstrate new, post-late Devensian (post-LD), karren features such as runnels and kamenitzas and might also include some pre-late Devensian (pre-LD) palaeo-karren features. Before surveying limestone boulders for such evidence it is important to ask five critical questions:

1. Could the 'boulder' have been sculpted *in situ* by loss of adjoining rock during weathering?
2. Is there a plinth under the boulder and does the boulder have any identifiable bedding with a different dip to that of the bedrock?
3. Are the current location and orientation due to primary deposition during glacial retreat or relocation by subsequent mass movement, soil creep, nivation processes or human agency?
4. Has the macro-morphology been changed since deposition by freeze thaw, drilling or explosives?
5. Where was the source of the boulders?

SUMMERHOUSE HILL, YEALAND CONYERS, LANCASHIRE

The Summerhouse Hill boulders provide a robust test of these criteria. The boulders are easily identified on the ground, in aerial photos (Fig. 3). and on the 1850s OS 1st Edition, 6 inch map. North and Spence (1936) considered that four prominent boulders lettered A-D formed a 460 ft (140.2 m) diameter megalithic stone circle. Resurveying shows that rocks A-D are four of a widely scattered collection of limestone boulders stretching from NE of Deepdale Doline to the Three Brothers in Warton Parish. Although a circle can be drawn to incorporate the positions of boulders A, C and D, it is difficult to align B into the circle depicted by North and Spence.

Of twenty boulders surveyed, only five have small, partially exposed plinths making any evaluation of surface lowering impossible. It is difficult to convincingly identify any post-LD runnels but several boulders have small kamenitzas on their tops or within deep clefts on their side walls. These serve as geomorphological "spirit levels" and must have developed since the boulders assumed their current positions and most kamenitzas are around 6-8 cm deep with a range of 2-17 cm (Fig. 4). The similarity of kamenitza patterns on boulders A-D with those of the many other limestone boulders in the area makes it difficult to support North's contention that this is a prehistoric stone

circle. Nevertheless, a Bronze Age round cairn was excavated nearby in 1785 and it is conceivable that an assemblage of erratic boulders, emplaced naturally in a rough circle, could have assumed some ritual significance.

The largest boulders at Summerhouse Hill have volumes up to 12 m³ with weights up to 28 t. Devensian ice could easily have transported such boulders which probably came from local limestone scars 200-1000 m north.



FIGURE 3. Aerial view of Summerhouse Hill, plinth remnants and boulders B-D (Boulder A is hidden from view).



FIGURE 4. Boulder B with eccentric kamenitza. The red lines show the likely original orientation of this boulder as evidenced by an eccentrically positioned kamenitza on the west side.

HOLME PARK BOULDERS

Farleton Fell, Holme Park, Clawthorpe Fell, The Rakes and Hutton Roof are all parts of a complex hilly limestone area just east of the M6 and the villages of Farleton and Burton. An extraordinary assemblage of erratic limestone boulders is scattered over 1 km² of pavements which dip 10° SSW (Fig. 5).

There are three categories of boulder.

Type 1. These are not erratics but simply upstanding detached remnants of limestone scars (Fig. 6, left) and examples of maturely weathered outcrops (Goldie, 2009).

Type 2. Orientations appear fairly similar to the scars and pavement and the boulders sit on solid pedestals that satisfy Goldie's criteria as reliable indicators of surface lowering (Fig. 6, right).

Type 3. Boulders have identifiable bedding but the dip differs markedly from the dip of pavements around them and of their likely source scars further north. This group and their new kamenitzas are of most interest to this study.

Type 4. There are numerous other boulders where the original orientation is difficult to establish.



FIGURE 5. Examples of Holme Park's erratic limestone boulders.



FIGURE 6. Type 1 boulder isolated from a maturely weathered outcrop (left); Type 2 with pedestals (right).

Example 1. One of the most spectacular Holme Park boulders is the 3 m high Trident (SD41669548), an erratic with three beds now orientated vertically. The boulder has separated into three parts (West, Central and East) and the central one has toppled northwards (Fig. 7). The rounded profile of the east face suggests this was the original upper surface before the boulder's reorientation (Fig. 7, bottom left). There are several small kamenitzas on top with depths around 6cm.

