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Ancient Monuments Laboratory
Report 2/97

HAMSTEAD MARSHALL, BERKSHIRE, REPORT ON GEOPHYSICAL SURVEYS, 1996

N T Linford

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Summary

Geophysical survey was conducted over three areas of the extensive archaeological landscape at Hamstead Marshall, Newbury, Berks., to examine the correlation between medieval features and the later re-modelling of the site into a 17th-century manor house and formal gardens. A combination of earth resistance and magnetic techniques were applied, with varied success, possibly conditioned by the change in geology from well drained plateau gravel over the higher ground to heavier clay as the site descends into the Kennet valley. The survey of the formal garden site confirmed the suitability of geophysical techniques for the location of ephemeral garden features and a plethora of anomalies were identified that augmented other available data sources. New evidence for the existence of an extensive drainage system throughout the formal garden site was revealed together with a more tentative identification of a series of tree planting pits over the area of the DMV.

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HAMSTEAD MARSHALL, Berkshire,
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Introduction

Hamstead Marshall is a small parish on the south bank of the river Kennet a few miles west of Newbury, Berkshire. The site is remarkable as it comprises three motte and bailey castles in close proximity to each other surrounded by a park pale defining a medieval deer park of over 100ha. Traces of a medieval village and fishponds are also evident, although the latter settlement was apparently re-sited during the establishment of a 17th-century manor house, complete with attendant formal gardens, built for the Earl of Craven by Sir Balthazar Gerbier and William Wynne.

The manor house and formal gardens are depicted in a contemporary engraving by Kyp of *circa* 1700 (Figure 1) prior to the total destruction of the residence by fire in 1718. Aerial photographs (APs) from the late 1950s (*eg* NAR 58/5225 F21, 48; Figure 2) still show much of the detailed layout recorded by Kyp as parchmarks. However, a significant alteration in land use has occurred, from permanent pasture to arable farming, since these photographs were taken following the sale of the Craven estate in 1984 (S. Brown *pers comm*).

The site of the former manor house (SU 419 666) lies on the top of a gravel-capped hill immediately SE of St Mary's Church and exists today as a marked depression in the arable field. The house was surrounded by formal gardens contained within high walls which included nine pairs of fine entrance piers, three of which survive and are abandoned without connecting walls. All the standing architectural features at the site surrounding the more recent residential development of the Home Farm buildings, are protected as listed buildings, although the site of the formal garden itself is not recognised as a Scheduled Ancient Monument.

Two of the motte and bailey earthworks (castles 2 and 3 following the numbering system proposed by Myres 1932), the fishponds and the partial remains of the medieval village lie within the grounds of North Lodge and have been the subject of a detailed topographic survey by the RCHME (Bonney and Dunn 1989). These features are protected as a Scheduled Ancient Monument (Berkshire 19010), together with castle 1 (Berkshire 19011) and the course of the park pale (Berkshire 19012). A possible building platform was also observed in the field immediately west of castle 3 that may form an extension to the bailey of this castle. However, the topographic surveyors were denied access to this land and were thus unable to fully investigate this hypothesis.

It was hoped that a detailed geophysical survey of the formal garden would elucidate the information contained within the aerial photographic record and provide an indication of the threat posed by the current agricultural regime. In addition, two small-scale surveys were conducted over an area of clear ground within the North Lodge and the raised platform possibly representing the west bailey of castle 3.

Both the site of the formal garden and the deserted medieval village are located on a cap of apparently well drained Plateau Gravel which overlies the heavier clays of the Reading Beds that form the substrate of the west bailey site (Institute of Geological Sciences 1971). The interface between the clays and gravel is readily apparent along the southern slope of the Kennet valley and is marked by the occurrence of numerous springs that break out along its course.

Method

Trial magnetometer survey over the site of the proposed west bailey building platform proved unsuccessful and thus earth resistance survey was adopted as the primary investigative technique (see note 1 of Annex 1) to examine both this site (Figure 4; squares 1-5) and the medieval settlement within the grounds of the North Lodge (Figure 4; squares 6-14). Following the success of the resistivity technique on other historic garden sites (*eg* Aspinall and Pocock 1996, Cole *et al* 1997) this technique was also applied, in the first instance, to survey the formal garden (squares 15-42). A subsequent magnetometer scan over this latter site suggested that the remains of brick wall footings would be revealed magnetically and a detailed survey was then conducted over squares 18-21 and 23-42 following the standard method outlined in note 2 of Annex 1.

A Geoscan MPX-15 mutliplexor and adjustable PA5 electrode frame was used to simultaneously collect 0.5m and 1.0m mobile-probe separation data from the deserted medieval village site. The greater separation of the mobile-probe electrodes forces the applied electric current to penetrate further into the ground and can often detect anomalies arising from more deeply buried features (Scollar 1990, 321-4; Linford 1993). It was hoped that the same system could also be applied during the survey of the formal garden. However, extreme contact resistances caused by the quantity of gravel in the topsoil over this site precluded the use of this equipment in this latter instance.

The geophysical survey was conducted during three site visits; the first during May 1996 investigated the west bailey and deserted medieval village sites was followed by two further visits in October and November 1996, after the harvest of the forage maize crop, to conduct the surveys over the formal garden.

Results

<u>west bailey site</u> - *squares 1 - 5*

Owing to time restraints and instrument failure the survey of the west bailey site was restricted to five 30m squares of 0.5m mobile probe spacing (shallow) resistivity data collected at a 0.5m x 1.0m sample interval. An initial trial magnetometer survey covering the bailey ramparts (clearly visible as an earthwork in the field) did not produce an encouraging magnetic response. The results of the resistivity survey are presented in plan A with a summary of significant anomalies in A3.

The only convincing anomaly **[1]** is found over the bailey rampart which appears as an outer high resistance anomaly enclosing a low resistance ditch-type response. Unfortunately, the survey does not extend over the rampart at any other point and thus it is impossible to determine whether the observed response at **[1]** continues along the entire circuit.

Other anomalies within this area are too amorphous to be attributed with a precise archaeological interpretation. However, a group of very faintly discernible ditch-type anomalies **[2]** does appear to form a series of three rectilinear enclosures, possibly indicative of former buildings - although this suggestion is highly conjectural.

<u>Deserted Medieval Village</u> - *squares 6-14*

Two data sets were collected from this area; a high resolution (at a 0.5m x 1.0m sample interval) near-surface survey (mobile probe spacing = 0.5m) and a deeper penetrating (mobile probe spacing = 1.0m) data set collected at a slightly coarser sample interval (1.0m x 1.0m). Both data sets are presented in both raw and image-enhanced form in Plan B and a summary of the significant anomalies is included in Plan C. In addition, plan C2 shows an extract of the RCHME earthwork survey with the bounds of the geophysical data marked for comparison.

The most obvious anomalies are represented by two linear low resistance responses **[3]** and **[4]** running NS across the survey area. These anomalies follow the alignment of the 'hollows' between the linear ridges identified in the earthwork plan and may possibly represent the course of former trackways. A linear high resistance anomaly **[5]** is also evident following the course of an earthwork anomaly running EW across the site.

A single high resistance linear anomaly **[6]** apparently follows the course of the raised ground recorded by the RCHME plan to the W of the survey area. To the N of **[6]** a single linear anomaly **[7]** is visible in the 0.5m data (B2) forming a short right-angled corner. Due to its shallow nature it seems most likely that this is associated with the recent animal enclosures sited in this area of the survey (visible on the NAR 543-403, F22 0095 AP taken in 1958).

Further low resistance ditch-type anomalies are evident at **[8]**, **[9]**, **[10]** and **[11]**. However, none of these are replicated in the earthwork survey. Anomaly **[10]** appears as a quite intense low resistance anomaly in both the shallow 0.5m and the deeper penetrating 1.0m data sets.

Three more tentative high resistance anomalies **[12]**, **[13]** and **[14]** are visible in the survey data, although, it is difficult to ascertain whether they have any archaeological significance.

Finally, a curious pattern of discrete pit-type anomalies **[15]** (marked as open circles on C1) is superimposed upon the survey data. These anomalies are distributed at approximately 7m intervals on a regularly spaced grid pattern. The size and distribution of these anomalies suggests that they represent former tree planting pits, possibly related to the extensive geometrical layout depicted by the Kyp engraving (Figure 1). An alternative explanation may be provided by the occupation of the site by an encampment of United States soldiers towards the end of the second world war; however, the morphology of the anomalies are not suggestive of any recognised military activity from this period (C. Dobinson *pers comm*).

Formal Garden - *squares 15 - 42*

Earth resistance data

Approximately 3ha of earth resistance data were recovered from the site of the former mansion house and formal gardens. The exact area to be covered was indicated in the field by the location of the surviving gate piers (**[16]**, **[17]** and **[18]** on Plan F). The survey grid was thus established to cover the entire garden with a slight overlap beyond the S and W enclosing walls. Plan D1 depicts the raw earth resistance data[1] as a histogram equalised greyscale image of the recorded values and demonstrates the wide range of resistance values encountered over the site. A contrast enhancing Wallis filter of radius = 15m (Scollar 1990, 175-7) was applied to the raw data to increase the contrast in areas of extreme values and the results are shown in Plan D2. Plan E1 shows the results of applying a high-pass Gaussian filter of radius 7m (Scollar 1990, 189) and E2 shows a plot created by a surface illumination/shading algorithm (Scollar 1990, 512-3) after the suppression of distracting EW linear anomalies. Plan F presents a summary of significant geophysical anomalies from this area.

The resistivity survey over this area has produced a plethora of anomalies and it is of use to separate those related to visible surface features prior to the discussion of more significant responses. The most striking of these is the course of the current trackway **[19]** from the Home Farm gate piers (square 15) that continues as a low resistance linear anomaly until it branches in grid square 17 to either side of the abandoned gate piers **[16]**. It is of interest to note the low resistance response from this feature, which is at odds with observations made in the field, that suggested the trackway was constructed from compacted gravel and would therefore be expected to produce a high resistance anomaly. Similar paradoxical responses have been noted during resistivity surveys over other near-surface high resistance features with a slight cover of earth or grass (*eg* Scollar 1990, 350). The boundary between the arable land and the permanent pasture in this area is marked by the course of the southern branch of **[19]** and an intermittent high resistance anomaly **[20]** that follows the raised step between the ploughed field and the stock fence. The course of the public footpath **[21]** is also replicated as a low resistance linear anomaly from its origin at the stile into the arable field in square 22 to the point where it exits the survey in square 41.

An amorphous area of low resistance surrounds the animal water trough **[22]** in square 22 and coincides with a damp patch of ground trampled by the sheep occupying this permanent pasture. The pair of linear low resistance anomalies **[23]** immediately NW of the trough may represent the course of water supply to **[22]**, although it is difficult to explain why two pipes should be present.

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[1] During the survey of the formal garden the remote electrode pair were separated to a distance at which their contribution to the recorded reading became negligible. Under these conditions measurements recorded with the twin-electrode array multiplied by a factor of $2\pi r$ (where r = mobile probe separation) express the apparent resistivity of the volume of ground immediately below the mobile electrodes in units of Ωm.

Further linear low resistance anomalies **[24]** are also evident on a regular EW alignment spaced at approximately 10m intervals throughout the entire survey area. Interpretation of these anomalies is confusing as they apparently extend beyond the confines of the formal garden (*eg* squares 32, 37, and 42) and are thus more reminiscent of either a recent cultivation pattern or a system of field drains. However, the ploughing regime at the time of the survey followed a predominately NS alignment (with a $\sim 45°$ variation along a 20m strip parallel to the NE field boundary visible in plan D1) and it seems unlikely that a site situated atop a gravel capped hill would require such meticulous drainage. Certainly, the current tenant farmer could provide no explanation for these anomalies based on his farming practice over the last 10 years (J. Homes *pers comm*) and it would appear that prior to his tenure the land was used solely for permanent pasture. It would therefore seem most likely that these anomalies represent either a more ancient agricultural pattern (ridge and furrow?) or perhaps a deliberate attempt to drain or irrigate the site prior to establishing the formal garden design. The absence of any associated anomalies in the magnetic data (*see below*) suggests that there is no ferrous or ceramic material in the causative features.

