

GEOPHYSICAL SURVEY ON ENCLOSURE CROPMARKS IN THE ENVIRONS OF TRAPRAIN LAW, EAST LOTHIAN

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INTRODUCTION

This report presents the first results of geophysical surveys carried out on a sample of cropmark sites around Traprain Law, East Lothian. This work forms the first phase of a longer term project by the Department of Archaeology, University of Durham, and Dickinson College, Pennsylvania, USA, investigating settlement and society in the East Lothian coastal plain during the 1st millennia BC and AD, and will be followed by further survey and excavations at selected sites. Owing to the outbreak of Foot and Mouth in February 2001, the preliminary survey programme had to be suspended only half way through, and will be resumed as soon as restrictions are lifted. The fieldwork was undertaken by Archaeological Services, University of Durham (ASUD).

The fortified hilltop site at Traprain Law, which dominates the East Lothian coastal plain, is one of the best known and most complex archaeological sites in Scotland, though it is still poorly understood. The original excavations in 1914-1923 indicated activity ranging in date from the Neolithic period to the 1st millennium AD, although the main periods of occupation were probably in the earlier 1st millennium BC and in the Roman Iron Age - when Traprain was evidently a major political and religious focal point for the region and probably the capital of the Votadini. Although a new programme of fieldwork on the summit is starting to clarify some of the outstanding uncertainties about Traprain, many other issues remain, notably the question of its relationship to other nearby settlements. Were these mostly occupied at the same time, and if so, what was their social and economic status in relation to Traprain? Or were they largely abandoned at the periods when Traprain itself was intensively occupied?

Since the 1950s, aerial survey by RCAHMS and others has revealed that Traprain lies in a densely settled landscape, with at least 100 cropmark enclosures recorded in the vicinity, as well as pit alignments and other sites of less certain character. The enclosures include curvilinear and more unusually rectilinear forms, some of which have multiple ditches, of types normally dated to the Iron Age. None of these nearby sites has yet been excavated, however, to ascertain their date, character or potential relationship to Traprain. Indeed, judging from sites which have been excavated elsewhere on the coastal plain, such as Broxmouth, Dryburn Bridge, Port Seton, and St Germain's, it is likely that many of these enclosures were themselves of different economic and social status, and had quite different histories of occupation.

Following analysis of the cropmarks at the NMRS, a block of landscape measuring 15km east-west by 10km north-south, following the course of the river Tyne, and approximately centred on Traprain, was adopted as the study area. Since work elsewhere has demonstrated that many enclosed settlements also had phases of unenclosed occupation, or formed part of more extensive complexes that do not show from the air, it was necessary to begin the project by establishing whether this is also true of sites around Traprain. The primary objective of Phase 1 of the work was therefore to determine the nature, extent and potential degree of preservation of a representative sample of enclosures, initially within 5km of Traprain, by means of geophysical survey.

A sample of one multi-vallate (East Linton), four rectilinear (East Bearford; Nunraw Barns; Stevenson Mains (R); and West Bearford) and five curvilinear enclosures (Chesters Quarry; Mitchell Hall; Standingstone; Stevenson Mains (C); and Whittinghame Tower) have been examined to date, broadly reflecting the proportions in which these cropmark types appear in the air photographic record. All ten sites are Scheduled Ancient Monuments. Two of the relevant sites (East Linton; Whittinghame Tower) were in escarpment edge locations, reflecting a preference shared by a significant minority of enclosures in the area (over 20%); the soils along the plateau edges can be intractable even to modern agriculture, so that in addition to enhanced possibilities for display or defence, and access to water, the use of such locations would have minimised the amount of better-quality land taken up by settlement. In addition, a survey was undertaken over a cropmark of a possible rectangular building (Sled Hill).

