ROMAN FORT ENVIRONS

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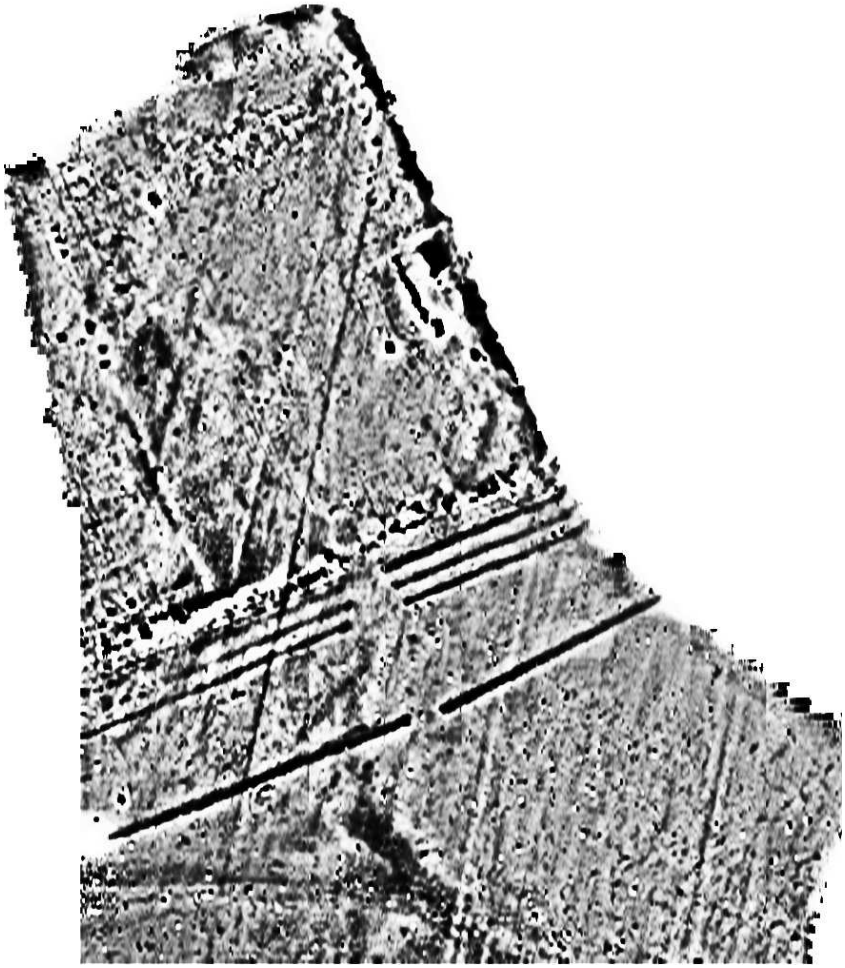
G1827 (2)

Report number : 719



Ymddiriedolaeth Archaeolegol Gwynedd
Gwynedd Archaeological Trust

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Prepared

By

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for

Cambria Archaeology

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GEOPHYSICAL SURVEY AT PEN LLWYN ROMAN FORT G1827

1. INTRODUCTION

The Gwynedd Archaeological Trust was contracted to carry out a fluxgate gradiometer survey at Pen Llwyn Roman fort by Cambria Archaeology (Dyfed Archaeological Trust). The survey formed part of a Cadw funded pan-Wales study examining aspects of Roman fort environs and Roman roads. Surveys had previously been carried out at several sites across Wales and had produced good results. The methodology developed in these surveys was adopted in the present project.

2. METHODOLOGY

Fluxgate gradiometer survey provides a relatively swift and completely non-invasive method of surveying large areas. Roman military sites are well suited to this technique as significant magnetic enhancement of the soil is an inevitable result of the day to day activities in a Roman fort. Recent surveys carried out in and around Roman forts in Gwynedd and Cumbria (Hopewell 2005 and Burnham Keppie and Fitzpatrick 2001) have demonstrated the suitability of this approach. A wide range of features was detected both within and outside the forts. Most of the sites produced evidence for the presence of *vici* in the form of ribbon development along at least one of the roads leading from the fort.

2.1 Instrumentation

The survey was carried out using a Bartington Grad601-2 dual Fluxgate Gradiometer. This uses a pair of Grad-01-100 sensors. These are high stability fluxgate gradient sensors with a 1.0m separation between the sensing elements, giving a strong response to deeper anomalies.

