Royd Edge and Oldfield Hill Earthworks,

Meltham,

West Yorkshire.

Geophysical Survey

Contents

Summary

Magnetometer surveys were undertaken at two earthwork enclosure sites south-west of Huddersfield. The objectives were to determine whether gradiometry is a suitable technique for identifying archaeological features on Millstone Grit geology and if there is any evidence for other domestic activity or for a ditched field system outside the main enclosures. Although outwardly similar in form and function the magnetic responses from the monuments are markedly different. At Oldfield Hill there was virtually no detectable response from the infilled ditch. It is thought that this primarily reflects the high percentage of stone in the fill. At Royd Edge the infill is predominantly silty soil and the ditch gives a strong magnetic signal thereby demonstrating that archaeological features can be identified on Millstone Grit geology under the right conditions. Isolated anomalies thought to be caused by archaeological activity have been identified inside both enclosures. There is no geophysical evidence for the continuation of archaeological activity outside the enclosure at Royd Edge but isolated responses north of the enclosure at Oldfield Hill could be indicative of further human activity.

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1. Introduction and Objectives

1.1 Archaeological Services WYAS, was commissioned to carry out geophysical (fluxgate gradiometer) surveys over two earthwork enclosure sites at Royd Edge and Oldfield Hill, south-west of Meltham, near Huddersfield (see Figs 1 & 2).

1.2 As both Royd Edge and Oldfield Hill are Scheduled Ancient Monuments (National Monument Numbers 31507 and 31494 respectively) a Section 42 licence was sought from, and approved by, English Heritage prior to the commencement of the survey (see Appendix 4).

1.3 At the time of the surveys (July 26th to August 4th 2000) Royd Edge had just been mown for silage and Oldfield Hill was under permanent pasture. The solid geology on which both enclosures are situated is classified as Huddersfield White Rock, part of the Namurian Millstone Grit series (British Geological Survey 1981). A total area of 4.4 hectares was surveyed.

1.4 There is a tripartate split in the solid geology of West Yorkshire from Magnesian Limestone in the east of the county, through the Coal Measures sequence in the centre, to the Millstone Grits on the upland areas predominantly in the west of the county. Although many magnetic surveys have been carried out on Magnesian Limestone and Coal Measures geology in West Yorkshire, very few have been carried out on Millstone Grits. This is primarily because the upland areas, where Millstone Grit is the underlying solid geology, are not prime sites for development. Relatively little is often known about the archaeology of these upland areas and this is also linked to the geology and topography. In the lowland areas in the centre and east of the county, where limestone and coal measures geology predominates, the agriculture is mostly arable. The growing of cereal crops is suitable for cropmark formation and consequently many archaeological sites have been located from analysis of aerial photographs. In contrast most upland areas, on Millstone Grit geology, support only moorland, rough grazing or at best improved permanent pasture. As these conditions do not usually suit cropmark formation one important source of evidence for the location of archaeological sites is lost.

1.5 The few magnetic surveys that have been carried out on Millstone Grit geology in West Yorkshire have not identified any probable archaeological anomalies. However, it is not clear whether the negative results to date reflect an actual lack of archaeology or to the inability of the fluxgate gradiometer to detect weak magnetic responses on a geology where the wide range of magnetic susceptibility of the parent rock, often coupled with a very thin soil horizon, results in a variable background response to survey. The principal aim of the project was, therefore, to carry out magnetic surveys at sites where archaeological features have previously been identified and excavated in order to investigate the level, or lack, of magnetic response from these features, and if possible to determine reasons for the observed responses.

1.6 The secondary objective was to continue the survey outside the upstanding archaeological remains to determine whether occupational activity was limited to the enclosed area or whether the enclosures lay within a ditched field system, a scenario which appears to be typical in the east of the county.

2. Archaeological Background

2.1 Royd Edge

2.1.1 Royd Edge, (Grid Reference SE 0910 0965) is a sub-rectangular earthwork enclosure, approximately 75m by 80m, located about 1km south-west of Meltham at approximately 315m OD. It overlooks the enclosure at Oldfield Hill, 0.5km to the south-east, from its situation on an east facing spur.

