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Ancient Monuments Laboratory
Report 169/88

# GEOPHYSICAL SURVEY AT CONEYBURY HENGE, AMESBURY, WILTSHIRE, 1980

A D H Bartlett

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Summary

Coneybury was the first of several sites surveyed by the Ancient Monuments Laboratory as a contribution to the fieldwork programme undertaken by the Trust For Wessex Archaeology, which became known as the Stonehange Environs Project. The site is a small ploughed-out henge on a chalk subsoil, and offers conditions suitable for geophysical investigation by a variety of techniques. It was therefore used as a test site at which the findings from different survey methods could be compared. This was one of the first sites where intensive magnetic susceptibility surveying of a substantial area was attempted, and the results influenced the survey strategy adopted at other Project sites, as well as being of wider interest.

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# Geophysical Survey at Coneybury Henge, Amesbury, Wilts

NG: SU 13428 41599 (centre)

Dates of fieldwork: 26-28 August 1980
(excluding susceptibility survey)

## Introduction

This survey of the Coneybury henge was requested by the Trust for Wessex Archaeology (then known as the Wessex Archaeological Committee) in advance of their excavation of the site, which was directed (as were the investigations at other Stonehenge Environs Project sites) by Julian Richards. The intention was to excavate only a selected sample area, and to leave the remainder of the site intact. The trenches needed to be accurately located, and one immediate practical motivation for the survey was therefore to confirm the exact position of the henge ditch, which was known only approximately from aerial photographs. The site proved to be highly responsive to the magnetometer, and the ditch was readily located. The opportunity was also taken, given that conditions were favourable and the site was of manageable size, to compare the results produced by several different survey techniques, and to examine how they related both to each other and to the excavation findings. A detailed magnetic susceptibility survey was therefore carried out, and produced results of sufficient interest to prompt additional and more extensive investigations of this kind at other sites during the course of the Stonehenge Environs Project. (Geophysical results from the other Project sites are described in a separate AM Laboratory report.)

Both the geophysical work and the excavation were located by reference to a common site grid, which was centered within the henge as indicated by the magnetometer survey. The OS reference of the centre of the site grid was subsequently determined by the excavators as indicated on plan 1, which shows the position and approximate orientation of the four 30m survey squares. Plans 2 - 6 enclosed show the results from the various geophysical investigations and the soil phosphate analysis, and plan 7 summarises certain excavation findings for comparison. It it shows the excavation plan together with plots of flint distribution which are based on data provided by the excavator.

## Magnetometer survey

The ditch of the Coneybury Henge is cut into a hard chalk subsoil, and provided an exceptionally clear magnetic response. This was evident from an initial scan of the site, which was used to locate the survey grid in the required position. The four 30m squares were then surveyed using the standard AM Laboratory procedure. Fluxgate magnetometer traverses were recorded at 1m intervals to give results as shown on plan 2. ( The plots as reproduced here have been redrawn from a digitised version of the survey, and corrections have been made for instability in the instrument zero setting.) Plot (i) clearly shows the magnetic anomaly representing the ditch, with an entrance to the NW. There is an outlying feature to the N which was caused by a substantial pit, which was sectioned in the excavation. A density plot of the positive anomalies is also enclosed (ii). Here the ditch is surrounded by a band of low readings (white on the plot), which probably corresponds to a reduced depth of topsoil over the remains of the bank. The effect is most distinct towards the N of the plot.

Features within the henge did not respond very clearly to the survey, although there is perhaps some correlation between the pattern of weak anomalies near the centre of the survey and the shallow pits which were found in the excavation. These pits were less than 50cm deep and are at the limit of magnetic detectability.

**Resistivity survey**

Readings were recorded at 1m intervals using a Martin-Clark resistivity meter with twin electrode probe configuration and 0.5m probe spacing. The initial plot of the results (not reproduced here) showed a high noise level with some wild readings, which were probably caused by the probes striking flint nodules. The plots as reproduced show the data with extreme values eliminated, and after numerical smoothing. The most conspicuous feature in the graphical plot (i) is the band of low readings which corresponds to the ditch. The density plot (ii) shows positive anomalies only (ie values above the mean of the data) after filtering to emphasise the more localized variations in the survey response. This treatment has successfully brought out the bank, which is visible as a dark outer ring. The irregular outer edge of this feature suggests the bank has been much eroded, and that material has spread particularly to the E and W. The anomaly is slightly more distinct, as with the magnetic survey, on the N side of the henge. The outlying pit found by the magnetometer does not appear to have been detected.