The instrument detects variations in the earth's magnetic field caused by the presence of iron in the soil. This is usually in the form of weakly magnetised iron oxides which tend to be concentrated in the topsoil. Features cut into the subsoil and backfilled or silted with topsoil therefore contain greater amounts of iron and can therefore be detected with the gradiometer. This is a simplified description as there are other processes and materials which can produce detectable anomalies. The most obvious is the presence of pieces of iron in the soil or immediate environs which usually produce very high readings and can mask the relatively weak readings produced by variations in the soil. Strong readings are also produced by archaeological features such as hearths or kilns because fired clay acquires a permanent thermo-remnant magnetic field upon cooling. This material can also get spread into the soil leading to a more generalised magnetic enhancement around settlement sites.

Not all surveys can produce good results as anomalies can be masked by large magnetic variations in the bedrock or soil or high levels of natural background "noise" (interference consisting of random signals produced by material within the soil). In some cases, there may be little variation between the topsoil and subsoil resulting in undetectable features. It must therefore be stressed that a lack of detectable anomalies cannot be taken to mean that that there is no extant archaeology.

The Bartington Grad601 is a hand held instrument and readings can be taken automatically as the operator walks at a constant speed along a series of fixed length traverses. The sensor consists of two vertically aligned fluxgates set 1.0m apart. Their Mumetal cores are driven in and out of magnetic saturation by an alternating current passing through two opposing driver coils. As the cores come out of saturation, the external magnetic field can enter them producing an electrical pulse proportional to the field strength in a sensor coil. The high frequency of the detection cycle produces what is in effect a continuous output (Clark 1990).

The gradiometer can detect anomalies down to a depth of approximately one metre. The magnetic variations are measured in nanoTeslas (nT). The earth's magnetic field strength is about 48,000 nT, typical archaeological features produce readings of below 15nT although burnt features and iron objects can result in changes of several hundred nT. The instrument is capable of detecting changes as low as 0.1nT.

2.2 Data Collection

The gradiometer includes an on-board data-logger. Readings in the surveys were taken along parallel traverses of one axis of a 20m x 20m grid. The traverse interval was 0.5m. Readings were logged at intervals of 0.25m along each traverse giving 3200 readings per grid.

2.3 Data presentation

The data is transferred from the data-logger to a computer where it is compiled and processed using ArchaeoSurveyor 2 software. The data is presented as a grey-scale plot where data values are represented by modulation of the intensity of a grey scale within a rectangular area corresponding to the data collection point within the grid. This produces a plan view of the survey and allows subtle changes in the data to be displayed. This is supplemented by an interpretation diagram showing the main features of the survey with reference numbers linking the anomalies to descriptions in the written report. It should be noted that the interpretation is based on the examination of the shape, scale and intensity of the anomaly and comparison to features found in previous surveys and excavations etc. In some cases the shape of an anomaly is sufficient to allow a definite interpretation e.g. a Roman fort. In other cases all that can be provided is the most likely interpretation. The survey will often detect several overlying phases of archaeological remains and it is not usually possible to distinguish between them. Weak and poorly defined anomalies are most susceptible to misinterpretation due to the propensity for the human brain to define shapes and patterns in random background 'noise'. An assessment of the confidence of the interpretation is given in the text.

2.4 Data Processing

The data is presented with a minimum of processing although corrections are made to compensate for instrument drift and other data collection inconsistencies. High readings caused by stray pieces of iron, fences, etc are usually modified on the grey scale plot as they have a tendency to compress the rest of the data. The data is however carefully examined before this procedure is carried out as kilns and other burnt features can produce similar readings. The data on some noisy or very complex sites can benefit from 'smoothing'. Grey-scale plots are always somewhat pixellated due to the resolution of the survey. This at times makes it difficult to see less obvious anomalies. The readings in the plots can therefore be interpolated thus producing more but smaller pixels and a small amount of low pass filtering can be applied. This reduces the perceived effects of background noise thus making anomalies easier to see. Any further processing is noted in relation to the individual plot.