2.1.2 The Huddersfield and District Archaeology Society carried out a limited archaeological investigation of the site starting in 1967 following on from the excavations at Oldfield Hill, completing four seasons digging in 1970. A seventy foot trench was dug across the northern side which showed '*only one phase of occupation, marked by a stone-revetted rampart and an inner ditch'* (Toomey 1982). This ditch was 2.4m wide and 1.7m in depth, similar dimensions to those of the rock cut ditches at Oldfield Hill.

2.1.3 A series of test pits in the entrance on the eastern side located the ends of the ditch, approximately 4m apart, with a badly damaged oval or circular building, evidenced by a spread of wall material and four small post-holes, located immediately west of the ditch gap. Finds recovered included the upper stone of a rotary quern, stone discs and fragments of friable reddish pottery and a lead spindle whorl.

2.1.4 Toomey concluded that the most likely function of the enclosure was '*as a pound for animals, whether for protecting sheep or cattle, or perhaps for breaking horses*'.

2.2 Oldfield Hill

2.2.1 The enclosure at Oldfield Hill, (Grid Reference SE 0875 1010), is outwardly very similar to that at Royd Edge. It is also sub-rectangular, approximately 80m by 75m in size, located about 1km south-west of Meltham, on an east facing spur at approximately 300m OD with an entrance on the eastern side. The most obvious difference is that whereas Royd Edge has an internal ditch at Oldfield Hill a low earthwork bank with an external ditch defines its extent. On the southern side the land drops of very sharply, a fact that initially lead to the erroneous supposition that there was no ditch on this side of the monument.

2.2.2 Nineteenth century references surmise that the site was thought to be *'the remains of a Roman encampment*' and this view persisted into the twentieth century when it was first excavated by the late I. A. Richmond in 1923. Despite finding no evidence for Roman occupation he remained convinced that the enclosure was the remains of a Roman fort and postulated an early Flavian date.

2.2.3 Between 1960 and 1967 the Huddersfield and District Archaeological Society undertook a series of excavations at the enclosure in '*an attempt to examine thoroughly a small defended enclosure in the Pennines*' (Toomey 1976). The results of this excavation demonstrated that there were three phases of development beginning with a small palisaded enclosure. This was succeeded by the construction of a stone-revetted rampart, with an entrance on the eastern side, and a V-shaped (external) ditch which enclosed a much larger area. A final phase was suggested by a later entrance cut through the western defences.

There was no evidence of buildings inside the enclosure but post-holes and iron slag waste, ironstone nodules and furnace lining were found. Other finds included rotary querns and stone discs. Although no precisely datable material was recovered it has been stated that '*none of the ..... material .....would be out of place in an Early Iron Age context*' (Toomey 1976).

3. Methodology and Presentation

3.1 The survey was carried out in accordance with English Heritage Guidelines (David 1995) and with the terms of the Section 42 licence, at the request of the Senior Archaeological Officer of the WYAS Advisory Service (see Section 1.1 above).

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3.3 A site location plan showing the greyscale magnetic data on an Ordnance Survey digital map base is presented, at a scale of 1:2500, in Figure 2. Processed greyscale plots of the two sites are presented in Figures 3 and 5, at a scale of 1:1000, with interpretations at the same scale in Figure 4 and 6. Further details on data processing and display are given in Appendix 1.

4. Results and Discussion

4.1 Royd Edge (Figs 2, 3, 4 and 7)

4.1.1 The internal, infilled, ditch at Royd Edge is identified as a coherent, positive, linear magnetic anomaly on the northern, southern and eastern sides of the enclosure, although there is no evidence in the magnetic data for the ditch on the western side. Unfortunately at this site only one trench was excavated across the bank and ditch and this was on the northern side of the enclosure where the infilled ditch was readily detected by the magnetic survey. The archaeological record shows that athough there is a slump of stone rubble on the northern edge of the ditch at least half of the ditch fill by volume comprises yellow and grey silts. This suggests that most of the fill material probably accumulated naturally rather than being deliberately imported. As the prevailing wind blows from the west any magnetically enhanced material inside the enclosure, possibly resulting from a fire or hearth, would tend to be blown into the (internal) ditches on the northern, southern and eastern sides of the enclosure. If there was little natural infilling of the western ditch a later deliberate infilling with non-magnetic material could explain the lack of a magnetic response from this ditch.