**Magnetic susceptibility survey: field coil measurements**

This survey was carried out some time after the other geophysical fieldwork by Dr A J Clark. The Bartington MS1 susceptibility meter was used with a field sensor coil to take readings from a sample area which covered most of the interior of the henge, and extended across the ditch and bank to the NE as shown on plan 4. Readings were collected on a 1m grid with additional readings offset at the centre of each metre square.

In plot (i) the results are displayed according to a symbolic scheme in which the readings close to the mean are blank, and positive and negative anomalies are shown as squares and triangles respectively. This emphasises the extremes of the data, and serves to isolate a number of positive anomalies, the largest of which is immediately below the centre grid point as shown on the plot. Elsewhere in the plot the negative readings can be seen to align in an E-W pattern, which is perhaps an effect of cultivation, as with the spread of bank debris seen in the resistivity plot.

Plot (i) was prepared soon after the survey, and is based on the initial data with no further processing. These results suffer from a certain amount of instrument drift which causes horizontal discontinuities in the data, and so some further processing has been attempted to correct for this. In plot (ii) the drift has been suppressed by subtracting a least-squares baseline from each line of readings, and the results have been smoothed slightly. (The readings have also been resampled on to a 1m grid.) The full range of values as shown is displayed, rather than just the extremes. The readings for the density plot (iii) have been treated similarly, but only the positive anomalies are shown. In each case the largest anomaly can be seen to be the one near the centre as noted in plot (i). Other high readings can be seen in the entrance, and also close to the ditch, which perhaps suggests that magnetically enhanced ditch fill has been brought up by the plough. The field sensor coil as used here penetrates to a depth of about 120mm. It therefore responds only to the composition of the topsoil and cannot directly detect underlying features. The suggested E-W cultivation pattern is particularly clear in plot (iii).

**Susceptibilty measurements from soil samples**

A set of soil samples was collected from the site, and these were also measured for magnetic susceptibility using the same Bartington meter with the laboratory sensor coil. These results should intrinsically be more accurate (because they are not subject to errors caused by faulty contact between the field coil and the ground surface), but spatial resolution is lost because it is impractical to take as many readings as with the field sensor. Samples were collected at the centres of the shaded squares as shown on plan 5, and measured after drying. The high readings seen in the second and sixth rows of the plot could perhaps represent magnetically enhanced soil spread by ploughing from the positive anomalies seen in plan 4, but the correspondence is only very approximate, and there appears otherwise to be very little pattern to the data.

Relatively coarse susceptibility sampling has proved effective elsewhere in locating settlement sites, but it would appear to have little to offer here where there is little overall change in readings between the interior of the site and its surroundings, and the significant variations are on a smaller scale as indicated by the closely spaced field sensor data.

This lack of any broad shift in susceptibility values across the site was demonstated by readings taken using the field sensor along a line extending 60m to each side of the centre of the grid. These readings are shown superimposed on plot 5, and can be seen to vary around a fairly constant background level. Low readings are visible over the banks, and there are both high and low values within the henge. (The calibration of the field sensor coil as shown on the axis of this graph is inconsistent with the soil sample measurements, but this does not affect the interpretation, which is based on relative values.)

#### Phosphate survey

Samples were collected at 3m intervals (from sample points centred within the shaded squares as shown on plan 6), and were tested for phosphate content by D. Gurney of the Norfolk Archaeological Unit. Plot (i) shows variations in the initial data within a range of two standard deviations above and below the mean, and plot (ii) shows the positive anomalies only after smoothing, and filtering to remove background variations. It is difficult, as was the case for the susceptibility soil sample readings, to attach any specific interpretation to the results. The filtering appears to have isolated some anomalies within the henge in plot (ii), but their significance is unclear. The most conspicuous feature, visible in both presentations of the results, is a band of low readings towards the south of the survey. This corresponds approximately to the bank, but no similar effect was obtained from the bank elsewhere.

