ICE AGE WESTON TURVILLE: PATTERNS IN THE GROUND

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This short paper notes the exposure of what appears to be 'patterned ground' on a surface stripped of soil prior to development near Weston Turville. The presence of patterned ground indicates the former existence of land once deeply frozen. It is common in some southern regions, such as East Anglia, but has only infrequently been recorded in Buckinghamshire. There are several periods during the Pleistocene when this might have been occurred, one of which is the Anglian glacial period over 400,000 years ago when a glacier came close to, if not up against, the Chilterns. However, elsewhere in lowland Britain similar features have been attributed to a later Devensian phase.

Probable Glacial Features at Weston Turville

The stripping of topsoil and subsoil to a depth of about 0.3m prior to a housing development north of Weston Turville not far from Aylesbury (SP 847 129: Fig. 1) in June 2016, exposed features which appear to be periglacial in character – that is having being formed at a time when land was frozen to some depth under arctic conditions. The stripped area was on a geological deposit mapped in 1923 by the Geological Survey of Great Britain as 'Valley gravel opposite chalk gaps' (GSGB 1923), and on recent mapping as 'Head, 1 – Clay, silt, sand and gravel' (mapapps.bgs.ac.uk/geologyofbritain/home.html). 'Head' can be described as a deposit of unconsolidated weathered material formed by solifluction, generally on slopes, under cold to freezing conditions. The deposit as a whole, which is roughly oval in outline, extends northwards from the village of Weston Turville almost to the A41[1]. The underlying formation mapped by the British Geological Survey is Gault (whose extent in this area has kindly been confirmed by Michael Oates).

The stripped surface had weathered well exposing archaeological features which were under investigation at the time. Dark, parallel stripes indicated that the land had once been under cultivation by ridge-and furrow ploughing. Extensive patches of strikingly white flint covered much of the area (Figs 2-3), their colour being due to the formation of cortex which was occasionally pitted and sometimes ferric stained. Most were angular, none was larger than 0.10m across and most were much smaller. The flints on the surface had clearly derived from the adjacent Chilterns and formed part of the 'head' deposit noted by the British Geological Survey. Similar flints were also sparsely present in the underlying grey clay. Also obvious, however, were a number of distinct almost stone-free zones, several of which were roughly oval, and which contained either light-brown silt or grey clay (Figs 2 & 4-6). In some cases these abutted the main areas of flint but in others distinct bands of flint, some quite narrow (c.0.25m or less) defined the outline of the features. On occasion a sequence of zone formation appeared to be evident. For instance, in one area a band of flint was butted by silt, truncated by another band of flint, then butted by clay which was in turn truncated by another band of flint, and then was again butted by silt.

No investigative trenches deeper than 0.8m had been cut into the underlying deposit or the apparent periglacial features, so their total depth was not determined. Over many millennia substantial erosion of the land surface would undoubtedly have led to considerable truncation so it is probable that the same, or similar, features would at one stage have been visible at a much higher elevation than that existing today. It is suggested that the observed features have been caused by differential sorting of the head deposit when the ground was deeply frozen. Before discussing such phenomena further, a brief overview of features which demonstrate glacial or interglacial activity elsewhere in the county is given below.