More significant archaeological anomalies are evident in the pattern of high resistance linear responses delineating the pathways of a former geometrical garden design **[25]** and **[26]** in the SE corner of the survey area. The design is made from four symmetric parterres each enclosing an approximately 30m square area separated by paths radiating from a central, apparently circular, planting bed or lawn. Two of these quadratic designs appear unambiguously within the resistivity data together with the main arterial pathways **[27]**, **[28]** and **[29]**. Anomaly **[29]** apparently continues E parallel to the course of the S wall of the garden, although its definition is somewhat obscured by the highly variable background resistance encountered over this part of the site. These high resistance linear anomalies correspond to parch-marks visible in the AP records and it seems most probable that they arise from compacted gravel walkways between the planting beds or lawn. The beds themselves would be expected to produce a low resistance anomaly due to the quantity of moisture-retentive organic matter added to the soil as manure (Cole *et al* 1997). However, the underlying geology of the site combined with recent mechanical agriculture has ploughed an appreciable quantity of gravel, some no doubt from the original garden paths, into the current topsoil thus obscuring the identification of such ephemeral features.

The course of the retaining garden wall, visible in the Kyp engraving, is also evident in the resistivity data and four convincing lengths **[30]**, **[31]**, **[32]** and **[33]** are identifiable. All of the wall lengths exhibit linear low resistance anomalies approximately 2m in width. This is a surprising response for the remains of a wall footing, which might be expected to produce a high resistance anomaly, possibly indicating that either the remains of the wall have been robbed out or that the porous fabric of the ceramic bricks is retaining more moisture than the surrounding subsoil. A similar low resistance response is evident around each of the isolated gate piers **[16]**, **[17]** and **[18]** together with a central area of high resistance between the pillars. This response may, perhaps, be caused by an accumulation of brick material from the former enclosing wall, although it is difficult to explain both the extremely low resistance of the response (lower than that of the lengths of wall) and its concentration around the gate piers. It is thought that the majority of the original wall was dismantled and used either in the construction of the new manor house or in the adjacent 19th-century Home Farm buildings.

An area of similarly very low resistance **[34]** is found to the N of the site in squares 20, 21 and 22 over the site of the former mansion house as indicated by a distinct depression in the ground where, presumably, the burning building collapsed into its own cellars. Anomaly **[34]** coincides with a diffuse area of magnetic disturbance and is represented as such on Plan F. Whilst an area of low resistance within the depression might be expected the anomalous area extends beyond the lowered topography and is apparently bounded by a group of linear high resistance anomalies **[35]** to **[38]** (best visualised in the high-pass and directionally filtered plots presented in plan E). It seems most likely that these anomalies represent the remains of the former manor house wall footings.

A series of linear low resistance anomalies **[39]** to **[42]** is evident to the W of the former manor house and may well represent domestic drainage conduits. This would concur with the remains of a vaulted brick conduit which survives at the edge of the arable field against the boundary wall of Craven House. Additional anecdotal evidence (J. Homes *pers comm*) suggests that other conduits exist to the N of the former manor house and it seems likely that anomalies **[43]** and **[44]** are related to such features. The area surrounding anomaly **[43]** (immediately N of the modern trackway **[19]**) displays an extremely high apparent resistivity which suggests that the ground has been deliberately made up with gravel. The course of anomaly **[44]** is of interest as it passes straight through the pair of standing gate piers **[16]** although there is little evidence to suggest that the anomaly continues beyond the garden.

Further low resistance linear anomalies **[45]**, **[46]** and **[47]** are seen to traverse the garden site on a NS alignment; however their significance is questionable due to the direction of the current cultivation pattern. An equally tentative interpretation must also be applied to anomalies **[48]** and **[49]**. Whilst both of these may, possibly, be related to a significant garden features the data is of insufficient clarity to advance any certain identification.

Magnetic data

The magnetometer survey was restricted to areas of open ground away from obvious sources of modern ferrous disturbance in the arable field. However, modern disturbance is evident where the survey meets the metallic stock fence enclosing the arable field (grid squares 18 and 19) and around the southern gate piers **[18]** which are protected by a substantial iron-railing fence (Stokes 1996; Figure 13). Further disturbance is evident along the W boundary of the survey although the response in this area is more indicative of ferrous pipe. The general magnetic response from the site is quite intense and the traceplot of the raw magnetometer data (Plan G1) has thus been plotted on a comparatively coarse vertical scale (75nT/cm at a scale of 1:1000).

The initial magnetometer scan over the course of the former E garden wall suggested that the brick wall footings would produce an identifiable magnetic response. Analysis of the recorded magnetometer data confirmed this observation and has identified a number of apparently brick-built structures. The magnetic response of a brick built structure is relatively diagnostic as fired clay is generally rich in ferro/ferri magnetic minerals, producing a strong induced magnetisation in the earth's ambient magnetic field. More importantly, as each brick cools in the kiln after firing the magnetic material within the clay will acquire a thermoremanent magnetisation causing each brick to retain a relatively strong permanent magnetic moment (Bevan 1994). Magnetic surveys over brick foundations confirm the relatively intense yet erratic nature of such features (*eg* Linford - *forthcoming*) and many brick-type anomalies are evident from the gradiometer data within the formal garden.

The former garden wall appears as a brick-type response and the magnetic anomalies correspond to lengths **[31]**, **[32]** and **[33]** identified by the earth resistance survey. A slight heading-error[2] in the data has occurred along the NS orientated branch of **[32]** where the anomaly runs parallel to the direction of the survey lines. A much stronger linear response **[50]** bisects the garden site EW and corresponds with a linear low resistance anomaly. This latter anomaly lies directly S of the former manor house which is represented in the magnetic data as a diffuse area of disturbance **[34]** containing a number of brick-type linear responses **[51]** and **[52]**. The magnetic disturbance in this area is no doubt caused by both a scatter of brick rubble within the soil and the underlying wall footings of the original manor house (see above). Similar areas of disturbance are found to the E of the manor house **[53]** and a more substantial scatter **[54]** beyond the garden wall in grid squares 27 and 32. The origin of both **[53]** and **[54]** is difficult to ascertain due to their amorphous nature, although, it seems likely that they represent the location of former brick-built structures. Anomaly **[54]** may be related to rubble from the former garden wall although it is difficult to explain the concentration of brick rubble abandoned in this area compared to the other lengths of the dismantled wall.

The magnetic response to the E and W of the former manor house is considerably less disturbed than anomaly **[34]**. Immediately W of the house the low resistance anomaly **[40]** is correlated with a strong positive response in the magnetic data. This would suggest that the causative feature is either a ferrous or ceramic pipe/brick-conduit possibly joining a ferrous pipe **[55]** which apparently runs NS down the length of the surviving garden wall. The area immediately E of the former manor house is dominated by an intense ($\sim$150nT) magnetic response **[56]** emanating from either a substantial buried thermoremanent or a buried ferrous feature. Unfortunately, it is not possible to determine from the magnetic response alone whether **[56]** is related to a feature of the original garden or to a more recent burial of ferrous detritus. A further arcuate negative anomaly **[57]** is identified in close proximity to **[56]** and may, tentatively, be identified as a circular gravel path forming part of the original garden design in this area.

Additional elements of the original garden design are replicated as magnetic anomalies over the site of the former parterres **[25]** and **[26]** identified by the resistivity survey. The magnetic response is most apparent over the E pathway of **[25]** which produces a negative anomaly bounded to the N by positive readings - possibly indicative of surviving brick cutwork separating the original gravel path from the adjoining planting bed. Other magnetic anomalies within this area are less distinct; however, the location of the former parterres can be distinguished from the more uniform response of the gravel paths **[28]** and **[29]**.

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[2] Due to the extreme directional sensitivity of fluxgate gradiometers data collected from a series of parallel lines walked in alternate "zig-zag" directions will often include an offset heading error dependant upon the direction of travel. The effect on a grid of data displayed as an X-Y trace plot is for adjacent pairs of lines to appear "bunched" together. As the effect is additive in the forward direction and negative in the reverse this results in a "striped" appearance when the data is displayed as a false colour image. This visually distracting artefact is easily removed by normalising the mean value of each line to zero, however, linear anomalies running along the direction of the survey lines may well be severely attenuated by the application of this process.

Comparison with other evidence

It is of interest to compare the results of the geophysical survey with the extremely clear AP evidence gathered 30 years ago before the Earl Craven estate was sold and the site of the former garden reverted to arable land. These parchmark patterns are most readily comparable to the earth resistance data as both techniques rely on a contrast in soil moisture to develop a distinguishable anomaly. In the case of the AP evidence three of the parterre designs and attendant pathways can be identified, the clearest corresponding to anomaly **[25]** whilst the other two in the SW corner of site have not been detected by the geophysical survey. The enclosing wall of the garden does not appear as a parchmark on the APs - an observation consistent with the results of the resistivity survey (low resistance anomaly) which suggest that the brick foundations of the wall are more moisture retentive than the high resistance gravel subsoil. To the N of the site the quality of the APs is reduced and only a single raised mound (now apparently ploughed out) related, perhaps, to the former manor house is visible.

Comparison of both the AP and the geophysical evidence with the Kyp engraving confirms the integrity of this latter representation and the survival of much of the geometrical layout as depicted by the artist. Furthermore, the geophysical data has located both the course of the EW garden wall **[50]** to the S of the manor house and more tentatively, the short section of wall **[52]** to the N of the star-shaped enclosed garden depicted by Kyp. The carriage drive immediately N of this area is of interest as it corresponds to the area of extremely high resistivity recorded in squares 15 to 17. It is possible that the high background resistance in this area is a direct result of a deliberately compacted layer of gravel laid to assist the passage of horse drawn traffic visiting the house.

One further speculation can be drawn from the detail of the Kyp print which shows a regular alignment of trees apparently extending NE of St Mary's church. Whilst the exact location cannot be ascertained from Kyp's artificially elevated angle, the tree planting would apparently extend into grid squares 6 to 14 and may well explain the regular pattern of low resistance anomalies observed during the survey of this area (Plans B and C).

Immediately after the magnetometer survey was conducted in November 1996 Mrs S. Brown obtained an extremely clear aerial photograph (Figure 3) of the formal garden site, a copy of which was kindly made available to the author for the preparation of this report. It is unclear whether this image represents a soil mark, presumably indicating accumulations of gravel in the topsoil, or the differential thawing of the heavy frost that covered the site at the time that the photograph was taken. In either case, the photograph reveals a pattern of pathways corroborating the parterre garden to the south of the manor house as depicted by the Kyp engraving. In particular, this photograph shows details of the geometric designs in the south-west corner of the garden that have not been reproduced in the geophysical survey data. Furthermore, it is of interest to note that many of the linear anomalies in the photograph appear to be alternately displaced along their length in an east-west orientation. This would suggest that the material causing the patterns is susceptible to damage from the modern ploughing regime.

Conclusion

Geophysical survey of the west bailey site (squares 1 to 5) has proved only partially successful as the identification of building remains on the raised earthwork platform has not been possible. Extension of the topographic survey over this platform would therefore offer the most suitable means of confirming the conjecture that this area represents an enlargement of the west bailey of castle 3.

A greater degree of success was encountered over the site of the deserted medieval village (grid squares 6 to 14) where a number of earth resistance anomalies were identified and correlated with the previous RCHME topographic survey. In addition, a pattern of planting pits was located that may tentatively be related to the 17th-century landscaping of the site initiated by Lord Craven. Magnetic and resistivity surveys over the site of the former manor house and formal gardens revealed a plethora of geophysical anomalies to augment the AP record and further confirm the general fidelity of the contemporary print by Johannes Kyp. A number of additional drainage features have also been located by the survey together with an improved definition of the layout of the original manor house.

Comparison of the geophysical data with the APs taken before the transfer of the formal garden from pasture to arable land in 1984 suggests that the destructive effects of mechanical agriculture have degraded the surviving historic garden features on this currently unprotected site. However, the more recent frost-mark AP, taken immediately after the geophysical survey was conducted, contradicts the geophysical evidence and indicates that a more complete pattern of the garden still exists - in the topsoil at least. Further work could investigate this disparity and establish the depth of burial of the surviving features so that the threat from modern agriculture can be more fully assessed. This is of particular importance at Hamstead Marshall as the comparatively short life of the formal garden suggests that a single phase of garden design has been preserved at a site which has largely escaped re-modelling according to later fashions in landscape design.