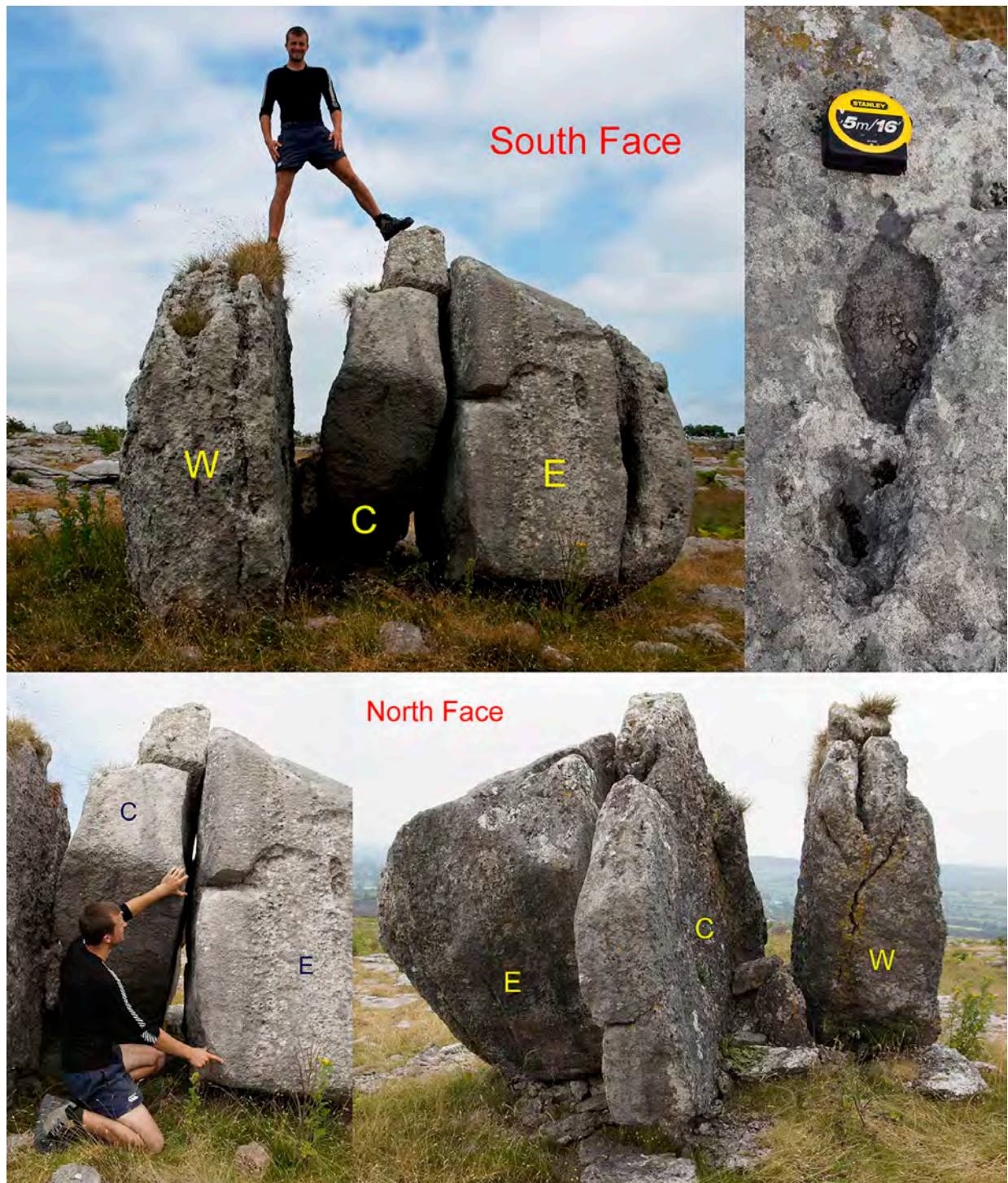


FIGURE 7. The Trident, a tripartite, type 3 erratic with 6cm deep kamenitzas on top (top right). The figure's hands mark the relation of C to E (bottom left) and the north face view shows how the central slab (C) has rolled northwards (bottom right).

Example 2. The pyramidal boulder at SD55097939 may be glacial or the result of mass movement from the cambered limestone scar 100 m away but the principles of erosion in its new position are similar. The boulder (Fig. 8) has fractured along the bedding with new runnels 7 cm wide and 5 cm deep on the lower slab (A) but no erosion on the sheltered upper slab surface (B).



FIGURE 8. Pyramidal Boulder – yellow ring marks new kamenitza, 11 cm wide, 5 cm deep.

Example 3. The much photographed *Easter Island* boulder at SD40909348 (Fig. 9) shows another dramatic bedding fracture. A and B form a measurable fit with A probably toppling from B which remains correctly orientated on the plinth. Both parts have new kamenitzas of around 6 cm but the now horizontal slit (C) on B is likely to be a palaeo-karren feature with a new kamenitza inside.

These are just three examples from a collection of several hundred Urswick boulders. Many are rounded with similar morphologies to the blocky scarp just north of the 265 m summit of Farleton Knott (Fig. 10). Today, the boulder field has patchy shallow soil cover of till and loess and Silurian clasts ranging from 1-70 cm are fairly common on open pavements and in grikes. How deep the drift was after Devensian retreat is difficult to say but it is most unlikely that boulders over 2 m high would have been buried.



FIGURE 9. Easter Island boulder –new kamenitzas ringed yellow.



FIGURE 10. Likely source for the Holme Park erratic boulders.

FUTURE RESEARCH

More extensive surveying of pre-LD palaeokarren and post-LD kamenitzas on other limestone erratics is needed. Whether the depths of these post-LD kamenitzas are a reliable proxy guide to erratic emplacement dates is the key question.

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