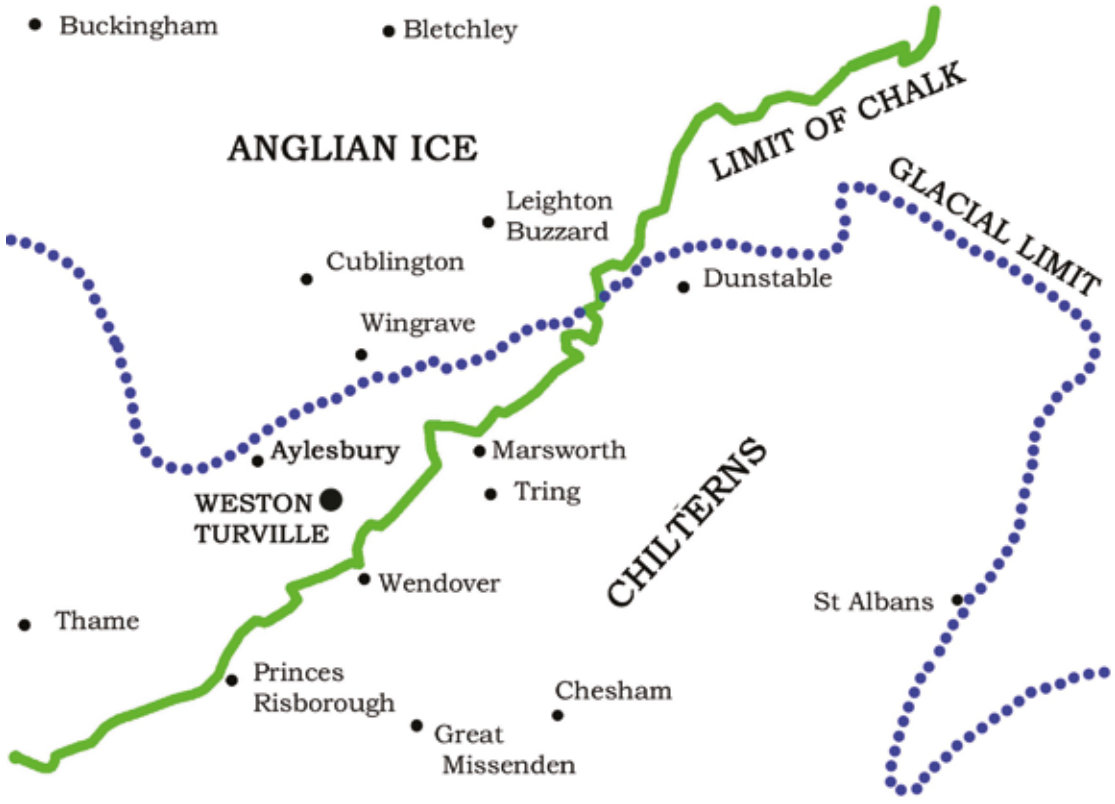

FIGURE 1 Map showing the limit of the Anglian glaciation and the location of Weston Turville (based on Murton *et al* 2015).

GLACIAL FEATURES IN MID AND NORTH BUCKINGHAMSHIRE

Most people are aware that the 'Ice Ages' – the Pleistocene, a period extending roughly from 2.6 Ma to c.11,400 years Before Present (Buteux *et al* 2009, 5), consisted of many phases of temperature change ranging from Arctic to warm. A fuller understanding of these variations has been gained over the last few decades through an international programme of deep sea core samples. As a result, where possible, land deposits of this period are referenced to these 'Marine Oxygen Isotope Stages' (MIS) the even numbers of which define major cold phases and the odd numbers warmer interludes.

The most extensive glaciation to be recorded on land in Britain during the Pleistocene is named the 'Anglian'[2] which has been related to MIS 12 and extends over the period between 474,000–427,000 years ago. The southern limit of this glacier lay close to Aylesbury. For convenience, a map showing the currently inferred location of its maximum extent, not far from the present Chiltern scarp, is provided (Fig. 1). One of the remarkable effects of this glacier was that it diverted the middle and lower Thames from its original course north of the Chiltern scarp in the general direction of Colchester (BGS 2004: it provided the gravels around Beaconsfield), into its present course south of the Chilterns (Sumbler 1996, Fig. 31; Catt *et al* 2006, fig. 17.12).

Central and north Buckinghamshire possess many indications of the former presence of an Ice Age environment, of which perhaps discoveries of extinct fauna of interglacial warm phases are the most immediately striking. A number of find locations are known, the sites at Pitstone/Marsworth

FIGURE 2 General view of stripped surface at Weston Turville showing patterned ground, looking northeast (2m scale)

FIGURE 3 Detail of flints present in the surface 'head' deposit

FIGURE 4 Flints defining the periphery of periglacial features; view 1 (2m scale)

FIGURE 5 Flints defining the periphery of periglacial features; view 2 (2m scale)

FIGURE 6 Flints defining the periphery of periglacial features; view 3

(Murton *et al* 2015, also Preece 2015) being of national significance; others in the county have been listed by the author (Farley 2012). However, the most obvious surface features of a full glacial period are deposits of till (boulder clay), the eroded detritus picked up by a glacier during its progress across the ground and subsequently dropped with rising temperature. Although till has not been recorded at Weston Turville – the area under consideration here – it has been mapped by the British Geological Survey at several locations nearby in the vicinity of Aylesbury, namely: Putlowes Farm, Fleet Marston (SP 779 153), Folly Farm, SW of Hardwick (SP 794 177), and Berryfields Farm near Quarrendon (SP 788 165 and SP 791 168; Horton *et al* 1995 and BGS sheet 237). An earlier survey of the area just east of Aylesbury (GSGB 1923) records till a little north and north-east of Bierton village (SP 828 171; SP 836 173; SP 843 171) and further east deposits at Wingrave and Cublington (Murton *et al* 2015, 22 and Fig. 1; see also Shephard-Thorn 1994, 94).