3. ARCHAEOLOGICAL BACKGROUND

The fort at Pen Llwyn (SH65058065) was discovered during aerial reconnaissance during the drought of 1976 (St Joseph 1977 152-4). Further work, including the excavation of six small trial trenches, was carried out by J L Davies in 1983 (Davies 1986). The fort covers an area of 2.7 hectares and lies on an irregular shelf above the confluence of the Afon Melindwr and the Afon Rheidol. The aerial photographs demonstrated that the defences of the fort comprise a triple ditch array, aligned on natural scarps on three sides. A further outer defensive ditch with at least one entrance aligned with the fort entrances was also visible. The south-western side of this outer enclosure appears to extend for at least 200m down to the valley bottom. Davies' excavations revealed details of the defences. The innermost ditch appeared to have been back-filled and the middle ditch appeared to have silted naturally. The rampart was found to be of turf possibly with wooden corner towers. The causeway between the termini of the ditches at the *porta decumana* was 9.25m wide. The foundations of a cill-beam structure were identified inside the western corner of the fort. Two trenches were excavated in the *retentura* but no definite signs of internal buildings were discovered. The fort stands on an unusually uneven site with several areas that appear to be unsuitable for the erection of buildings due to steep slopes.

4. RESULTS (Figs 1 and 2)

The survey was carried out on the 26-30th November 2007. An irregular area with maximum dimensions of 240 x 200m was surveyed, within one field of open pasture. The survey was started to the north-west of the fort because this was a fairly level that appeared to be the most logical place for the site of a *vicus*. It soon became clear that there was little or no activity in this area so the survey was

expanded to cover the rest of the field including the south-western half of the fort. The field at the north-east was being used to graze cattle and had become very churned up and muddy and was unsuitable for survey. Permission was not granted by the landowner to survey the field to the south-west.

The field was under pasture with few impediments to survey. There were quite high levels of background noise across parts of the survey, presumably as a result of the bedrock being close to the surface. The grey-scale plot is presented in two versions. The first (Fig. 1) shows the results with a minimum of processing. The second (Fig. 2) has been processed using a high-pass filter which removes large scale variations in the data such as geological anomalies. An interpretation diagram (Fig. 3) was produced and each anomaly was allocated a number.

4.1 Interpretation

The fort is almost rectangular with dimensions of 185m x 151m. The north-western side of the defences appear to run at a slight angle to the rest resulting in a narrowing of the north-eastern end of the fort to 146m. The fort covers an area of 2.7ha.

The defences of the fort are clearly visible on the north-western side. The triple ditches (1) are separated from the outer ditch (2) by a gap of 26m. The southern part of the outer ditch in this area runs at a slight angle to the inner defences. The break in the inner ditch and rampart (3) for the *porta principalis dextra* is 10.6m wide and the gap through the outer of the three ditches is 14m wide. The rampart is visible as a relatively quiet area about 5m wide with a strip of thermoremnant enhancement indicating hearths or ovens running along its inner edge. A faint linear anomaly, possibly indicating turf facing, marks the outer edge of the rampart which is separated from the ditch by a narrow berm.

A series of very faint anomalies were detected in the interior of the fort, which can in places be resolved into the plans of buildings. The narrow weak anomalies suggest that the buildings were wooden. In most cases, parts of buildings are visible separated by blank areas suggesting that the archaeology may have been truncated by ploughing. This is supported by both Davies' excavations and observations in the field during the present survey, which suggest that the topsoil is relatively shallow with bedrock close to the surface.

The courtyard of the *principia* (4) is visible and is flanked by the distinctive parallel anomalies of a granary (5) and a complex building with dimensions of 24m x 35m (6) that is typical of a *praetorium*. The buildings in the rest of the *praetentura* are only intermittently visible and cannot be resolved with any certainty. Part of a building, divided up into small rooms (7), is visible on the on the north-west side. This could extend to the corner of the fort and could therefore be interpreted as a barracks block arranged *per strigas*. A series of cross walls in an area of noise appear to indicate further barracks (8) in the north east side. The anomalies are faint but could represent the edge of two blocks with hints of a third (9) to the north-west. A large building (10), with dimensions of about 26m x 27m, set against the south-western rampart is fairly well-defined and contains several discrete areas of thermoremnant anomalies suggesting hearths or ovens or perhaps partial destruction by fire. This does not form part of a typical fort plan and either overlies or lies very close to the *via praetoria*. The hearths suggest that it could have an industrial function. Its anomalous position suggests that it belongs to a later phase than the conventionally positioned buildings in the *praetentura*. Elsewhere in the *praetentura* there are other short lengths of walls and possible lines of post holes. These are however too fragmentary to allow interpretation.

Only a small area of the *retentura* was surveyed. There are clearly structures present but the area is too small to allow the identification of building types. There are however several strong hearth/oven types of anomalies (11). A fairly well-defined linear (12) anomaly runs across the fort roughly along the line of the *via quintana*. Other roads on the survey are visible as magnetically quiet areas so this is probably another type of structure such as a rampart. It can be traced about half way across the fort and then its line is marked by two sets of three thermoremnant anomalies. The groups of three anomalies are best interpreted as ovens which would commonly be found on the inside of a rampart. This evidence would appear to indicate that the fort was divided into two. This may have occurred as part of the general reduction in troop numbers across the region at the end of the first century or may indicate a change of use.