4.1.2 Areas of magnetic enhancement immediately inside and just outside the entrance on the eastern side of the enclosure suggest anthropogenic activity. This reflects the results from the test pitting which identified the probable remains of a small hut just inside the entrance. Evidence for the burning of the palisade was also found during the excavation.

4.1.3 Similar small areas of magnetic enhancement and individual isolated responses have been identified throughout the internal area of the enclosure, with particular clusters 30m east of the entrance and around the southern ditch.

There are relatively few such responses in the western half of the enclosure and even fewer still outside the enclosure itself. This marked disparity in the number of isolated responses outside the enclosure relative to the internal area suggests that, although these responses may have a geological origin an archaeological cause is considered more probable.

4.2 Oldfield Hill (Figs 2, 5, 6 and 8)

4.2.1 The strongest response is exhibited by the linear anomaly running from south-west to north-east at the southern edge of the plot. This is caused by a stone-lined and capped stream/drain which was located at the bottom of the slope.

4.2.2 Other non-archaeological anomalies locate a trackway and possible field drains. Vague linear trends suggest that ridge and furrow ploughing took place to the east of the enclosure; the remnants of ridge and furrow ploughing were still visible in the fields to the south of the enclosure.

4.2.3 Ubiquitous across both sites are 'iron spike' responses that are commonly caused by ferrous rubbish in the topsoil. However, during the excavations at Oldfield Hill iron stone and pieces of slag and furnace waste were recovered. This suggests that some of the anomalies identified as 'iron spikes' could be caused by material of archaeological significance.

4.2.4 Despite the size of the enclosure ditch (typically 1.5m deep and 3m wide) there is no coherent magnetic response to locate it. However, by overlaying the results of an earthwork survey (carried out by the Royal Commission on Historic Monuments in England) and a brief topographic survey carried out during the current magnetic survey, on top of the magnetic data it can be seen that at least two short, discontinuous, linear anomalies, on the southern and eastern edges of the enclosure, correlate with the position of the external ditch. The excavation trench plan (Toomey 1976) shows that two of the trenches across the bank and ditch correspond with the location of the positive magnetic anomaly. The drawn record of the section across the bank and ditch in these two locations shows that in both cases at least 50% of the ditch fill comprises soils, particularly in the upper fills, with rubble, presumably from the collapsed rampart, making up the remainder. This contrasts with the ditch fill recorded in section from trenches in two other locations, where the ditch has not been detected as a magnetic anomaly. In both these two cases rubble comprises between approximately 50% and 75% of the fill material. The obvious conclusion is that where stone is the major component of a ditch fill there is insufficient magnetically enhanced material for the gradiometer to detect a magnetic contrast between the ditch fill and the surrounding topsoil/subsoil.

4.2.5 Inside the enclosure no linear anomalies were identified to suggest that it had been sub-divided for any purpose. However, many small isolated responses and areas of enhanced magnetic susceptibility have been identified, particularly around the inside of the bank on the southern and eastern sides. These anomalies could be indicative of discrete features such as pits or areas of burning associated with domestic activity. At least one of these areas corresponds with an area of slag found during test pitting. Alternatively some of these anomalies might be the result of much later activity such as clearance of the site in the 19th century, an explanation suggested by Toomey for some of the burnt features identified during trenching. Interestingly though there are no such anomalies outside the enclosure on the eastern side. This might tend to increase the probability that those anomalies inside the enclosure are archaeological.

4.2.6 To the north of the enclosure several isolated areas of enhanced susceptibility have been identified, with a cluster in the north-western corner of the survey block being particularly prominent. These anomalies could be archaeological but the *in situ* burning of tree stumps, during a much later land clearance, might also account for the observed response.

5. Conclusions

5.1 The two surveys have demonstrated that it is possible to identify infilled archaeological features on Millstone Grit in upland areas of West Yorkshire using gradiometry. It has also been possible, with the availability of excavation information, to offer an explanation for the non-detection of some of the other infilled ditches.