#### Flint distribution

The weight of burnt flint recovered from each 1m square of topsoil and subsoil was recorded during the excavation, giving values which are illustrated in plan 7 (plots ii - iv). The excavation plan is also included (i). The flint data provide an interesting comparison with the susceptibility findings. There is a pronounced peak in the total burnt flint concentration (with a value of 492 $g/m^2$) close to the centre grid point, and there is a cluster of other high readings (in the range 225 to 305 $g/m^2$) around the point labelled A immediately to the south. The high readings at A coincide with the susceptibility anomaly as shown on plan 4, but fall between the pits as shown on the excavation plan. This suggests, therefore, that the susceptibility anomaly is a consequence of past burning which has affected the properties of the topsoil only, and does not reflect the presence of deeper features. The lack of any significant corresponding increase in burnt flint concentration in the subsoil (plot ii) is consistent with this interpretation.

### Conclusions

Coneybury provided the opportunity to integrate and compare the findings from a number of surveying technques, and produced results which show the potential value of such an approach to problems of archaeological site investigation. The main findings can be summarised as follows:

The magnetometer detected the ditch of the henge with exceptional clarity, but the fact that pits some 0.5m deep were scarcely identifiable in the survey also showed that magnetic surveying has its limitations. The magnetometer sensitivity here was about 1nT, but improvements both in sensitivity and resolution would be desirable to achieve greater detail. The resistivity survey performed well in detecting a bank which was so severely ploughed out that it was not raised above the general ground level, and appeared to provide quite subtle indications of the extent and direction of erosion.

The results obtained with the susceptibility field sensor showed that, in spite of the high noise level associated with this type of detector, significant localized anomalies can be identified if the site is sampled closely enough. The results produced further evidence of plough damage consistent with the resistivity findings, and a remarkable correspondence between the susceptibility anomaly and flint concentration near the centre of the site was observed by the excavator. This suggests that evidence of genuine archaeological features which are defined only by variations in the composition and magnetic properties of the topsoil can be recovered by this method. The lack of equivalent findings from the results based on soil samples shows the value of intensive sampling, and also that this site is different in character to a settlement, where broad variations in susceptibility and phosphate values would usually be evident.

The application of a full range of physical and chemical investigation techniques to the site has therefore provided evidence not only of its plan and state of preservation, but has also produced findings which tempt speculation about the distinctive nature of the activites which took place there. A picture begins to emerge which is more complete than any single investigation technique, or even excavation by itself, could provide.

Surveyed by:

A D H Bartlett, A E U David, Dr A J Clark

Date of report:

July 1988

Acknowledgements

The phosphate analyses were carried out by D Gurney of the Norfolk Archaeological Unit on behalf of the A M Laboratory. The excavation director, Julian Richards of the Trust for Wessex Archaeology, supplied the site plan and the flint data on which the plots shown in plan 7 are based. I wish to thank Mr B Turton for the provision of computing facilities used in preparing this report, which also owes much to the accounts of the Coneybury survey as given in the papers by Dr Clark noted below. Errors of fact or interpretation remain the responsibility of the present writer.

References

Reports on the Coneybury survey have been included in the following publications by Dr A J Clark:

Archaeological Geophysics in Britain: Geophysics, 51, No. 7, July 1986, 1404-1413

The Testimony of the Topsoil: *in* Maxwell, G S , Ed, The impact of aerial reconnaissance on archaeology: CBA Research Report 49, 1983, 128-135

