Land off Church Lane,

Normanton

West Yorkshire.

Additional Gradiometer Survey

by

Mark Whittingham BSc MA

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Land off Church Lane,

Normanton

(SE 3955 2200 site centred)

Gradiometer Survey

1. Summary

Objectives
To determine the presence and extent of any sub-surface archaeological remains within the survey area and to ascertain whether a feature identified in an earlier survey continued into, and was detectable under, an adjoining golf course .

Methodology
A detailed magnetometer survey using a Geoscan FM36 fluxgate gradiometer was carried out over an area of 5 hectares east of Church Lane, Normanton.

Results & Conclusions
Very strong responses from ridge and furrow ploughing were observed in the east of the survey area, together with anomalies thought to be caused by recent land drainage.

The anomaly identified in an earlier survey was not observed continuing into the golf course. No other archaeological anomalies were identified.

2. Introduction & Archaeological Background

2.1 Archaeological Services (WYAS) were to undertake a gradiometer survey over an area of approximately 5 hectares on the eastern edge of Normanton (see Figs 1 & 2). This work was in addition to that commissioned earlier (Webb 1997) over part of a large site for which outline planning permission has been granted for a residential development.

2.2 The site lies in a region in which cropmark evidence of prehistoric and Romano-British settlements and fields is commonplace. Those adjacent to the site under evaluation possibly indicate linear ditches. However, these features have only been recorded once during aerial reconnaissance so it is unclear whether their fragmentary appearance was due to the time of the reconnaissance or the unsuitability of the soils to cropmark formation in this area.

Two geophysical surveys within 0.5km of the current survey area have been carried out in the last three years along the proposed road corridor (both Webb 1994); one immediately borders the current site. These both identified linear anomalies which were thought could be infilled ditches forming part of an ancient enclosure system or be due to recent land drains.

A more recent survey (Webb 1997) identified a square enclosure at SE39522210 with a possible second enclosure continuing towards the adjoining golf course. Other anomalies to the south were thought to be indicative of infilled ditches or land drains.

2.4 The survey was carried out between November 4th and November 7th 1997. At this time the northern part of the survey area was under stubble with the majority of the remainder having been recently ploughed and resown with a cereal crop. A small area was also surveyed over the adjoining golf course.

2.5 The underlying geology comprises shales and sandstones of the Middle Coal Measures.

3. Results & Discussion (Figs 2 & 3)

3.1 The gradiometer data is presented as a greyscale plot on an Ordnance Survey 1:2500 base map in Figure 2. This data is interpreted in Figure 3. Large scale (1:500) dot density and X-Y trace plots are included as Appendix 3.

3.2 Several types of anomalies can be observed in the data. The first of these are the isolated positive/negative (dipolar) responses ("iron spikes") which are ubiquitous across all parts of the site. They are indicative of ferrous material on the ground surface and in the topsoil and are not normally archaeologically significant.

3.3 A strong, dipolar linear anomaly, caused by a modern service pipe, can be observed in the northern part of the survey area.

3.4 Also common across the whole site are the positive linear anomalies aligned from north-west to south-east parallel with the current hedge boundaries. These anomalies are caused by the former practice of ploughing using a moulder board (rather than a share which was a later development), to turn over the sod. Over time this method resulted in the formation of distinctive ridges and furrows, which are still visible in the golf course to the north-east of the site. Even after modern ploughing has destroyed the visible earthworks the magnetic vestiges can still be detected.

These anomalies are much stronger on the golf course, where the ridge and furrow is still extant, and in the eastern field, where there are no visible ridge and furrow remains.

3.5 The recent survey (Webb 1997) identified three intersecting positive, linear anomalies, which are aligned on a north-west to south-east/south-west to north-east orientation, at an oblique angle relative to the current field boundaries. It can be observed that the more northerly of the south-west to north-east trending anomalies continues into the field to the east. It was suggested that the most probable interpretation of these anomalies was that they are part of an earlier system of land division. However, as can be observed in the eastern field, the ridge and furrow does not respect these anomalies, indicating that if they did represent field boundaries they must predate the ridge and furrow. The anomaly in the eastern field is so strong that this does not seem likely. It is therefore more reasonable to suggest that the anomalies represent modern land drains.

The strong positive linear anomaly in the south-west corner of the site, aligned from west to east, is also believed to be a land drain.

3.6 Two other strong, positive linear anomalies, and a weaker, curvi-linear anomaly can also be observed in the eastern field. It is possible that the more southerly of the two linear anomalies is a continuation of the linear anomaly in the western part of the site, and is also probably a field drain.

The more northerly of the linear anomalies is less regular than the others and corresponds with the southern edge of a magnetically quiet area in which their are no detectable responses from the ridge and furrow ploughing. This suggests that this anomaly post-dates the ridge and furrow. A possible explanation for this anomaly is that when the feature was cut and then infilled the more magnetic components of the soil were dispersed evenly throughout the feature, thus giving a more homogenous magnetism for this area. The positive linear may be due to an area where the more magnetic soils accumulated, or it may represent a true feature within the area of disturbance.