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Enclosed Figures and plans

Figure 1	Johannes Kyp's engraving of Lord Craven's house and formal gardens at Hamstead Marshall, Berks., before the house was destroyed by fire in 1718.
Figure 2	Aerial photograph (NAR 58/5225 F21, 48) of the former manor house site showing parchmarks related to the formal garden. ©RAF/MoD.
Figure 3	Monochrome reproduction of the original colour slide showing frost-marks indicating the design of the formal garden taken by Mrs S. Brown immediately after geophysical survey was completed.
Figure 4	Location of the geophysical surveys, May, October and November 1996. (1:2500).
Figure 5	Greytone image of raw resistivity data superimposed upon the OS map. (1:2500).
Plan A	Earth resistance data from the west bailey site (1:1000).
Plan B	Earth resistance data from the Deserted Medieval Village site (1:1000).
Plan C	Summary of significant anomalies from the Deserted Medieval Village site with extract from RCHME topographic survey of the same area (1:1000).
Plan D	Earth resistance data from the Formal Garden site (1:1000).
Plan E	Enhanced earth resistance data from the Formal Garden site (1:1000).
Plan F	Summary of significant geophysical anomalies from the Formal Garden site.
Plan G	Magnetic data from the Formal Garden site (1:1000).

Annex 1: Notes on standard procedures

1) **Resistivity Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all aligned parallel to one pair of the square's edges, and each separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metres from the nearest parallel square edge. Readings are taken along each traverse at 1 metre intervals, the first and last readings being 0.5 metres from the nearest square edge.

   Unless otherwise stated the measurements are made with a Geoscan RM15 earth resistance meter incorporating a built-in data logger, using the twin electrode configuration with a 0.5 metre mobile electrode separation. As it is usually only relative changes in resistivity that are of interest in archaeological prospecting, no attempt is made to correct these measurements for the geometry of the twin electrode array to produce an estimate of the true apparent resistivity. Thus, the readings presented in plots will be the actual values of earth resistance recorded by the meter, measured in Ohms (Ω). Where correction to apparent resistivity has been made, for comparison with other electrical prospecting techniques, the results are quoted in the units of apparent resistivity, Ohm-m (Ωm).

   Measurements are recorded digitally by the RM15 meter and subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Ancient Monuments Laboratory using desktop workstations.

2) **Magnetometer Survey:** Each 30 metre square is surveyed by making repeated parallel traverses across it, all parallel to that pair of square edges most closely aligned with the direction of magnetic North. Each traverse is separated by a distance of 1 metre from the last; the first and last traverses being 0.5 metre from the nearest parallel square edge. Readings are taken along each traverse at 0.25 metre intervals, the first and last readings being 0.125 metre from the nearest square edge.

   These traverses are walked in so called 'zig-zag' fashion, in which the direction of travel alternates between adjacent traverses to maximise survey speed. However, the magnetometer is always kept facing in the same direction, regardless of the direction of travel, to minimise heading error.

   Unless otherwise stated the measurements are made with a Geoscan FM36 fluxgate gradiometer which incorporates two vertically aligned fluxgates, one situated 0.5 metres above the other; the bottom fluxgate is carried at a height of approximately 0.2 metres above the ground surface. The FM36 incorporates a built-in data logger that records measurements digitally; these are subsequently transferred to a portable laptop computer for permanent storage and preliminary processing. Additional processing is performed on return to the Ancient Monuments Laboratory using desktop workstations.

It is the opinion of the manufacturer of the Geoscan instrument that two sensors placed 0.5 metres apart cannot produce a true estimate of vertical magnetic gradient unless the bottom sensor is far removed from the ground surface. Hence, when results are presented, the difference between the field intensity measured by the top and bottom sensors is quoted in units of nano-Tesla (nT) rather than in the units of magnetic gradient, nano-Tesla per metre (nT/m).

3) **Resistivity Profiling:** This technique measures the electrical resistivity of the subsurface in a similar manner to the standard resistivity mapping method outlined in note 1. However, instead of mapping changes in the near surface resistivity over an area, it produces a vertical section, illustrating how resistivity varies with increasing depth. This is possible because the resistivity meter becomes sensitive to more deeply buried anomalies as the separation between the measurement electrodes is increased. Hence, instead of using a single, fixed electrode separation as in resistivity mapping, readings are repeated over the same point with increasing separations to investigate the resistivity at greater depths. It should be noted that the relationship between electrode separation and depth sensitivity is complex so the vertical scale quoted for the section is only approximate. Furthermore, as depth of investigation increases the size of the smallest anomaly that can be resolved also increases.

Typically a line of 25 electrodes is laid out separated by 1 or 0.5 metre intervals. The resistivity of a vertical section is measured by selecting successive four electrode subsets at increasing separations and making a resistivity measurement with each. Several different schemes may be employed to determine which electrode subsets to use, of which the Wenner and Dipole-Dipole are typical examples. A Campus Geopulse earth resistance meter, with built in multiplexer, is used to make the measurements and the Campus Imager software is used to automate reading collection and construct a resistivity section from the results.

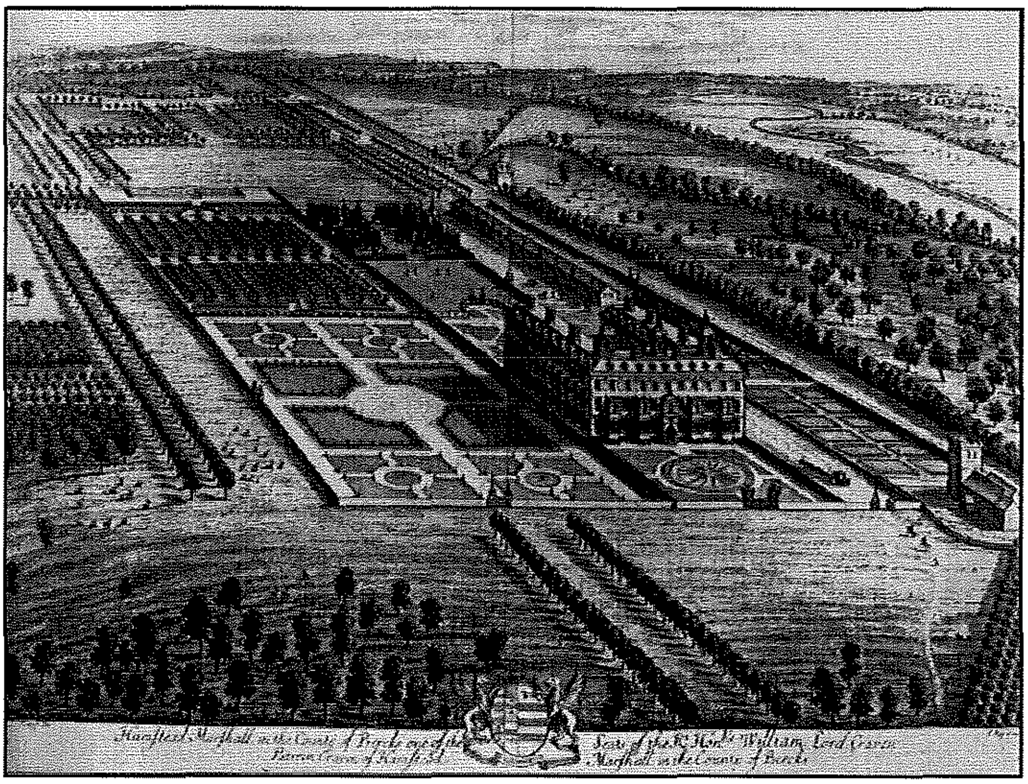


***Figure 1; Hamstead Marshall, Berks.**, Johannes Kyp's engraving of Lord Craven's house and formal gardens at Hamstead Marshall before the house was destroyed by fire in 1718.*

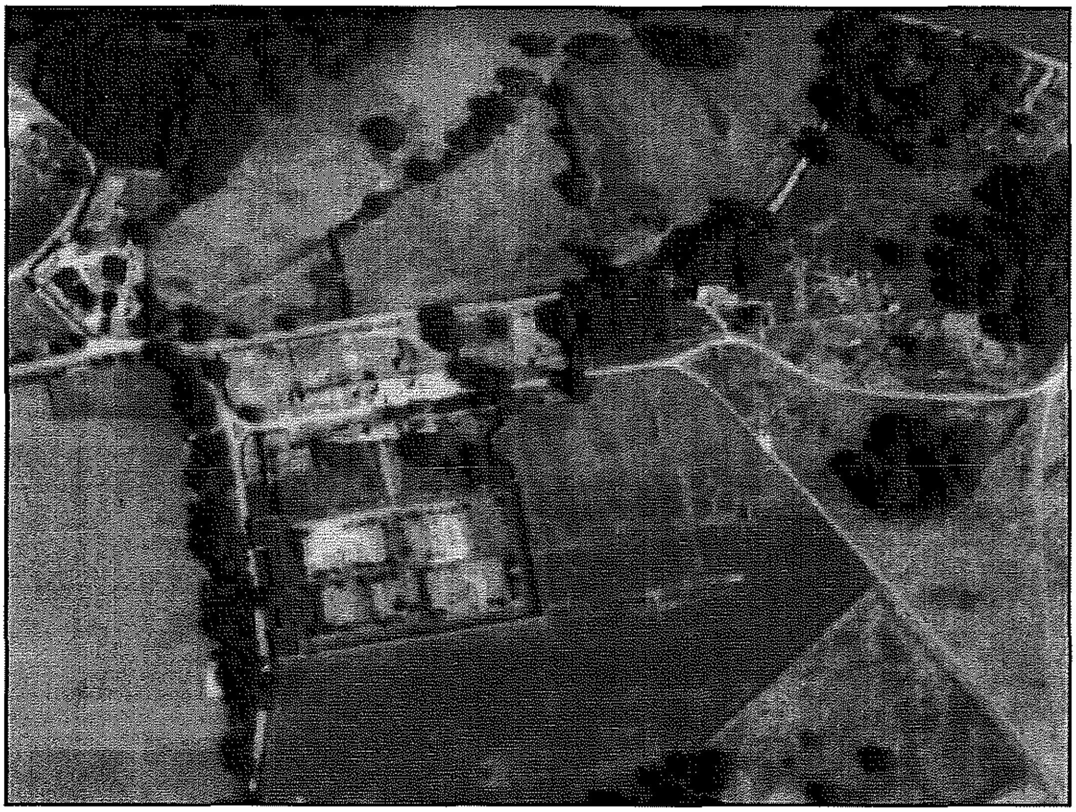
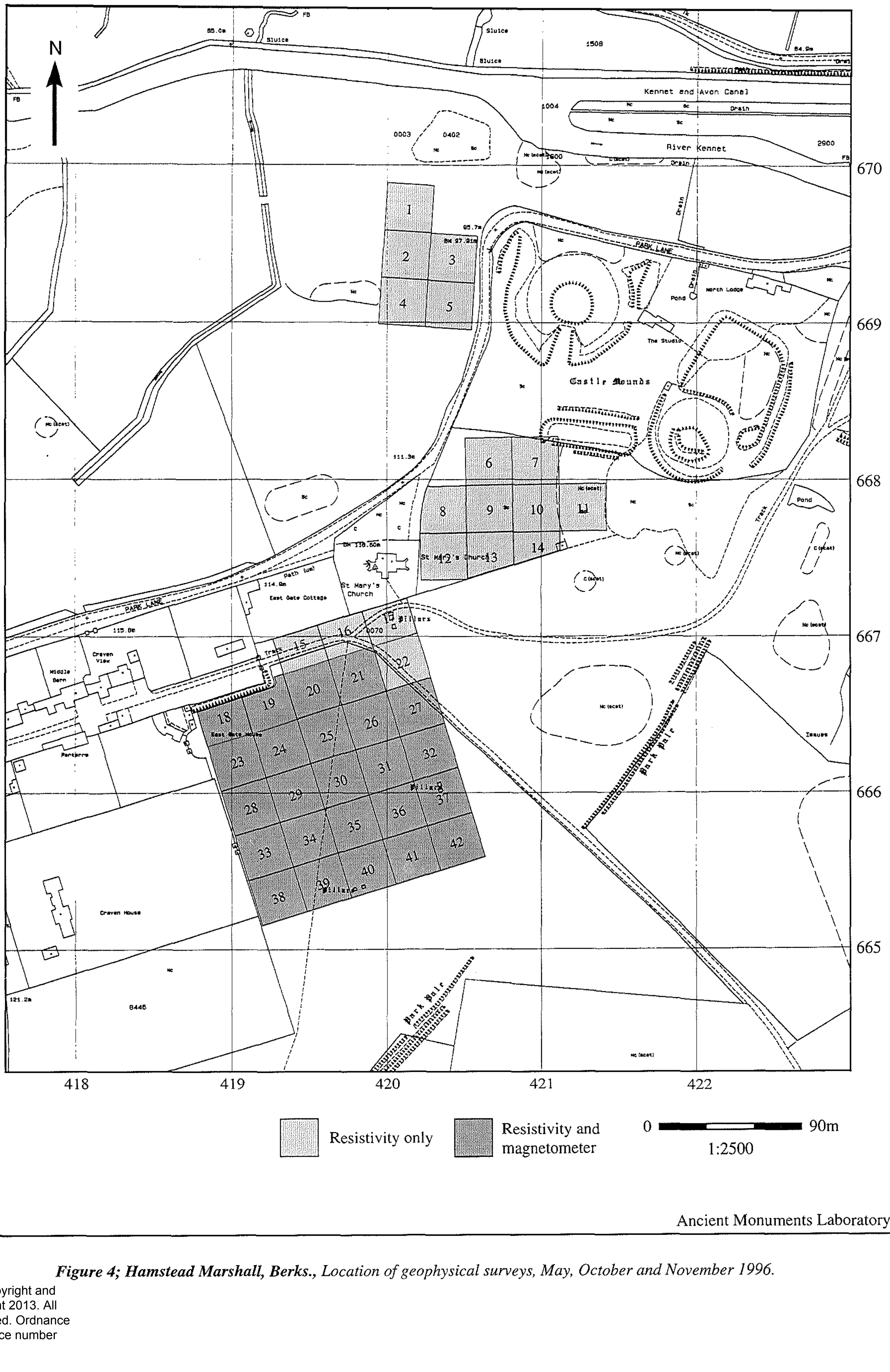