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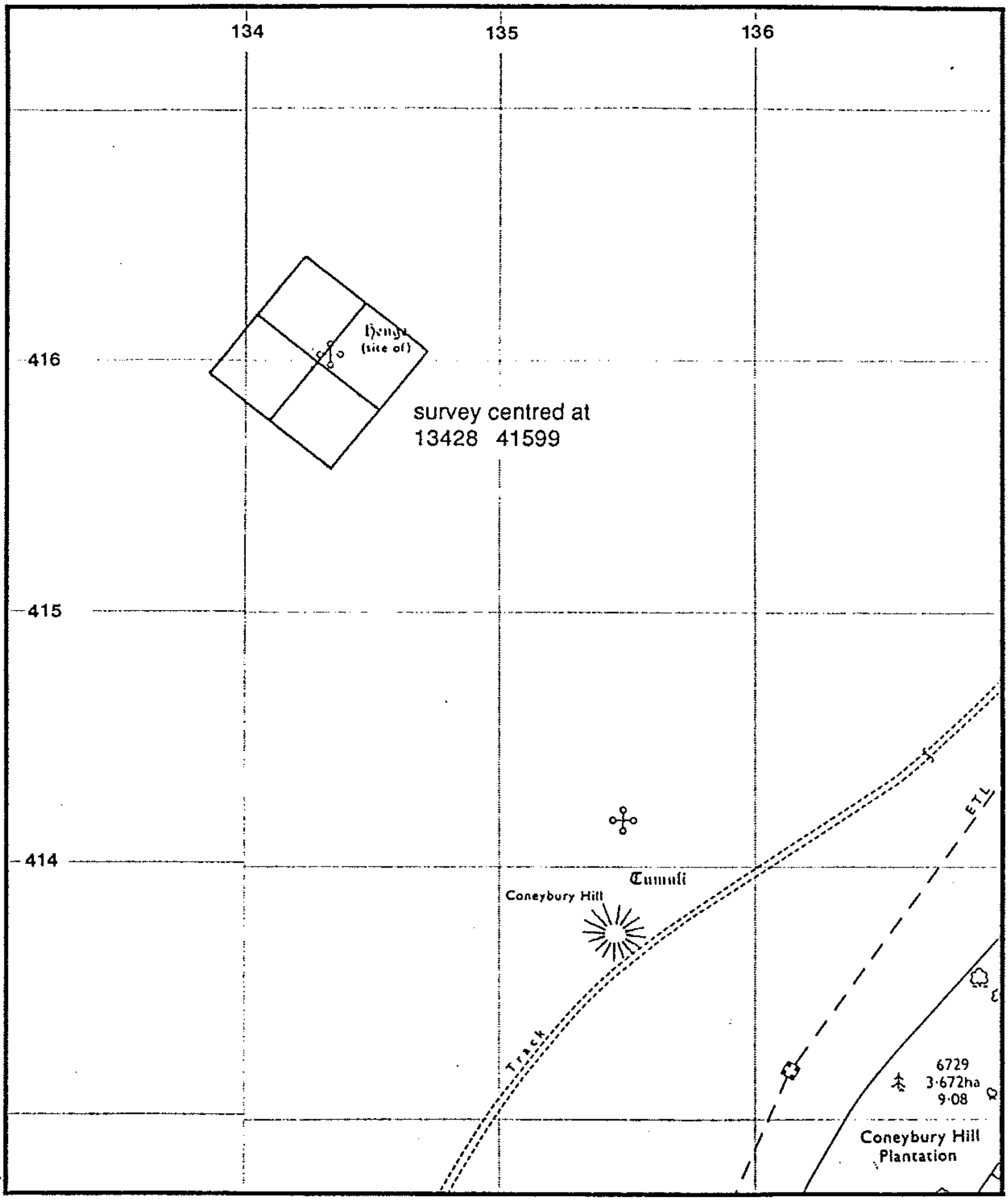
(Seven plans are enclosed with this report)