The positive, curvi-linear anomaly does not have the same orientation as the linear anomalies and is much weaker and is therefore probably not a land drain. It is not possible to reliably interpret this anomaly, due to its faintness and lack of continuity with other features or anomalies, but an archaeological origin cannot be ruled out.

3.7 The area of "magnetic disturbance", identified in the south-western part of the site, is not as noticeable as that identified in the previous survey, but there are two areas where the ridge and furrow can be seen to be slightly "disturbed". The suggestion that the disturbance represents a palaeochannel (Webb 1997) can now probably be ruled out because the ridge and furrow, although disturbed, is continuous through these areas. A stream would be expected to cause more significant erosion. It is probable, therefore, that these areas represent later plough damage of the ridge and furrow.

3.8 There is no evidence for the anomaly, which was interpreted in the recent survey as being a partial enclosure, continuing into the golf course. As the anomaly, in the original survey area, is very faint, it may be that the feature does continue but is masked by the very strong ridge and furrow responses or that it was destroyed by the ridge and furrow ploughing for which there is no evidence in the field in which the square enclosure was identified.

4. Conclusions

4.1 No further anomalies of probable archaeological origin were detected in the additional survey areas.

4.2 Very strong responses from ridge and furrow ploughing can be observed in the east of the survey area. These responses are strong even in areas where the ridge and furrow is not extant.

4.3 The areas of magnetic disturbance are probably caused by modern agricultural activity.

4.3 The linear anomalies in the southern part of the site are on a different alignment both to the enclosures and to the current hedge boundaries. They also appear to post-date the ridge and furrow. Whilst this does not preclude the possibility that they are not contemporary with the enclosures it might increase the probability that they are non-archaeological, probably being due to modern field drains.

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.

Acknowledgements

Project Management: A. Webb BA
Geophysical Survey: A. Webb BA, M. Whittingham BSc MA
Report: M. Whittingham BSc MA
Graphics: M. Whittingham BSc MA
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Appendices

Appendix 1 Gradiometer Survey: technical information and methods
Appendix 2 Survey location information
Appendix 3 Gradiometer data plots

Appendix 1

Gradiometer Survey: technical information and methods

1. Technical Information

1.1 Iron makes up about 6% of the Earth's crust and is mostly dispersed through soils, clays and rocks as chemical compounds. These compounds have a weak, measurable magnetic response which is termed its magnetic susceptibility. Human activities can redistribute these compounds and change (enhance) others into more magnetic forms. These anthropogenic processes result in small localised anomalies in the Earth's magnetic field which are detectable by a 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 the more magnetic compounds to concentrate 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 will tend to 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.

1.4 High, sharp responses are usually due to iron objects in the topsoil. These produce a rapid change from positive to negative readings ("iron spikes").

1.5 The types of response mentioned above can be divided into five main categories which are described below:

1. **Iron Spikes (Dipolar Anomalies)**
   These responses are referred to as dipolar and are caused by buried or surface iron objects. Little emphasis is usually given to such responses as iron objects of recent origin are common on agricultural sites. Occasionally, however, iron spikes can indicate the presence of smithing activity by detecting hammerscale.

2. **Rapid, strong variations in magnetic response**
   Also referred to as areas of magnetic disturbance, these can be due to a number of different types of feature. They are often associated with burnt material, such as industrial waste or other strongly magnetised material. It is not always easy to determine their date or origin without supporting information.

3. **Positive, linear anomalies**

The strength of these responses varies depending on the underlying geology. They are commonly caused by ancient ditches or more recent agricultural features.

4. **Isolated positive responses**
These usually exhibit a magnitude of between 2nT and 300nT and, depending on their response, can be due to pits, ovens or kilns. They can also be due to natural features on certain geologies. It can, therefore, be very difficult to establish an anthropogenic origin without an intrusive means of examining the features.

5. **Negative linear anomalies**
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.

2. Methodology

2.1 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 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. This method is used as a means of selecting areas for detailed survey when only a percentage sample of the whole site is to be surveyed. Scanning can also be used to map out the full extent of features located during a detailed survey.

2.2 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.

2.3 During this survey a Geoscan FM36 fluxgate gradiometer and ST1 sample trigger were used to take readings at 0.5m intervals on zig-zag traverses 1m apart within 20m x 20m square grids. 800 readings were therefore taken in each grid and in-house software (Geocon Version 9) was used to interpolate the “missing” line of data so that 1600 readings in total were obtained for each complete grid. The instrument was held pointing north-east.

Appendix 2

Survey location information

The semi-permanent marker pegs from the previous survey (Webb 1997) were no longer in place so a new baseline was laid out parallel with the golf course for those grids to the north of the stream. In the eastern field a baseline was laid out parallel to the northern field boundary, adjacent to the golf course.

The site grid and boundaries were surveyed in using a Geotronics Geodimeter 600 series theodolite. The new survey area was tied in to the previous grid system using several grid pegs, which remained from the previous survey, and the field boundaries.

Using the Ordnance Survey 1:2500 series National Grid co-ordinates were obtained for the two original semi-permanent marker pegs and these are given below:-

A 39605E 22043N
B 39613E 22045N

These co-ordinates are accurate to +/- 1m at 1:2500.

Appendix 3

Gradiometer data plots