The surviving thickness of till around Aylesbury is rarely more than 1.5m (Horton 1995, 109). Near Leighton Buzzard it 'rarely exceeds 15m except where preserved in channel fills', but here the till also 'overlay another 9.5m of glacial lake deposits'. In a similar situation at Tattenhoe, Milton Keynes, 29.38m of till was recorded (Shephard-Thorn 1994, 88, 89). Although the maximum thickness of glacial ice during the Anglian phase cannot be known for certain, the basal height of the surviving deposits of till near Aylesbury (now between 80-90m OD) must still reflect the base level of the glacier, although allowance has to made for subsequent uplift of the ground once freed from its icy overburden.

Although as noted above, the presence of till in the Aylesbury area is localised in comparison with the hundreds of hectares of land in north Buckinghamshire which are covered with it, from Newton Purcell to Milton Keynes (BGS 2002: Buckingham; GSGB 1971 MK), these small areas near Aylesbury must represent only a surviving fraction of the original ice cover, bearing in mind that since deposition and subsequent major phases of climate

variation, many thousands of tons of till, together with other deposits, will have eroded away. Under these circumstances it also seems unlikely that the present recorded locations provide a definitive indication of the final southern limit of the glacier's former extent.

A recent paper on Pleistocene features at Marsworth, north-east of Weston Turville (previously noted), where no till was recorded, in describing the content of an early fluvial deposit here, does, however, note the presence of '… far-travelled' rounded quartzose rock. After discussing conflicting suggestions for the dates of other surviving local glacial features the writer observes:

'A source for the far-travelled clasts … is difficult to visualise apart from the glacial deposits of Anglian age in the Vale of Aylesbury. This source suggests that either Anglian ice extended some 10km to the south of the limit inferred by Horton *et al* (1995) and reached the chalk escarpment near Marsworth or that Anglian glacial sediment was transported south to Marsworth sometime later than MIS12.' (Murton *et al* 2015, 43–4).

It has been suggested that the absence of till on the Chiltern dip slope indicates that the glacier 'did not generally override it' (Shephard-Thorn 1994, 85), which may be fair comment, but taking all of the above factors above into consideration it seems not unreasonable to hypothesise that the Anglian glacier's onward progress might have been halted by the Chiltern scarp.[3] However, it worth noting in this connection that the scarp face itself is likely to have retreated since the Anglian period. The potential rate of regression over a very long period has been considered in a note by Michael Oates (http://www.bucksgeology.org.uk/pdf_files/BEHG_Newsletter_January_2013.pdf).

Apart from deposits of till, many other features of the Buckinghamshire landscape demonstrate powerful processes at work during the Pleistocene including the terracing of rivers – most notably of the Thames where they have been studied for many years, but also of the Thame, the Great Ouse and many tributaries. There are also deposits of 'head' (noted above), of glaciofluvuial sand and gravel[4], and of a number of relatively superficial features including cryoturbation (for example near Newton Longville; Horton 1974, fig. 18) and ice wedge casts. The former are distinctive wave-like soil distortions often seen in section a little below ground level, and the latter are ice-formed fissures which have subsequently infilled with sediment, seen for example in a gravel pit at Wendover (Farley 2012, fig. 5). Ice wedge casts are one component of variety of features classified as 'patterned ground' which are often visible on aerial photographs.[5] It is suggested that the features observed at Weston Turville may fall into this class.