The solid geology of the study area is complex. Traprain Law itself is a phonolite laccolith, a mass of igneous rock that has risen in a molten condition and bulged up through the overlying strata to form a dome. Erosion has subsequently revealed the original form of the laccolith by stripping away the soft sedimentary cover. The sites selected for survey occupy a variety of geologies: East Linton is situated on Carboniferous extrusive basalts and tuffs, which form part of the Garleton Hills Volcanic Rocks; Mitchell Hall, Stevenson Mains, and West Bearford all lie on Calciferous Sandstone Measures of the Carboniferous era; East Bearford and Standingstone are situated on Carboniferous extrusive trachyte, which forms part of the Garleton Hills Volcanic Rocks; Chesters Quarry lies just south of the Dunbar-Gifford Fault on intrusive igneous rock of the Carboniferous era; Nunraw Barns, Sled Hill, and Whittinghame Tower all lie between the Dunbar-Gifford Fault and the Lammermuir Fault, on Devonian-Carboniferous Upper Old Red Sandstone. A subsidiary objective of the geophysical surveys was therefore to establish whether their archaeological effectiveness differed significantly on different subsoils.

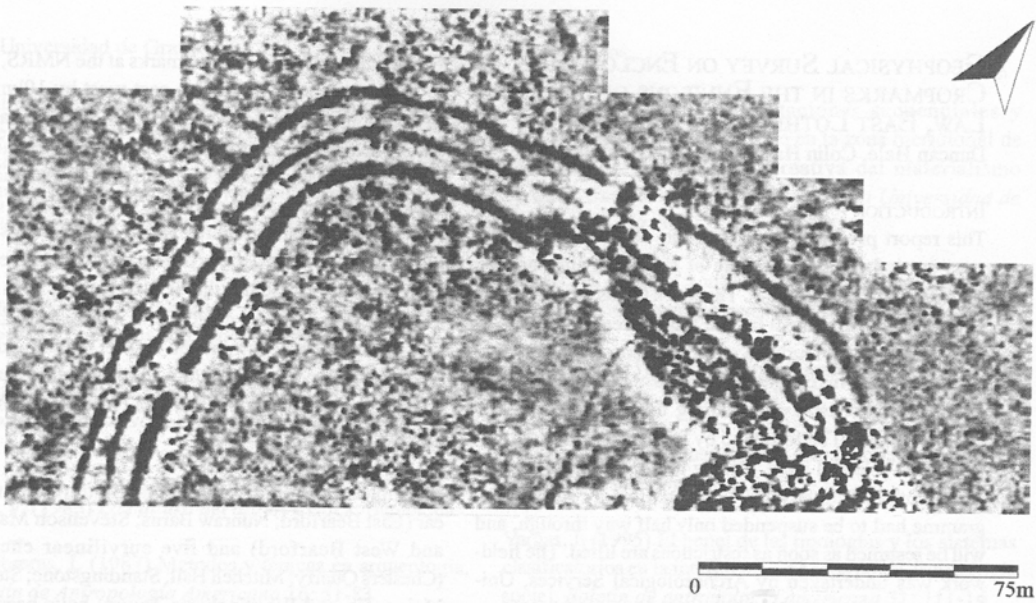


Figure 1. SAM 4169 East Linton – geomagnetic survey

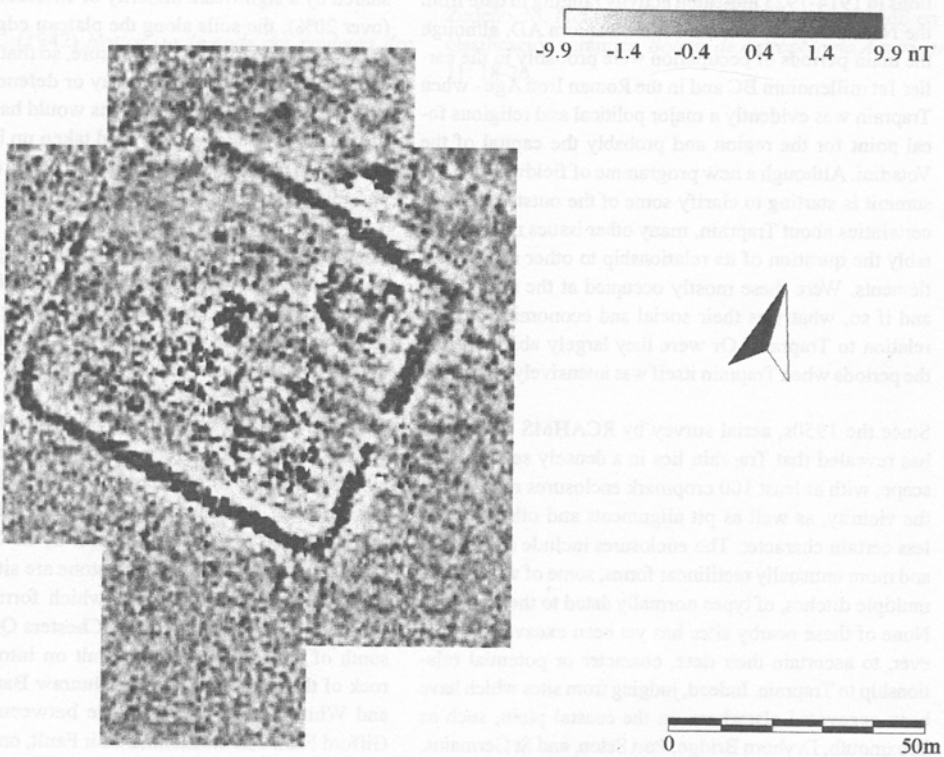


Figure 2. SAM 5928 East Bearford – geomagnetic survey

FIELD METHODS AND DATA PROCESSING

All surveys were undertaken on a 20m grid, tied-in to Ordnance Survey points using a Wild T1000 total station survey instrument and SDR33 datalogger. Measurements of geomagnetic field gradient were determined using a Geoscan FM36 fluxgate gradiometer fitted with an ST1 sample trigger to enable automatic data logging. A zig-zag traverse scheme was employed and data logged in 20m grid units. The instrument sensitivity was set to 0.1nT, the sample interval to 0.5m and the traverse interval to 1.0m, providing 800 sample measurements per 20m grid unit. Data were downloaded on-site into a RM NoteBook computer, and subsequently transferred to a desktop computer for processing, interpretation and archiving. The geophysical data was processed using InSite v.3 software.