***Figure 2; Hamstead Marshall, Berks.**, Aerial photograph of the formal garden site showing parchmark anomalies corresponding to the original design of the garden (NAR 58/5225 F21, 48; © Crown Copyright/RCHME).*

Figure 3; Hamstead Marshall, Berks., the frost mark recorded by Mrs S. Brown shortly after the magnetometer survey was completed in November 1996.

HAMSTEAD MARSHALL, NEWBURY, BERKS.
Location of geophysical surveys 1996.

SU 4166 & 4266



Ancient Monuments Laboratory 1996.

Figure 4; Hamstead Marshall, Berks., *Location of geophysical surveys, May, October and November 1996.*

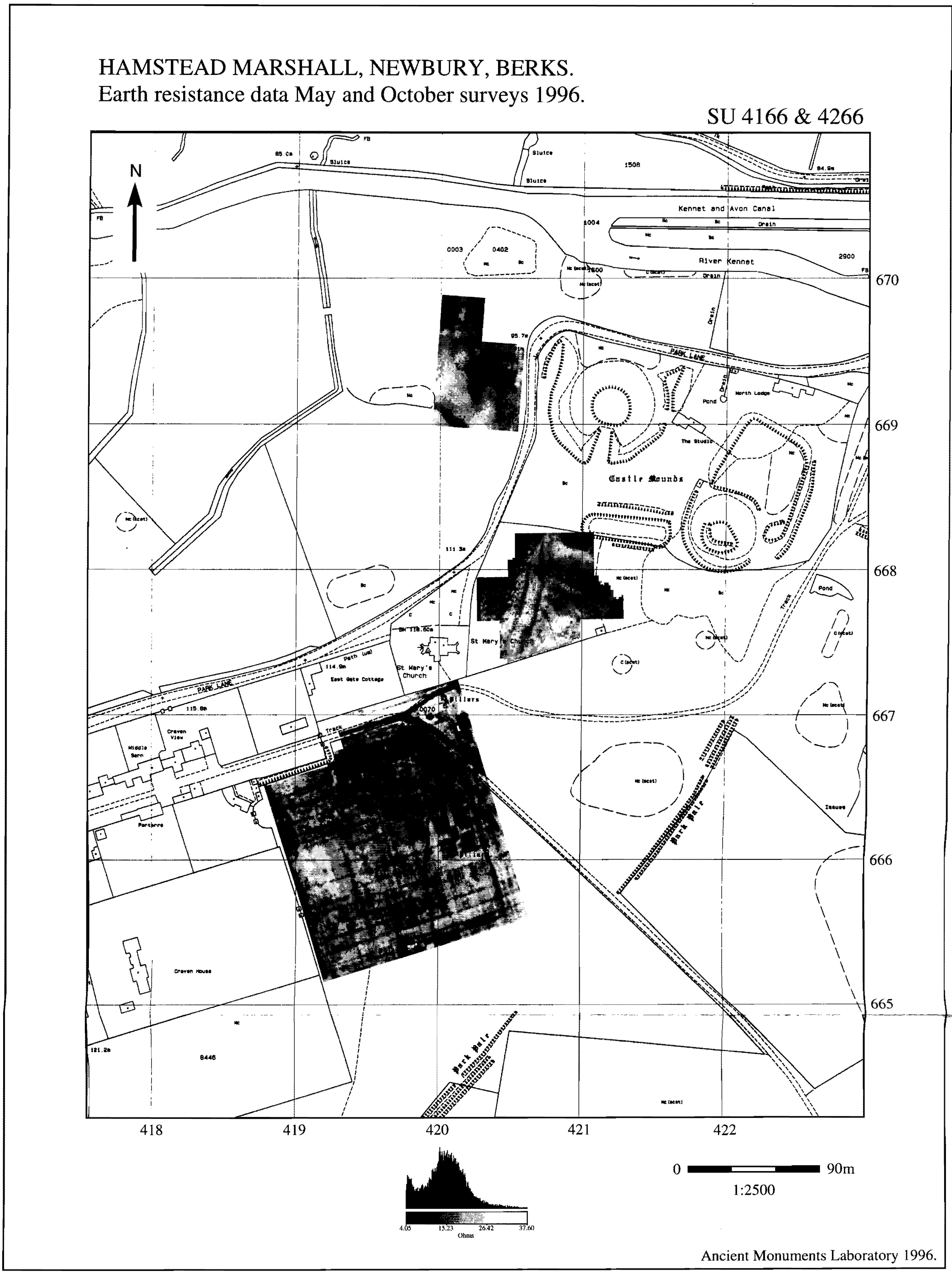


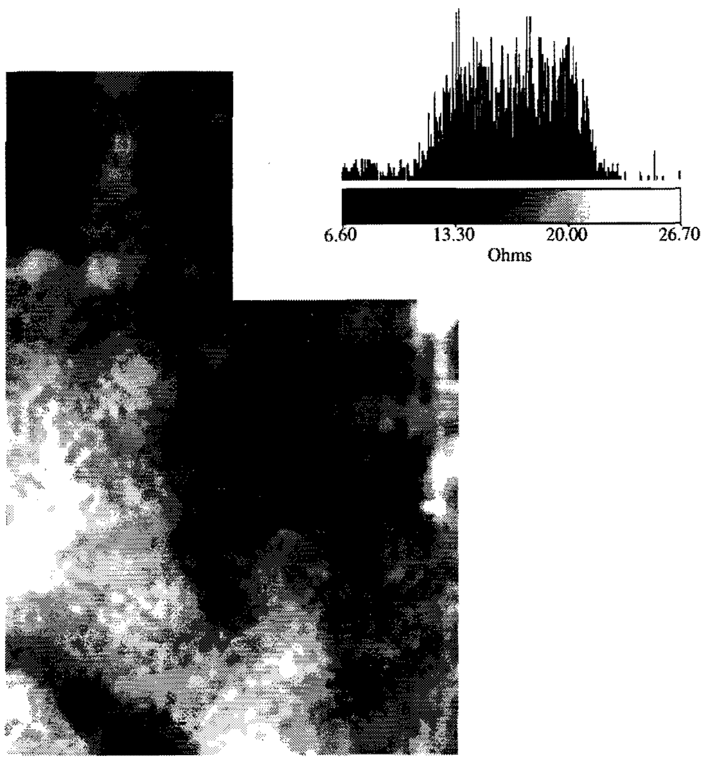
***Figure 5; Hamstead Marshall, Berks.**, Greytone image of raw resistivity data superimposed on OS map.*

PLAN A

HAMSTEAD MARSHALL, BERKS.
Resistivity survey, May 1996.

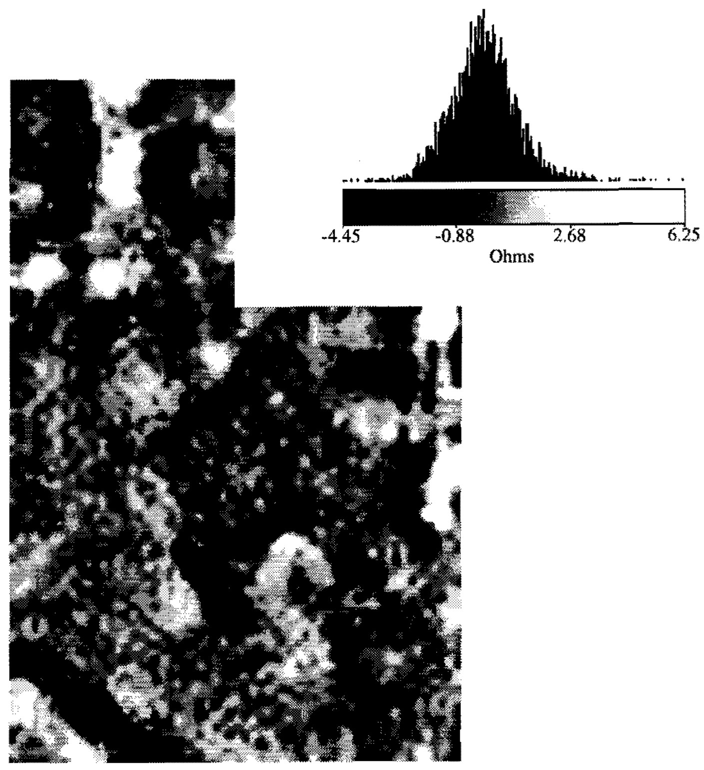
West Bailey site

*1. Smoothed resistivity data**



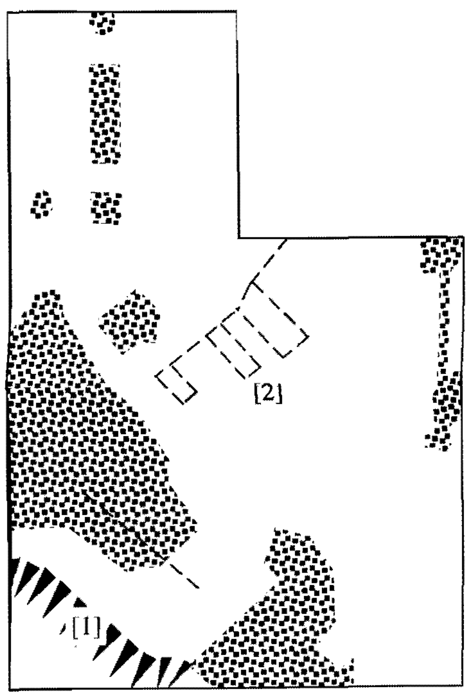
*Resampled to 1m by 1m reading interval, then smoothed with a thresholded median filter to replace all values differing by more than 1Ω from the local median, calculated using a 3 by 3 window.