5.2 The number of areas of magnetic enhancement and discrete anomalies identified within the enclosure at Royd Edge suggests that, whilst its function may primarily have been as a stock enclosure, it appears that there might have been a greater degree of anthropogenic activity than indicated in the, albeit limited, archaeological investigations carried out during the 1960's.

5.3 In contrast the large number of strong internal magnetic anomalies identified at Oldfield Hill suggests activities associated with domestic occupation and industrial activity.

5.4 The geophysical surveys suggest that both enclosures sit in isolation with no evidence to suggest that the land outside either enclosure was divided, by ditches, into fields.

5.5 Isolated anomalies to the north of the enclosure at Oldfield Hill might indicate further human activity but a non-archaeological explanation cannot be discounted.

The results and subsequent interpretation of geophysical surveys should not be treated as an absolute representation of the underlying archaeology. It is normally only possible to prove the archaeological nature of anomalies through intrusive means such as by trial excavation.

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Appendices

Appendix 1

Magnetic Survey: Technical Information

1. Magnetic Susceptibility and Soil Magnetism

1.1 Iron makes up about 6% of the Earth's crust and is mostly present in soils and rocks as minerals such as maghaemite and haemetite. These minerals have a weak, measurable magnetic property termed magnetic susceptibility. Human activities can redistribute these minerals and change (enhance) others into more magnetic forms so that by measuring the magnetic susceptibility of the topsoil, areas where human occupation or settlement has occurred can be identified by virtue of the attendant increase (enhancement) in magnetic susceptibility. If the enhanced material subsequently comes to fill features, such as ditches or pits, localised isolated and linear magnetic anomalies can result whose presence can be detected by a magnetometer (fluxgate gradiometer).

1.2 In general, it is the contrast between the magnetic susceptibility of deposits filling cut features, such as ditches or pits, and the magnetic susceptibility of topsoils, subsoils and rocks into which these features have been cut, which causes the most recognisable responses. This is primarily because there is a tendency for magnetic ferrous compounds to become concentrated in the topsoil, thereby making it more magnetic than the subsoil or the bedrock. Linear features cut into the subsoil or geology, such as ditches, that have been silted up or have been backfilled with topsoil will therefore usually produce a positive magnetic response relative to the background soil levels. Discrete feature, such as pits, can also be detected. Less magnetic material such as masonry or plastic service pipes which intrude into the topsoil may give a negative magnetic response relative to the background level.

1.3 The magnetic susceptibility of the soil can also be enhanced significantly by heating. This can lead to the detection of features such as hearths, kilns or burnt areas.

2. Types of Magnetic Anomaly

2.1 The types of response mentioned above can be divided into five main categories:

2.2 Isolated Dipolar Anomalies (Iron Spikes)

2.3 These responses are typically caused by ferrous objects on the surface or in the topsoil. Whilst they could be caused by archaeological artefacts, unless there is supporting evidence for an archaeological interpretation, then little emphasis is given to such anomalies, as modern ferrous objects are common on rural sites, often being present as a consequence of manuring.

2.4 Areas of Magnetic Disturbance

2.5 These responses can have several causes and are often associated with burnt material, such as industrial waste or other strongly magnetised/fired material. They are usually assumed to have a modern origin unless there is other supporting information. Ferrous fencing can be a major source of magnetic disturbance as they produce very strong magnetic responses that can mask weaker archaeological anomalies.

2.6 Positive Curvi/Linear Anomalies

2.7 They are commonly caused by infilled ditches which may be archaeologically significant. Former or current agricultural practice can also result in these anomalies.

2.8 Isolated Positive Anomalies

2.9 These anomalies can exhibit a magnitude of response of between 2nT and 300nT and can be caused by pits or post holes, ovens or kilns. They can also be caused by natural/geological features on certain geologies. It can often be very difficult to establish an anthropogenic origin without intrusive investigation.

2.10 Negative Linear Anomalies

2.11 These are normally very faint and are commonly caused by features such as plastic water pipes which are less magnetic than the surrounding soils and geology. They too can be caused by natural features on some geologies.