RESULTS

East Linton: This multi-vallate enclosure occupies a relatively level spur of land at an elevation of 65-70m OD, c. 1km south-west of East Linton village. The maximum extent of the enclosure is approximately 185m by 100m. Immediately to the south of the site is a narrow gorge containing the River Tyne. North of the site the ground falls away less steeply to the A1 trunk road. Despite the underlying extrusive basalts and tuffs, the geomagnetic survey provided a particularly clear image of the site (Fig. 1).

The most apparent anomalies comprise three curvilinear bands of high magnetic susceptibility material, which reflect the soil-filled ditches of the enclosure. The innermost ditch appears to be the most substantial, measuring up to 4m in width. The two outer ditches measure up to 3m in width. Although not clear on the aerial photos, there are causewayed entrances at two locations on the western side of the enclosure. No causeways were detected across other parts of the main ditches. Another high susceptibility, positive magnetic lineation was detected aligned north-south within the eastern half of the enclosure. This almost certainly reflects another soil-filled ditch, of maximum width 2m, which is also crossed via a causeway. The ditch, which turns eastward at its northern end but is then obscured by more intense anomalies, effectively distinguishes this part of the site from the rest of the fort interior and, like the main enclosure ditches, has a west-facing entrance. There are hints of a possible continuation of this feature outside the main enclosure, which if confirmed, would indicate that the ditch belongs to a different phase of the site. Within the interior of the multi-vallate enclosure there are indications of intense archaeological activity, including several possible circular structures, particularly towards the west end of the site.