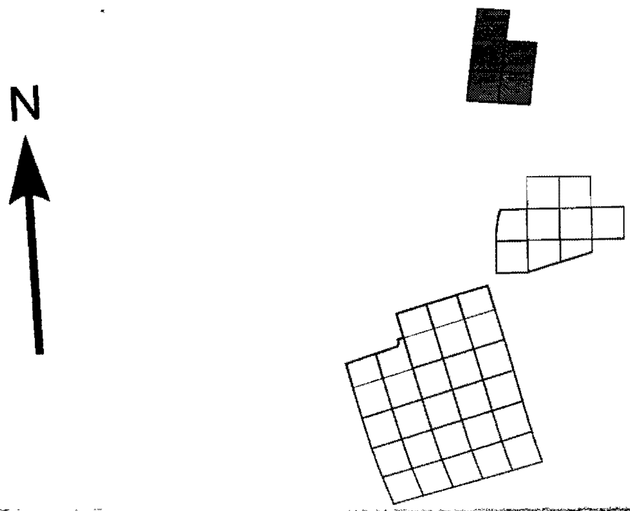
2. High-pass filtered resisitivity data†



†Smoothed data filtered with a 5m radius Gaussian high-pass filter.

3. Summary of significant anomalies



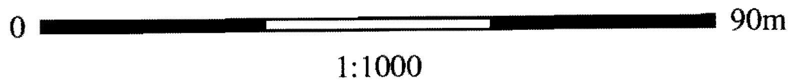


Key

Possibly significant area of high resistance

Bailey rampart (visible as earthwork) [1]

--- Tentative linear low resistance anomaly

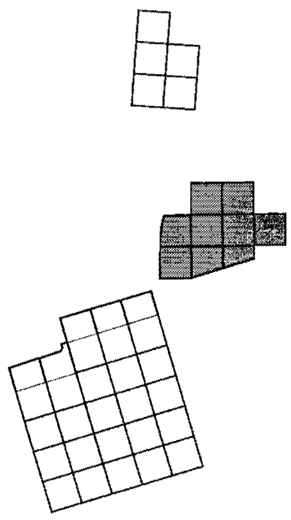


Ancient Monuments Laboratory 1996.

PLAN B

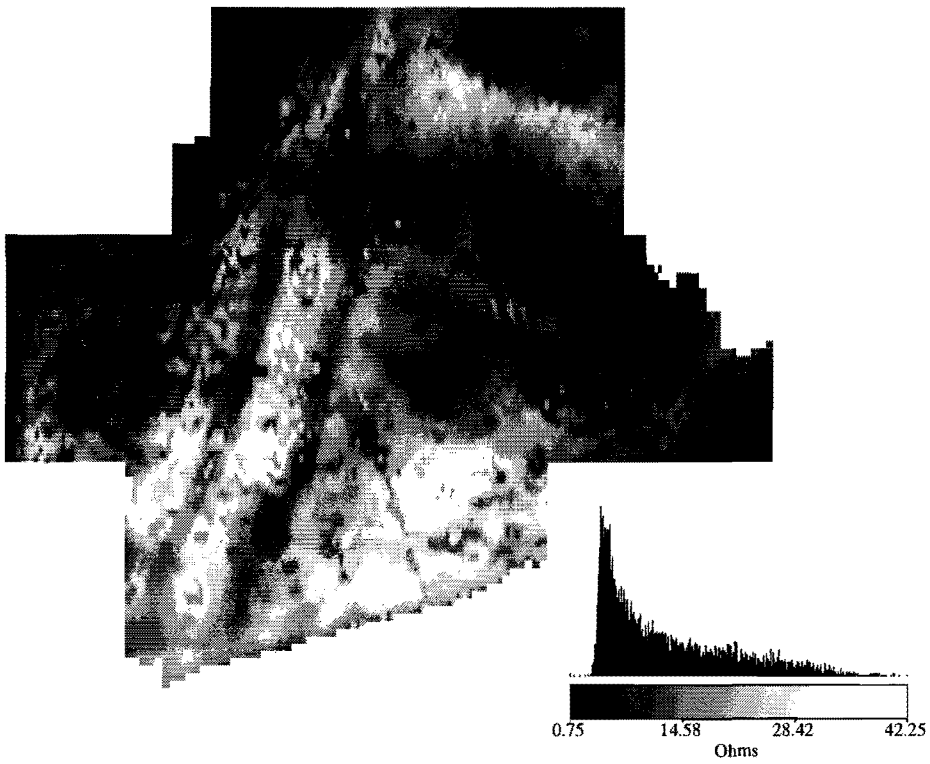
HAMSTEAD MARSHALL, BERKS.
Resistivity survey, May 1996.

Deserted Medieval Village site

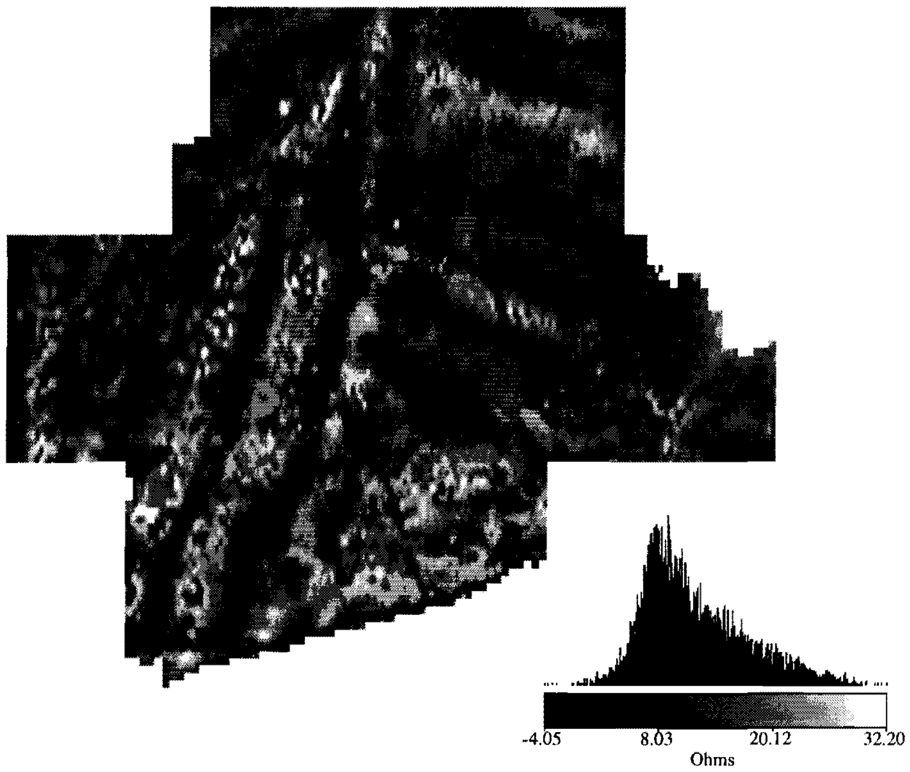


N

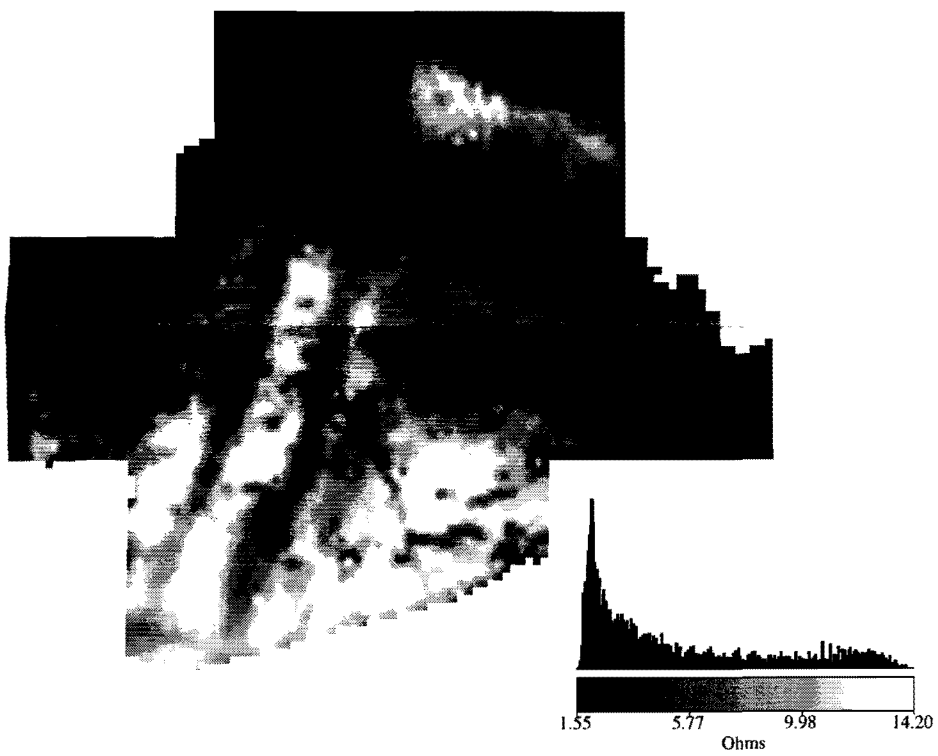
1. Raw 0.5m resistivity data



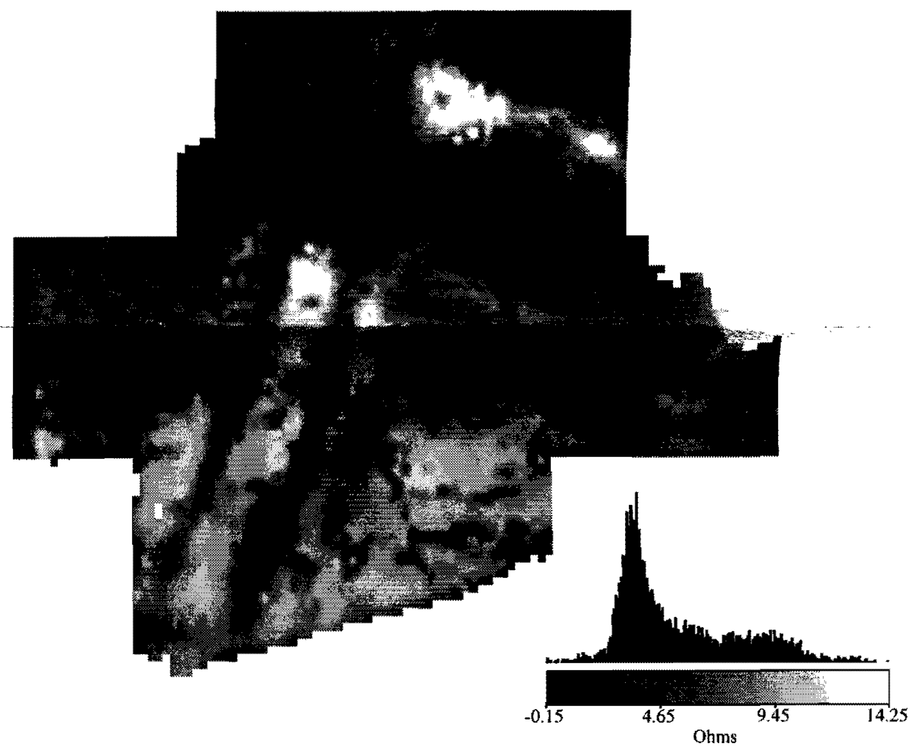
2. Contrast enhanced 0.5m resisitivity data



3. Raw 1.0m resistivity data



4. Contrast enhanced 1.0m resistivity data



0 90m

1:1000

Ancient Monuments Laboratory 1996.