Discussion of the Weston Turville Features

As previously noted patterned ground occurs under conditions of permafrost. It can take the form of circles, polygons, and nets (which normally occur on level or gently sloping surfaces), and stripes which are found on steeper gradients. The 'patterns' may be defined by relatively stone-free surfaces defined by coarser material (Allaby 2013, 429) or by e.g. ice wedge casts which have been subsequently infilled. In periglacial areas permafrost can extend to a depth of 400m. In the summer temperatures may reach five degrees above freezing but for three months of the year can fall to minus twenty-five. Patterned ground can be readily observed today under these circumstances, for example in the Canadian Arctic (Martini *et al* 2011, 1–13) and Spitzbergen (Akerman 1987, figs 1.11 & 1.12). The patterns may of course form on land which has never had a glacier covering its surface (although one might exist in the vicinity), or may be formed during a glacier's advance or retreat. Under favourable conditions these distinctive features can survive long after permafrost has ceased to exist. They are for instance well-represented today in East Anglia (Lee *et al* 2015: Bateman *et al* 2014), where they are also accompanied by examples of 'palsas' and 'pingos', evidence for the mounding up of ice or of frozen local soils and their subsequent collapse (French 2007, 116–52; Harris 1990, fig. 63). Formation of the latter can lead to the dispersal of heavy constituents to the periphery, as with other ice-formed features (Seppälä 1987, 47).

The stripped area at Weston Turville (OD height 86-87m, similar to the basal height of till deposits around Aylesbury previously noted) was relatively level, with only a difference of a metre between the north and south ends of the site, giving a gentle upward slope of about 0.45 degrees from north to south towards Weston Turville. Unfortunately the

stone-free zones observed here don't readily fit into any well-recognised grouping. They do not form the polygons, common on level ground, nor 'stripes' which occur on ground with a greater degree of slope (see Addendum 2). A stronger possibility is that they mark the former presence of palsas and pingos whose distribution and outline is more irregular (French & Harris, cited above). A sequence of replacements on the same site over time also seems possible. As the 'head' deposit in which the formations occur extend over a far wider area than was affected by the development noted here, it is hoped that other opportunities for a properly resourced study may occur in the future.

Finally, although the features seem to demonstrate fairly clearly the existence of frozen ground here, the date they were formed is not certain. The proximity of the Anglian glacier (which indeed might have once covered the site) makes this a likely candidate. However, there are other major glacial episodes – including the Devensian when sea ice reached the Wash on the east and glacial deposits of the same age occur on the Welsh border, when permafrost might have extended this far south (Catt *et al* 2006, 443; Lee *et al* 2015, fig. 43b). Murton and Giles (2016) for instance, have noted the presence of periglacial features in north Kent, some distance from the presence of any glacial front, where ground ice caused the fracture of bedrock chalk to a depth of up to forty-nine metres.

Acknowledgements

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Figure 7 Aerial view of patterned ground at Olney, looking south-east; contrast enhanced (Michael Farley, July 2015)

University, and Jonathan R Lee, British Geological Survey, for advice although none of the above bear any responsibility for the final product.

Addenda

1. Quarrendon

Although only marginally relevant to this piece, it is worth noting that during a fieldwalk by the society's Active Archaeology Group in 2017, in a field adjacent to the 'deserted medieval village' of Quarrendon just NNW of Aylesbury, a number of non-local rock fragments were collected. These were mainly limestone but included three quartz or quartzite pebbles, Midland rocks ('Bunter'), commonly associated with glacial deposits.

2. Olney

The accompanying photograph (Fig. 7) shows patterned ground on sand and gravel on the west side of Olney (SP 879 515). The land slopes from c 80m OD on the left side of the image to c.68m on the right towards the bank of the Great Ouse. Numerous roughly parallel bands can be clearly seen, roughly parallel to the slope. These are typical products of frozen ground formed on a slope. A very similar example of 'stripes' on Kentish chalk is shown in Murton & Giles 2016, Fig. 6.4.

Footnotes

1. M. Oates, *pers. comm*, comments that he observed in 1965 that this deposit extends further to the NW where it was observed to be at least a metre deep.
2. The Anglian reference has been retained although a paper by Sumbler (1975) suggests that two widely separated phases of glaciation may have in the past been confused in the area.
3. However, in East Anglia it is thought that the Anglian glacier was responsible for 'widespread lowering of the chalk escarpment' (Bateman 2014, 302)
4. A periglacial outwash channel containing 'undifferentiated calcareous silty marls' was recorded on an archaeological site at Aston Clinton. Report by MJ Allen 2012, kindly provided by Museum of London Archaeology.
5. An example at Olney is included in Addendum 2.

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