Elsewhere on the survey, parallel anomalies crossing the site obliquely are land drains or other agricultural features. A track (13) leading from a gate in the field is visible at the north-west of the survey. This continues across the field to the north and appears to be metalled but is, however, now covered in mud and turf. This may have early origins but it cuts the outer defences of the fort so would not appear to be Roman.

5. CONCLUSIONS

The buildings in the fort at Pen Llwyn appear to have been wooden throughout. The interior appears to initially have followed a standard layout with the *principia, praetorium* and granary in the central range and barracks in the *praetentura*. Several anomalous features suggest that a second phase of activity is also present. The fort appears to have been divided in two along the line of the *via quintana* and a large building, possibly with an industrial function added immediately adjacent to the *porta praetoria*. The fort may have simply been reduced in size, possibly with one end reused as an annexe in a similar fashion to Bryn-y-Gefeiliau. This seems to be somewhat unlikely as it suggests a reasonably long occupation. The sparse finds from Davies' excavations and the lack of any consolidation in stone suggest a brief occupation. It also seems unlikely that both Pen Llwyn and Trawscoed 8.9 km to the south would have both remained in use for long. The division and anomalous building are probably better viewed as part of a continued low level use of the site, with it possibly functioning as an industrial base.

The area to the north-west of the fort being fairly level appeared to be the most likely site for a *vicus*. No signs of activity were detected in this area and given that the results from within the fort were relatively clear it can be assumed that there was not a *vicus* here. Other possible sites could be on the saddle to the north-east or on a shelf to the south-west.

The patchy results probably indicate that the archaeological deposits within parts of the fort have been truncated by agriculture. Further geophysical survey across the remainder of the fort would clearly assist in the interpretation of this somewhat anomalous and vulnerable site.

6. REFERENCES

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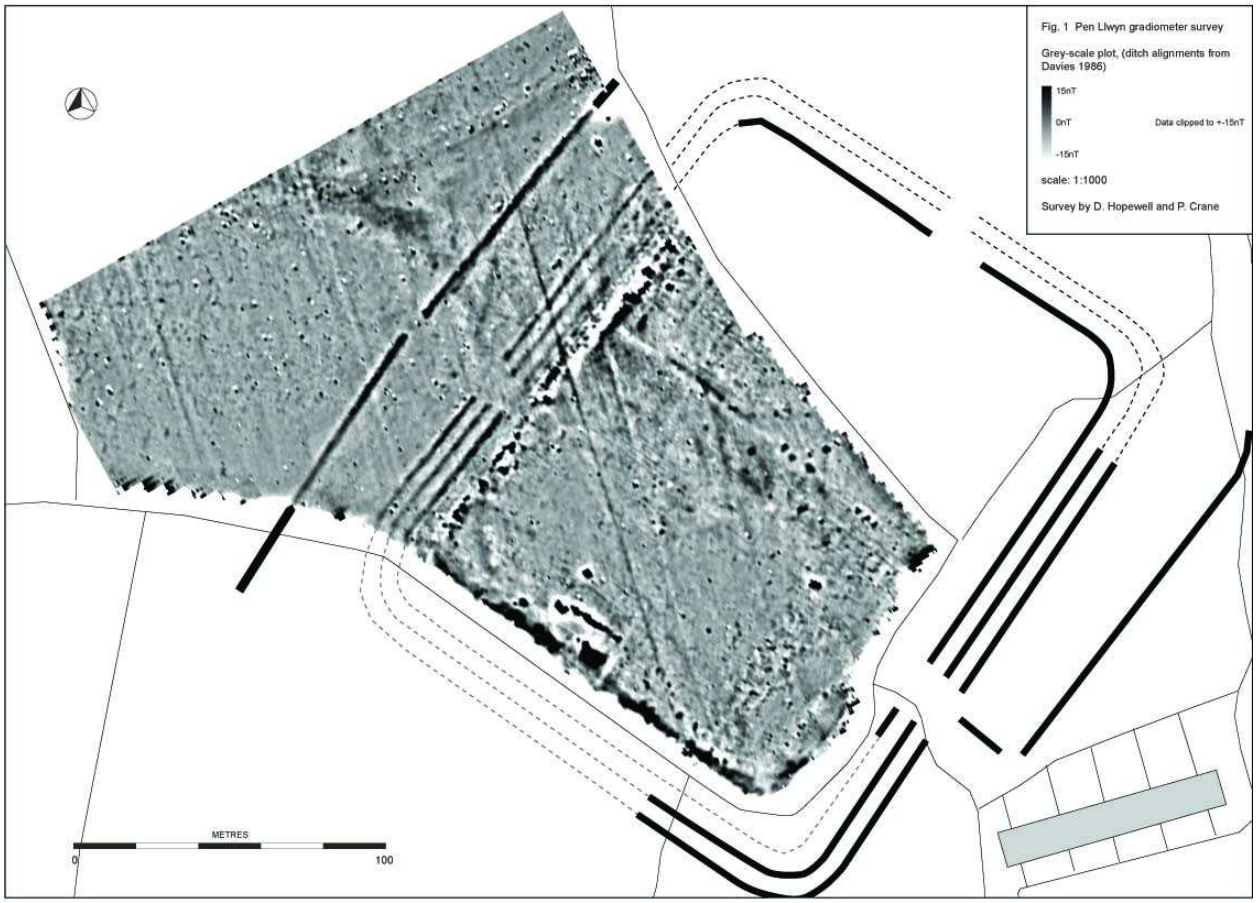
Fig. 1 Pen Llwyn gradiometer survey
Grey-scale plot, (ditch alignments from Davies 1986)
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-15nT
Data clipped to +-15nT
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Survey by D. Hopewell and P. Crane
METRES
0
100