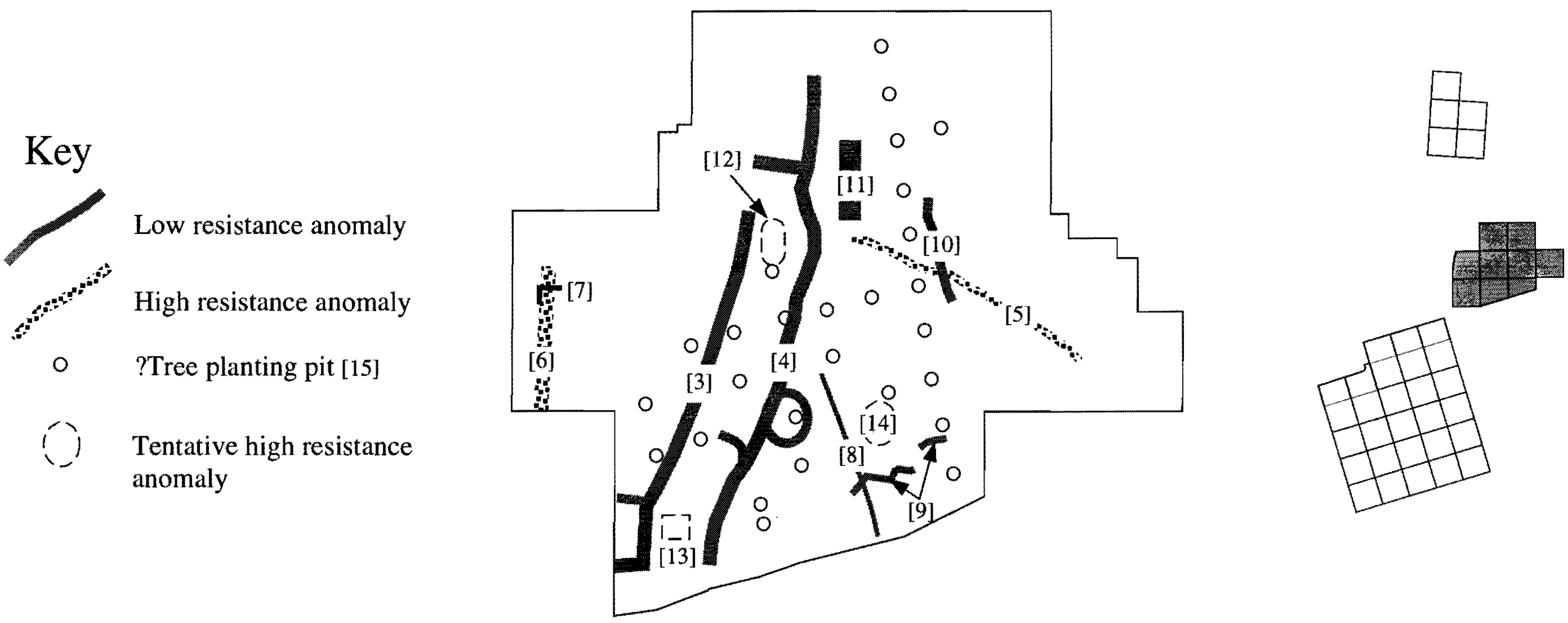
HAMSTEAD MARSHALL, BERKS.
Resistivity survey, May 1996.

PLAN C

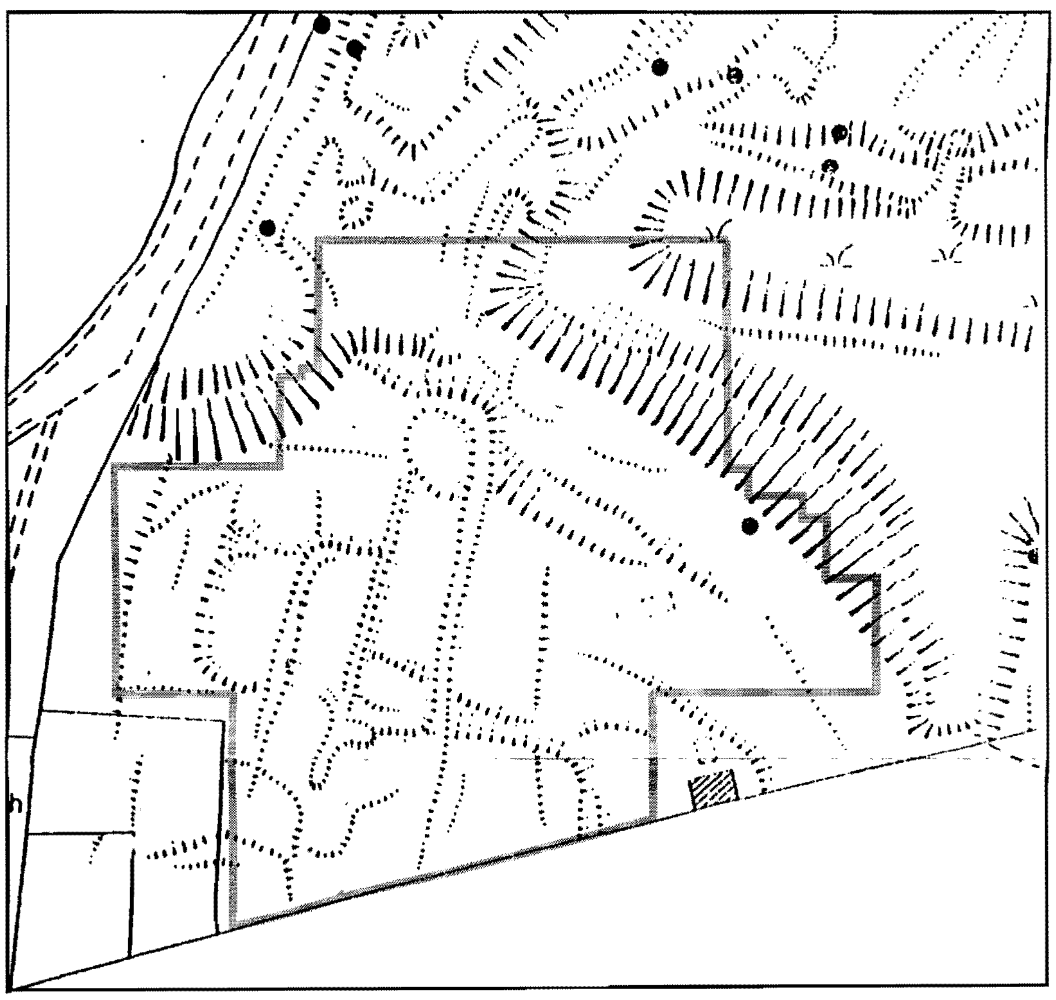
N

Deserted Medieval Village site

1. Summary of significant anomalies



2. RCHME earthwork survey of the same area



0 90m

1:1000

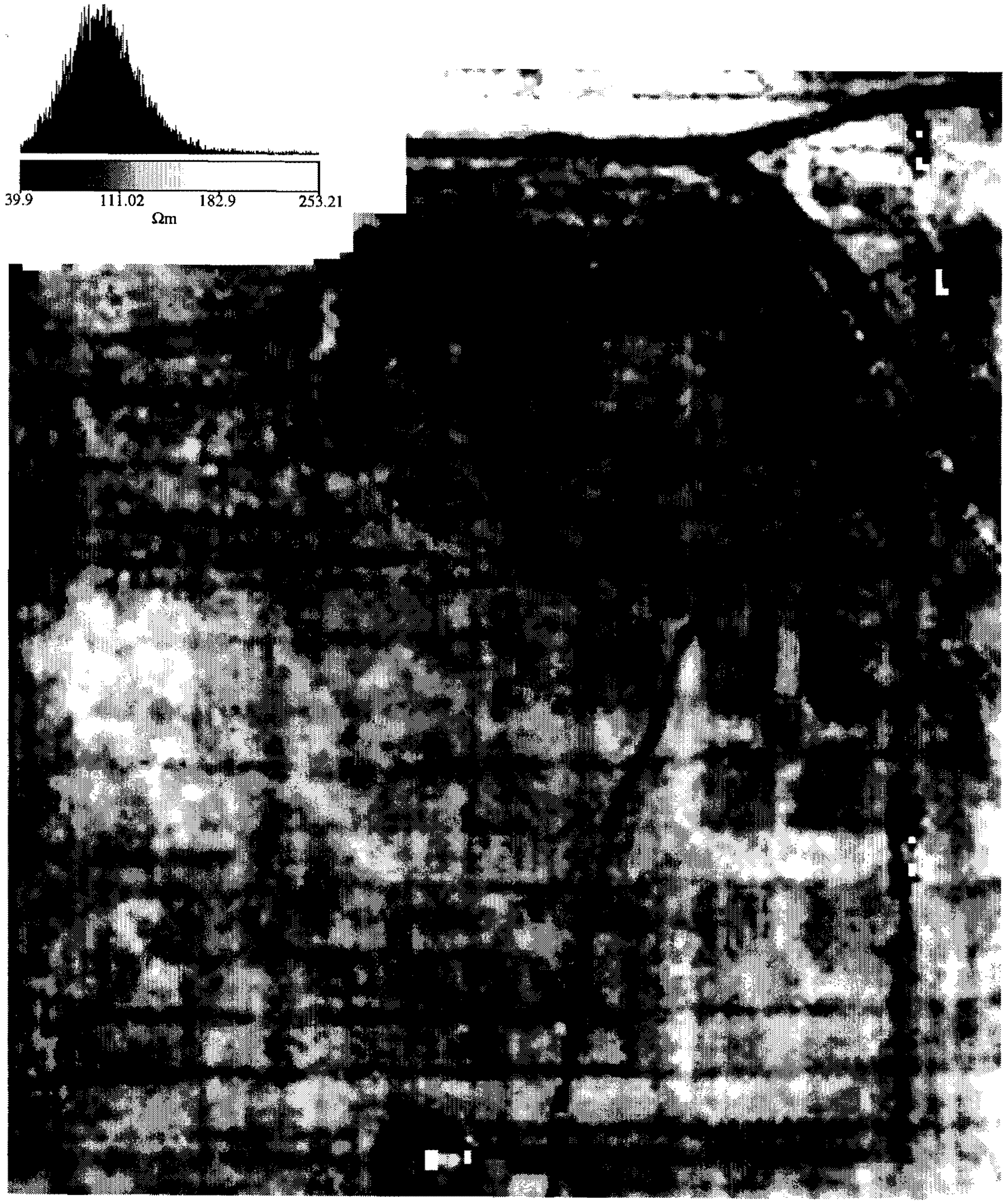
Ancient Monuments Laboratory 1996.

HAMSTEAD MARSHALL, BERKS.
Resistivity survey, October 1996.

PLAN D

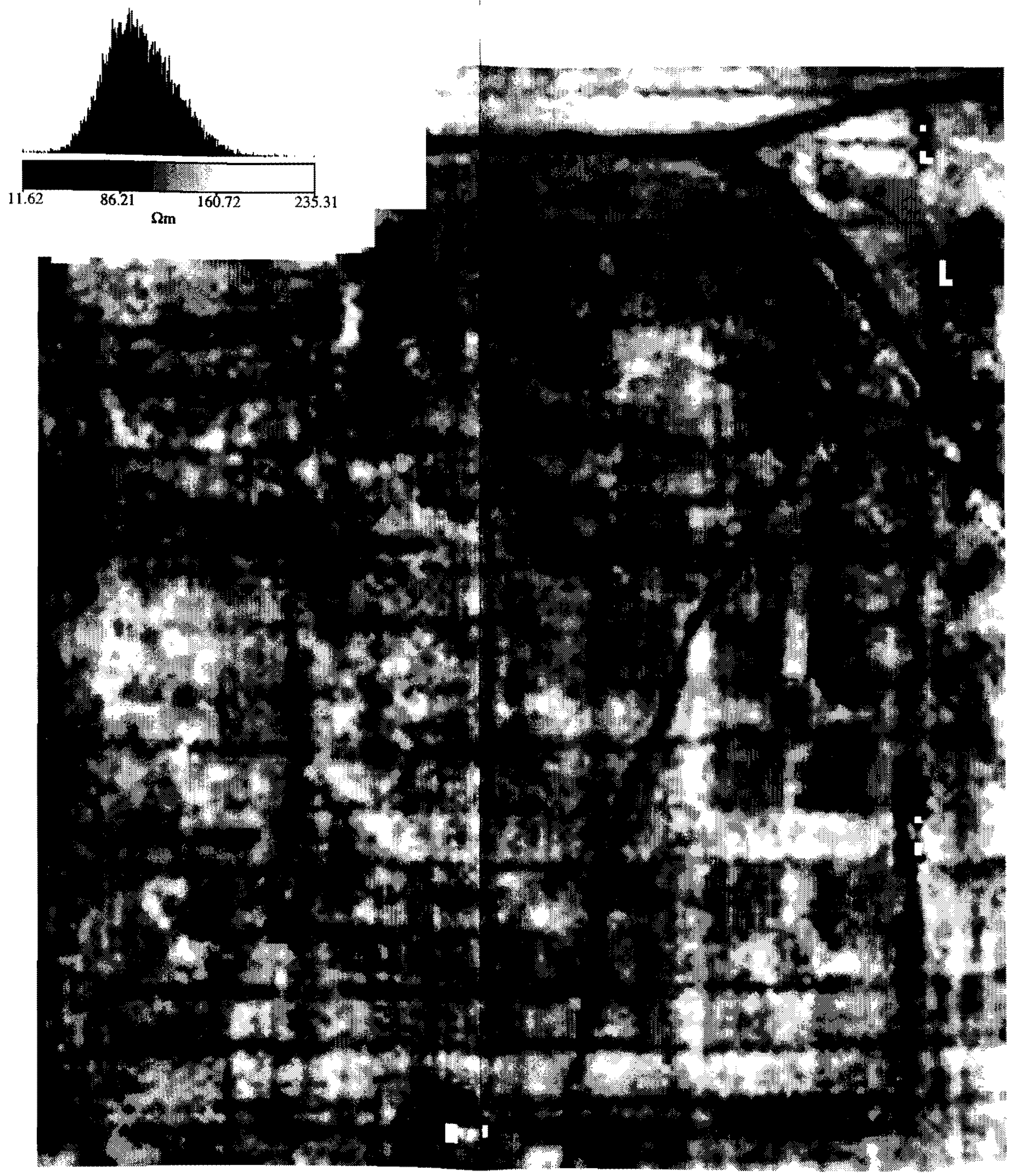
Formal Garden

*1. Raw 0.5m resistivity data**



* Histogram equalised greytone image of raw resistivity data after treatment with a median filter (radius = 1m) to remove anomolously high values caused by high contact resistance.