3. Methodology

3.1 Magnetic Susceptibility Survey

3.1.1. There are two methods of measuring the magnetic susceptibility of a soil sample. The first involves the measurement of a given volume of soil, which will include any air and moisture that lies within the sample, and is termed volume specific susceptibility. This method results in a bulk value that it not necessarily fully representative of the constituent components of the sample. The second technique overcomes this potential problem by taking into account both the volume and mass of a sample and is termed mass specific susceptibility. However, mass specific readings cannot be taken in the field where the bulk properties of a soil are usually unknown and so volume specific readings must be taken. Whilst these values are not fully representative they do allow general comparisons across a site and give a broad indication of susceptibility changes. This is usually enough to assess the susceptibility of a site and evaluate whether enhancement has occurred. Magnetic susceptibility readings were not taken as part of this evaluation.

3.2 Gradiometer Survey

3.3 There are two main methods of using the fluxgate gradiometer for commercial evaluations. The first of these is referred to as scanning and requires the operator to visually identify anomalous responses on the instrument display panel whilst covering the site in widely spaced traverses, typically 10-15m apart. The instrument logger is not used and there is therefore no data collection. Once anomalous responses are identified they are marked in the field with bamboo canes and approximately located on a base plan. This method is usually employed as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be subject to detailed survey, as in this case. In favourable circumstances scanning may be used to map out the full extent of features located during a detailed survey.

3.4 The second method is referred to as detailed survey and employs the use of a sample trigger to automatically take readings at predetermined points, typically at 0.5m intervals, on zig-zag traverses 1m apart. These readings are stored in the memory of the instrument and are later dumped to computer for processing and interpretation.

3.5 The Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used for the detailed gradiometer survey. Readings were taken, on the 0.1nT range, at 0.5m intervals on zig-zag traverses 1m apart within 20m by 20m square grids.

3.6 Data Processing and Presentation

3.7 The detailed gradiometer data has been presented in this report in X-Y trace and greyscale formats. The former option shows the 'raw' data with no processing other than grid biasing whilst in the latter the data has been selectively filtered to remove spurious errors such as striping effects and edge discontinuities caused by instrument drift and inconsistencies in survey technique caused by poor field conditions.

3.8 An X-Y plot presents the data logged on each traverse as a single line with each successive traverse incremented on the Y-axis to produce a 'stacked' plot. A hidden line algorithm has been employed to block out lines behind major 'spikes' and the data has been clipped at 10nT. The main advantage of this display option is that the full range of data can be viewed, dependent on the clip, so that the 'shape' of individual anomalies can be discerned and potentially archaeological anomalies differentiated from 'iron spikes'. In-house software (XY3) was used to create the X-Y trace plots.

3.9 In-house software (Geocon 9) was used to interpolate the data so that 1600 readings were obtained for each 20m by 20m grid. Contors software was used to produce the greyscale images. All greyscale plots are displayed in the range –1nT to 2nT, unless otherwise stated, using a linear incremental scale.

Appendix 2

Survey Location Information

On both sites the survey grid was laid out from baselines established on a north-west to south-east axis (parallel with the existing system of field division) using a Geotronics Geodimeter 600 series theodolite to set out points at 20m intervals. The site grids were then tied-in to permanent landscape features such as the dry stone field boundary walls. In Figures 2 and 3, and all subsequent figures the data has been superimposed on a digital Ordnance Survey map base as a 'best fit'.

It should be noted that the Ordnance Survey co-ordinates for 1:2500 digital maps have an error of +/- 1.08m at a 99% degree of confidence. These errors should be taken into account during any re-location of the site grid.

Appendix 3

Geophysical Archive

The geophysical archive comprises:-

- an archive disk containing the raw data, grid location information, report text (Word 97), and compressed (CorelDraw6) files of the graphics
- a full copy of the report

At present the archive is held by Archaeological Services WYAS although it is anticipated that it will eventually be lodged with the Archaeology Data Service (ADS). Brief details will also be forwarded for inclusion on the English Heritage Geophysical Survey Database after the contents of the report are deemed to be in the public domain (i.e. available for consultation in the relevant Sites and Monument Record Office).

Appendix 4

Geophysical Prospection Licence