Two hemispherical concentrations of intense dipolar magnetic anomalies were detected in the eastern part of the site, the more northerly of the two obscuring the ditch described above, broadly corresponding to slightly darker

patches on the aerial photographs. The anomalies almost certainly reflect concentrations of either near-surface ferrous materials or highly magnetic, igneous rocks. Each spreads across the area of the three outer ditches and so is unlikely to represent material contemporary with the fort. It is apparent that this material was deposited some time after the ditches had been infilled. Further along the ramparts to the west, there are indications of a circular building, c. 10m in diameter on the line of the outermost ditch, set within a possible enclosure. These features suggest that several phases of activity may be represented by the geophysical anomalies.

Stevenson Mains (R) and (C): These two enclosures, one rectilinear and one curvilinear, situated approximately 100m apart from one another, occupy predominantly level ground at c. 60m OD, c. 2km due east of Haddington. In each case, the enclosure is located on a terrace with the land falling away gently to the north. At the first location, the survey confirmed the presence of a rectilinear ditched enclosure roughly 50m by 50m. The anomalies which reflect the enclosure are, however, very weak and it was not possible to identify any entrances. Possible internal, ditched features may be present, as indicated by further very weak positive magnetic anomalies.

At the second site, the geophysical survey confirmed the presence of a small curvilinear enclosure measuring approximately 35m by 25m. The ditch appears as a positive anomaly, reflecting the high magnetic susceptibility of the fill. The air photo indicates an entrance on the eastern side of the enclosure, which was confirmed by the magnetic data. The discontinuous remains of a ditch heading east from the entrance are represented as another positive magnetic anomaly. There was a high concentration of small positive and dipolar anomalies in the interior of the enclosure, which probably reflect soil-filled pits and ferrous/fired materials respectively, perhaps reflecting some small-scale industrial activity. A curvilinear negative anomaly to the north and east of the enclosure may be the remains of another, larger enclosure.

West Bearford: This small rectilinear enclosure lies c. 300m south of Stevenson Mains (C). The site occupies a level terrace at a height of c. 70m OD, with the land again falling away gently to the north. The survey confirmed the presence of a small ditched enclosure, measuring approximately 35m by 35m. The ditch is evident as a negative anomaly, reflecting materials of low magnetic susceptibility: given its location on Sandstone Measures, this could indicate that stone wall-footings are present adjacent to the ditch, or that the ditch is filled with rubble as opposed to a soil-filled ditch. Although the anomaly is rather weak, it appears that there may be an entrance on the eastern side of the enclosure, as indicated by the air photographs. There is no definite evidence for internal