2. Contrast enhanced 0.5m resisitivity data†



† Histogram equalised greytone image of raw resistivity data after treatment with a contrast enhancing Wallis algorithm (radius = 15m).

0 ——— 90m

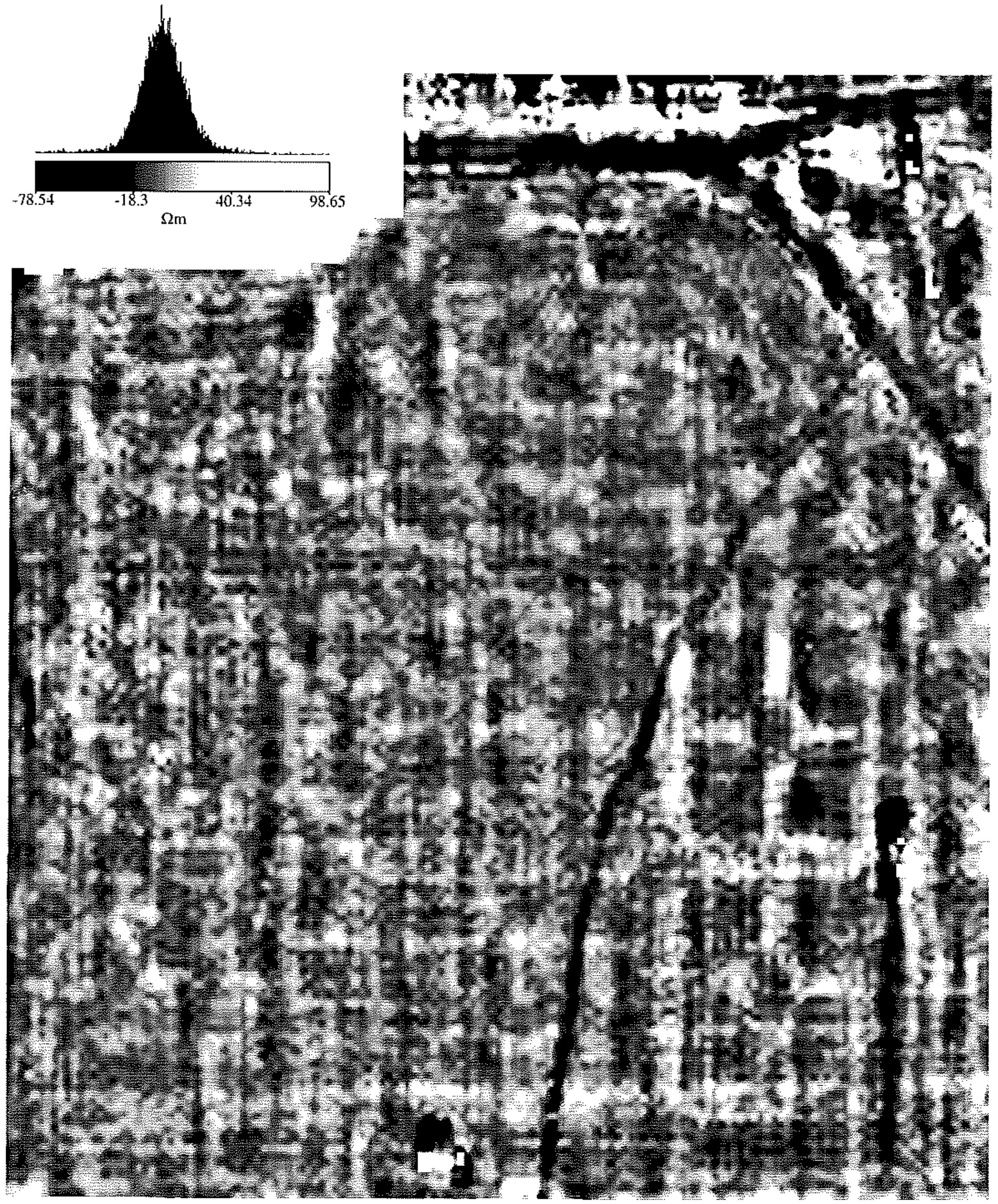
1:1000

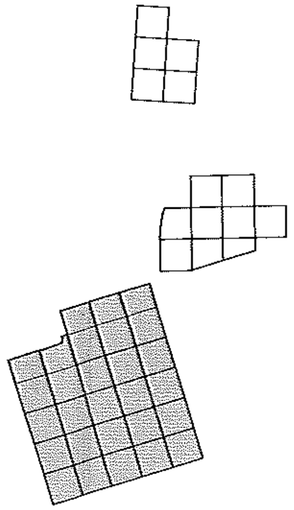
Ancient Monuments Laboratory 1996.

HAMSTEAD MARSHALL, BERKS.
Resistivity survey, October 1996.
Formal Garden

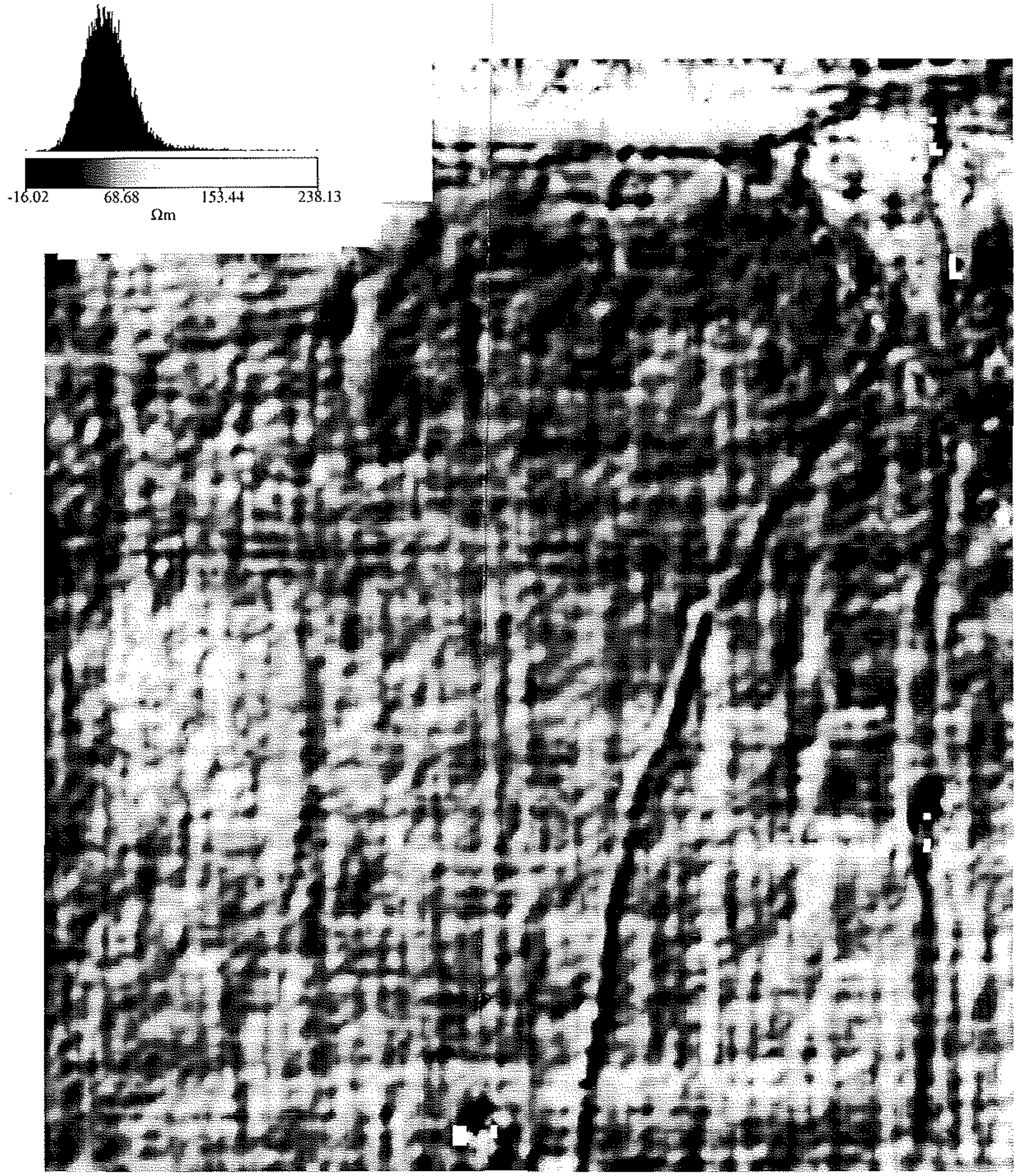
PLAN E

*1. High-pass filtered 0.5m resistivity data**





2. Directionally filtered 0.5m resistivity data†



* Linear greyscale plot of raw data after the application of High-Pass, Gaussian filter (radius = 7m).

† Directionally filtered raw data (single light source, azimuth = 45°, elevation = 5°) after suppression of linear EW anomalies.