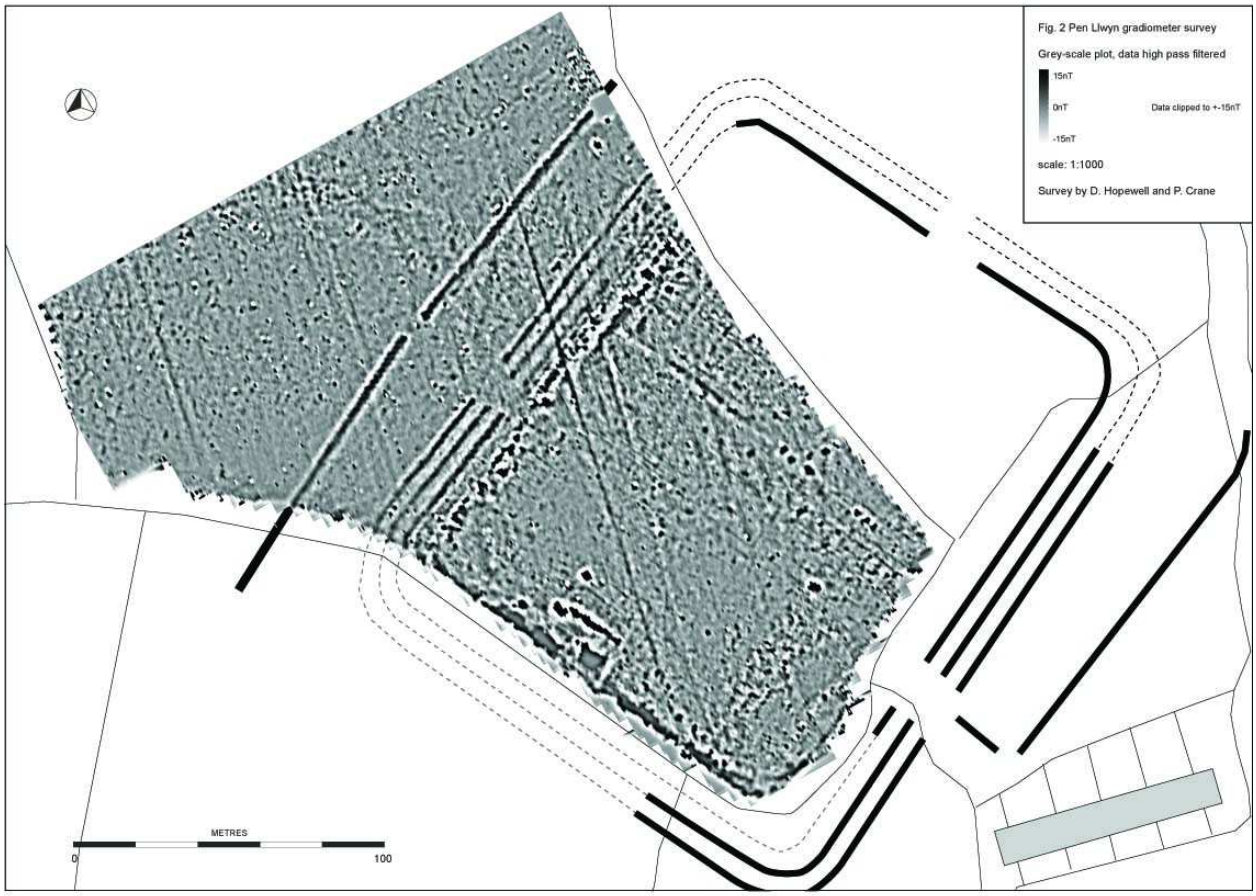
Fig. 2 Pen Llwyn gradiometer survey
Grey-scale plot, data high pass filtered
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-15nT
Data clipped to +-15nT
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Survey by D. Hopewell and P. Crane