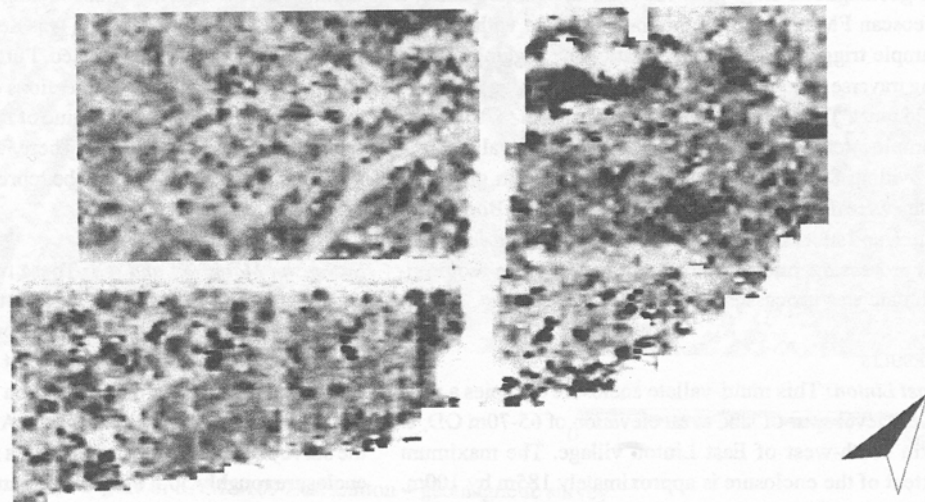


Figure 3. SAM 6067 Whittinghame Tower – geomagnetic survey

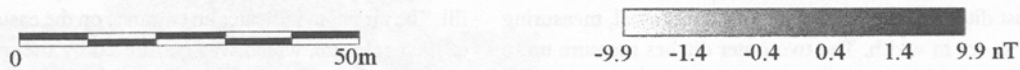


Figure 4. SAM 6050 Standingstone – geomagnetic survey

features; a possible linear feature passes the enclosure on an east-west alignment, some 60m to the north.

Nunraw Barns: This survey was undertaken over the site of a possible sub-rectangular, double-palisaded enclosure noted on an air photo in 1977, which lies on a terrace at c. 185m OD, some 600m south of Garvald village. The area was magnetically noisy, but parts of two parallel ditch features representing part of the eastern side and south-eastern corner of the enclosure were nevertheless identified, evident as very weak positive magnetic anomalies.

East Bearford: this site occupies the top of a terrace at c. 55m OD, 100m east of Bearford Burn, 500m south-south-west of East Bearford farm and 2km west of Traprain. To the west the land falls away fairly steeply to Bearford Burn. Despite the extrusive trachyte geology of this area, the survey confirmed the presence of a very regular, rectilinear ditched enclosure, in the form of a strong positive magnetic anomaly, measuring some 75m by 65m (Fig. 2). The anomaly reflects high magnetic susceptibility materials, such as organic-rich sediments or igneous rocks within a ditch fill. The ditch appears to vary in width, being only c. 2m across on the western side of the enclosure and up to 4m across on the eastern side. A causewayed entrance is clearly visible in the eastern side of the enclosure. The negative anomalies evident on either side of the main positive anomaly could either be a shadow effect associated with the strength of the positive anomaly, or could reflect the remnants of a bank and counterscarp.

Within the enclosure there is evidence for internal features, represented by both positive and dipolar magnetic anomalies. These anomalies may reflect both soil-filled features such as pits and gullies, and hearths or ferrous/fired materials respectively. A probable roundhouse lies in the north-eastern corner of the enclosure, with other possible examples in the southern half of the interior. Additional weak positive magnetic lineations were detected outside the main enclosure ditch, which almost certainly reflect the remains of further ditches, which are not apparent on the air photos. The clearest of these is aligned parallel to the northern enclosure ditch, forming a possible annexe, 20m to the north. Other features are evident on the southern and eastern sides of the enclosure, including possible structures outside the south-east corner.

Mitchell Hall: This survey was undertaken over the site of a probable curvilinear enclosure site which occupies relatively level ground at c. 80m OD, 1.5km south-east of Haddington. The air photo evidence suggests the presence of two concentric ditches, the larger measuring c. 75m in diameter and the inner one 40m. However, the magnetic susceptibility contrasts in this area are very low and the survey only detected the merest hint of a circular feature measuring c. 40m in diameter. This anomaly could reflect

the inner ditch of the enclosure, however, this remains tentative and the survey has not detected any evidence for the outer enclosure ditch. In view of the regularity of the features on the air photo, there must be some possibility that the site has not been correctly interpreted.

Chesters Quarry: This survey confirmed the presence of a curvilinear enclosure, verging on sub-rectangular in plan, situated on level ground south of Ninewells Burn at c. 145m OD, c. 1.5km west of Garvald village. As well as the enclosure, the air photos indicate several linear features traversing the area. The soils at this location are underlain by intrusive igneous rock and are presumed to be highly magnetically susceptible. This is borne out by the survey data which exhibit very strong anomalies and show the material of the enclosure ditch to be less magnetically susceptible than the surrounding materials.