0 ——— 90m

1:1000

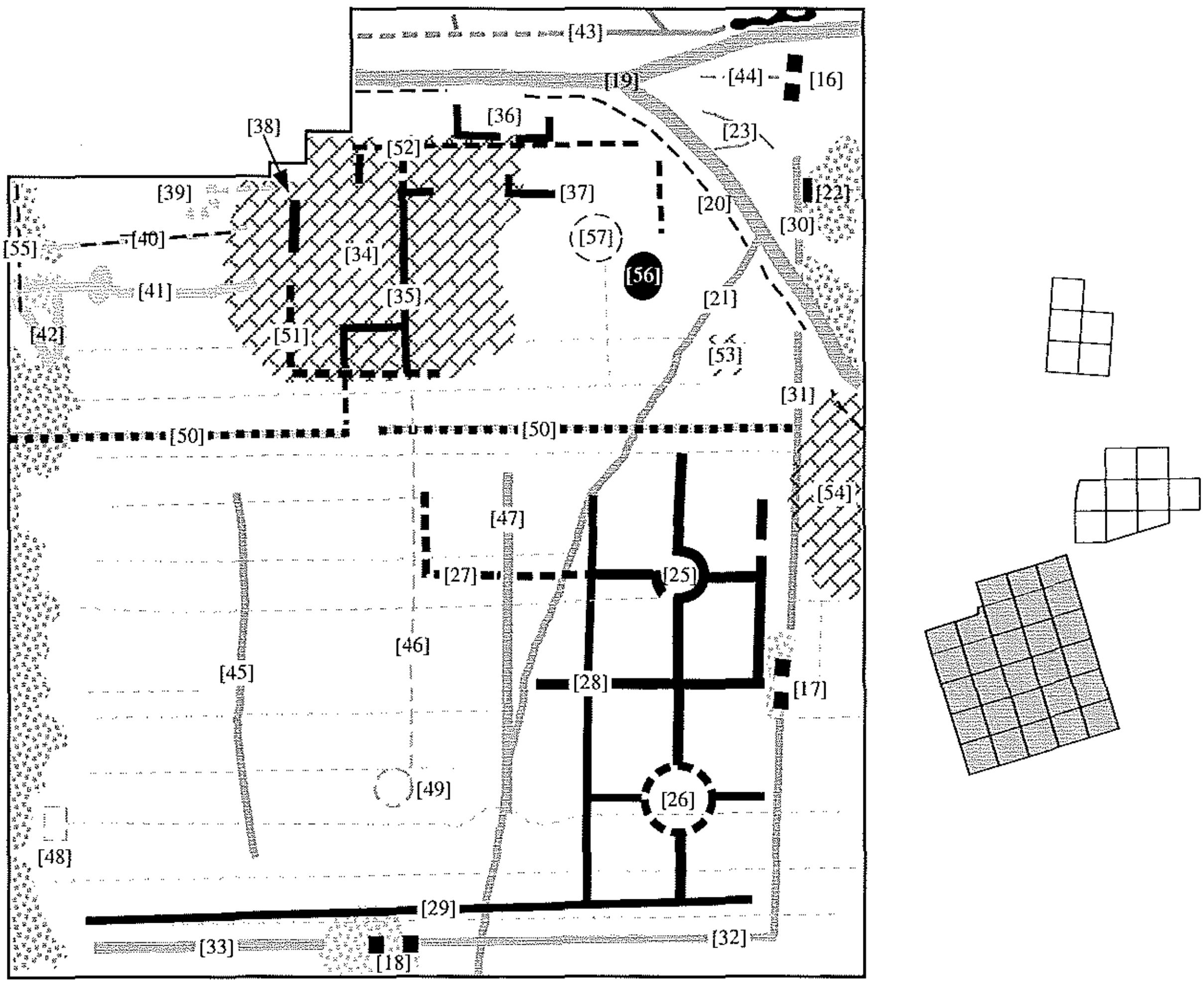
Ancient Monuments Laboratory 1996.

HAMSTEAD MARSHALL, BERKS.
Resistivity survey, May 1996.

PLAN F

Formal Garden

1. Summary of significant anomalies



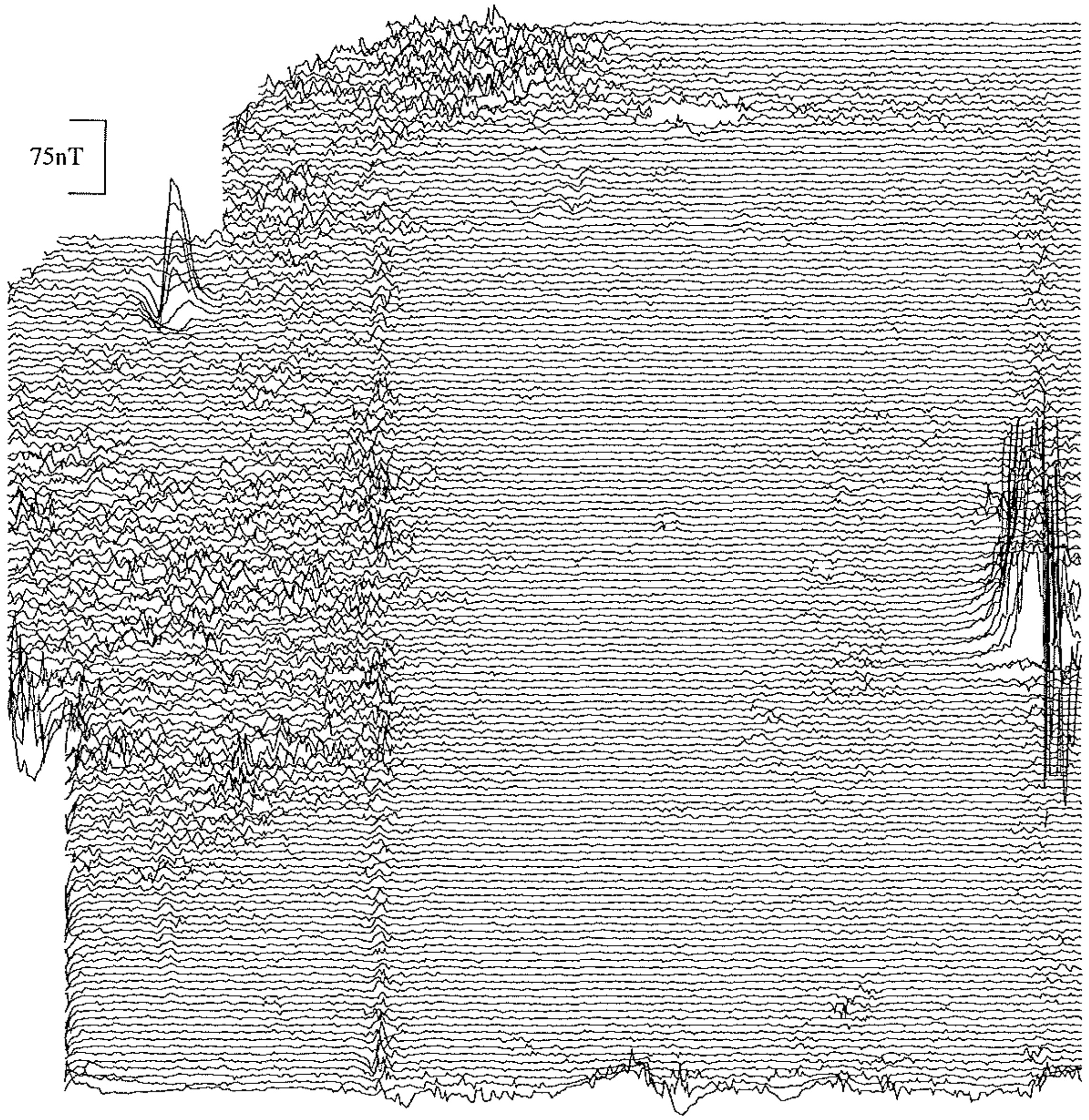
- *Standing gate piers*
- *High resistance anomaly*
- *Significant magnetic response*
- *Diffuse magnetic response (possibly brick rubble)*
- *Low resistance anomaly*
- *Diffuse low resistance scatter*
- *Drainage ditch?* [24]

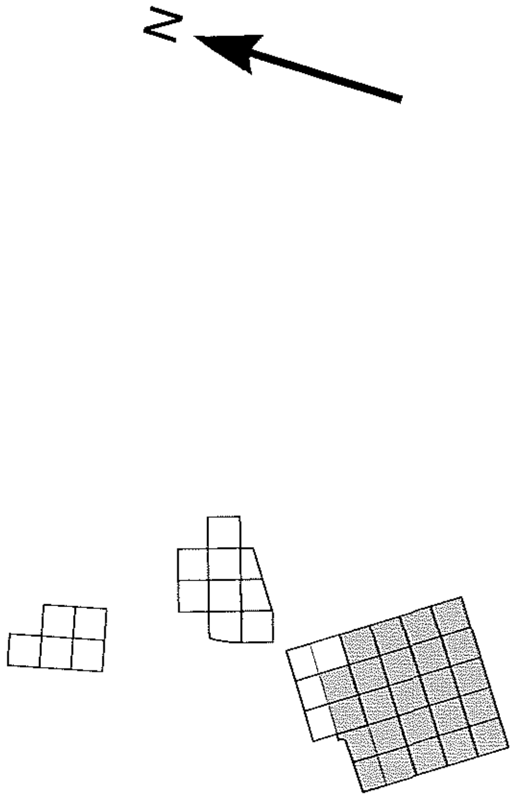
Ancient Monuments Laboratory 1996.

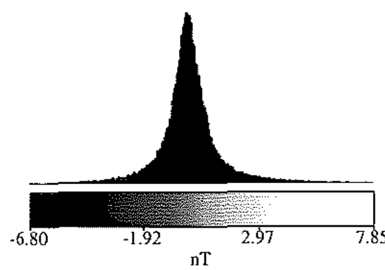
HAMSTEAD MARSHALL, BERKS.
Magnetic survey, November 1996.
Formal Garden

PLAN G

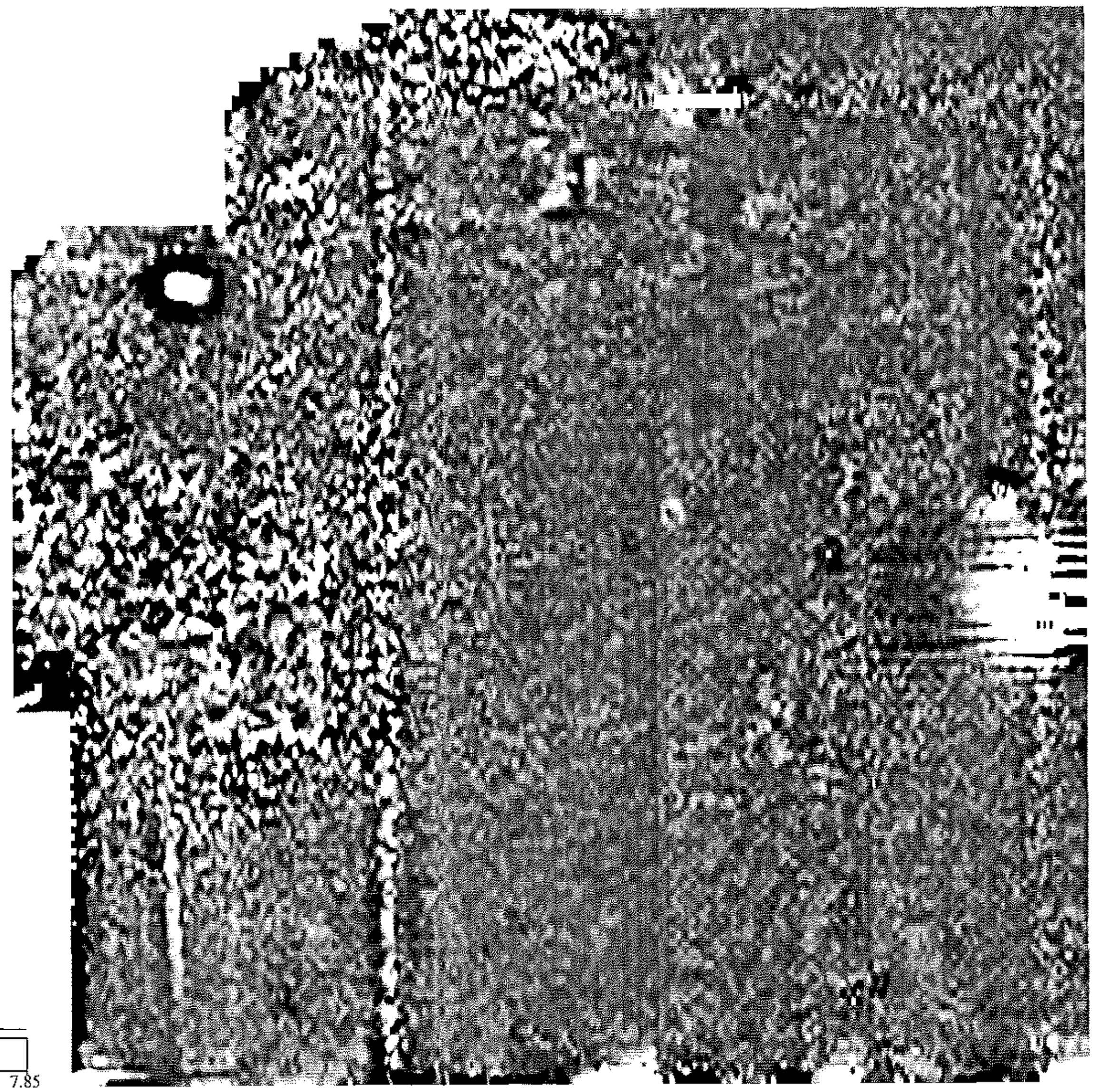
1. Raw magnetometer data.







2. Smoothed magnetometer data†



† Linear greytone of magnetometer data following convolution with a low-pass Gaussian filter (radius = 0.5m).

0 90m
1:1000

Ancient Monuments Laboratory 1996.