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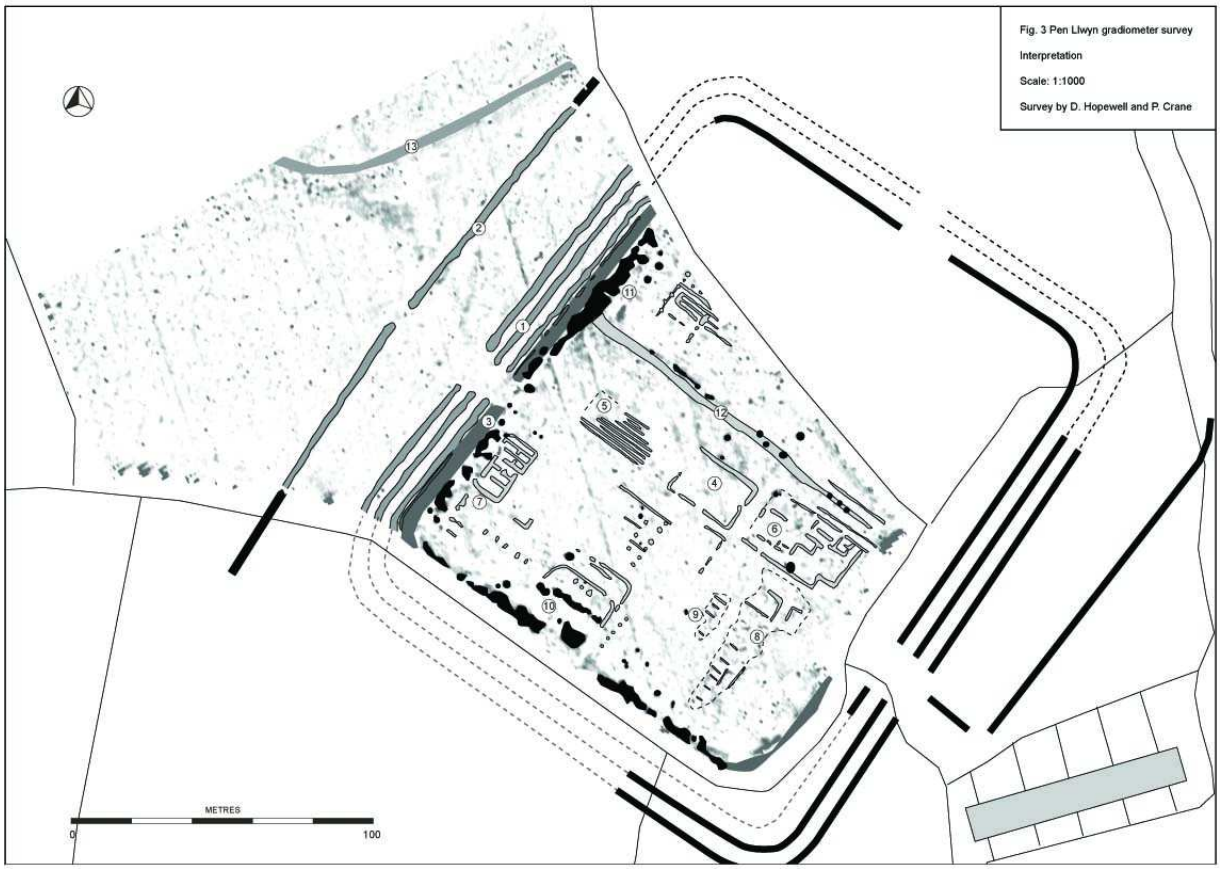
Fig. 3 Pen Llwyn gradiometer survey
Interpretation
Scale: 1:1000
Survey by D. Hopewell and P. Crane
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