The enclosure was evident as a clear negative magnetic anomaly, which, given the geology at this location, could indicate that the surrounding ditch is cut into the underlying igneous strata; the soil fill being considerably less magnetic than the surrounding rock into which it is cut. The ditch measures up to 5m in width and an entrance measuring c. 12m in width is clearly located in the western part of the enclosure. It has not, however, been possible to identify internal archaeological features with the exception of one tentative ring-ditch, represented by a weak positive magnetic anomaly in the northern part of the enclosure. The lineations on the AP have also been detected magnetically as strong negative magnetic anomalies. In this geological environment the anomalies could reflect soil-filled fissures in the underlying bedrock.

Whittinghame Tower: This semi-circular enclosure occupies land at c. 115m OD, immediately north of a steep-sided ravine housing Whittinghame Water, 200m south-west of Whittinghame Tower and 2.5km south-east of Traprain Law. Air photos indicate that the western quadrant of the enclosure comprises two ditches, the inner being considerably broader than the outer ditch. These features appear as two concentric negative magnetic anomalies, the outer one being weaker and more diffuse; in addition, the inner ditch was confirmed as continuing into the adjacent pasture area to the east (Fig. 3). As this is an area of sedimentary, sandstone geology, the low magnetic susceptibility values recorded over the enclosure would appear to indicate the presence of stone rubble or wall-footings, as at West Bearford.

An arcuate, positive magnetic anomaly was detected just to the west of the enclosure, which might indicate a soil-filled ditch intersecting with the main enclosure ditches. This may have formed part of an earlier enclosure as it appears to be overlain in part by the negative magnetic anomaly of the scheduled enclosure. To some extent the

identification of features at this site has been hindered by the presence of many small, intense dipolar magnetic anomalies which obscure weaker anomalies of possible archaeological origin. One possible internal feature is represented by a positive magnetic anomaly in the eastern part of the enclosure, which could reflect a substantial soil-filled pit.

Standingstone: This curvilinear ditched enclosure occupies a gentle west-facing slope at c. 110m OD, 2km south-west of Traprain. The photo shows approximately three-quarters of an enclosure and this is confirmed by the geophysical data (Fig. 4). Although the site is located over extrusive trachyte rock, the upper boundary of the bedrock is apparently at a greater depth than the enclosure ditch, since this appears as a positive magnetic anomaly which almost certainly reflects an earth-cut, soil-filled ditch as opposed to a rock-cut one. An alternative interpretation for the main anomaly is that it reflects local, high magnetic susceptibility rock used as wall-footings. However, this is considered unlikely given the low intensity of the anomalies compared with the surrounding soil.

A very weak, circular positive magnetic anomaly was detected in the centre of the enclosure. This is also interpreted as a ditch feature, perhaps associated with a roundhouse. A weak negative curvilinear anomaly on the north-east side of the enclosure could indicate the presence of a second enclosure phase or annexe.

Sled Hill: This survey was undertaken over the site of a possible rectangular timber building, situated near the summit of Sled Hill at c. 175m OD, 100m south-west of a known curvilinear enclosure. Two parallel, positive magnetic lineations, were detected, 10m apart and continuing for 28m, which probably reflect the beam slots or other

foundations of the building. The spacing of the anomalies corresponds to the width of the structure as recorded on aerial photos. It has not been possible to discern definite internal features or subdivisions, although some are apparent on the air photos, but the wall line does seem to step in slightly c. 7m from the east end of the building, as with many early medieval timber hall plans. The survey of this site is characterised by the presence of many small, intense dipolar anomalies, which have obscured the identification of weaker, quite possibly archaeological, features, at least one of them curvilinear.

CONCLUSIONS

The eleven geomagnetic surveys undertaken to date have all confirmed the presence of sub-surface archaeological features, first recorded as cropmarks. Despite the complex and often igneous geology of the study area, several of the surveys indicated the presence of other previously unrecorded features, such as probable roundhouses and annexes, both internal and external, and in some cases, it has been possible to distinguish additional phases of occupation. The possibility of *in situ* stone footings at more than one site is significant, as such features are clearly at particular risk from continued ploughing.

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