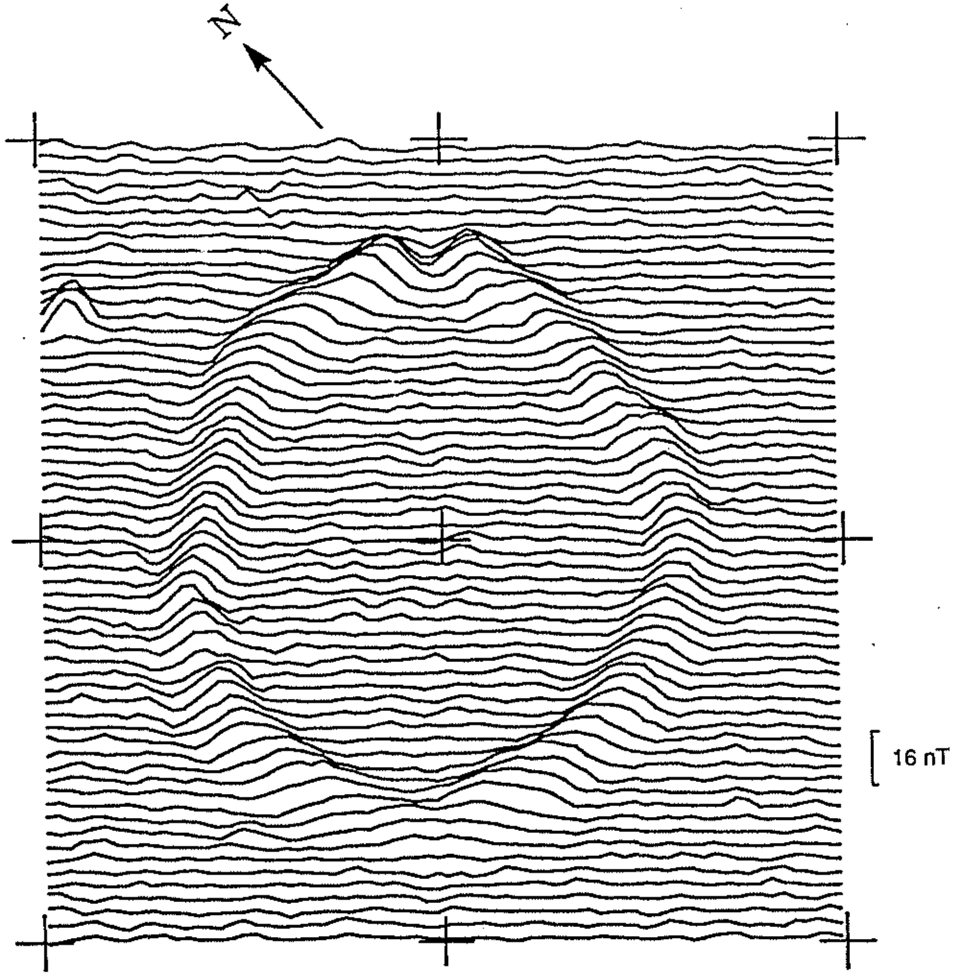

# Coneybury Henge

Location of geophysical survey

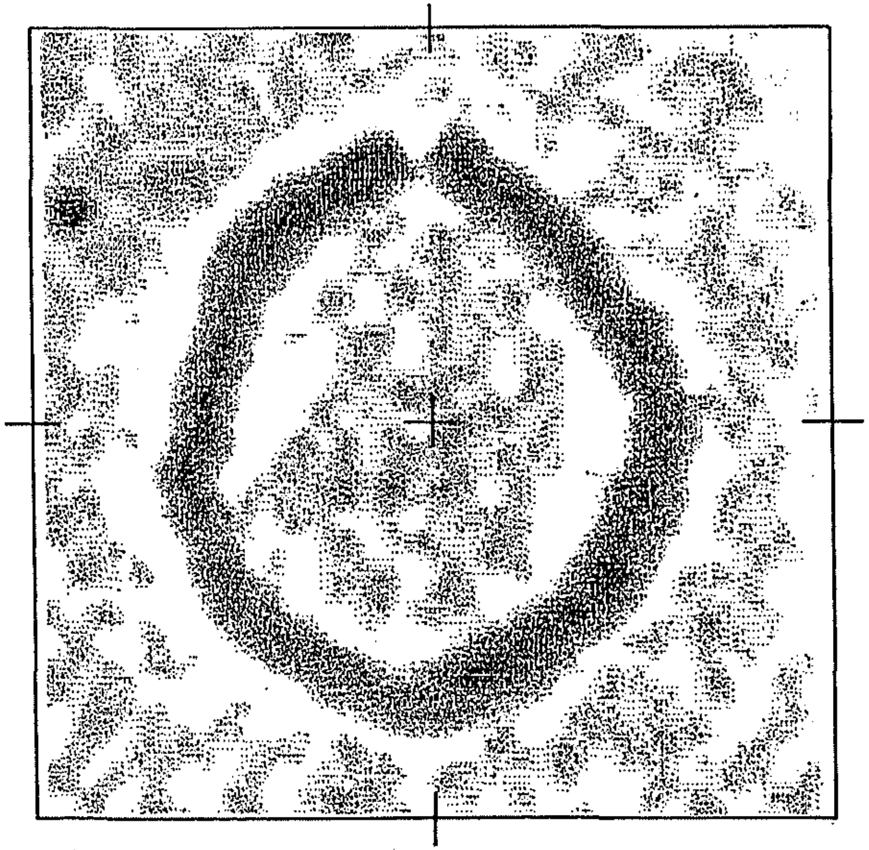
1:2500

A M Laboratory

AB




(i) Data corrected for zero drift



(ii) Positive anomalies

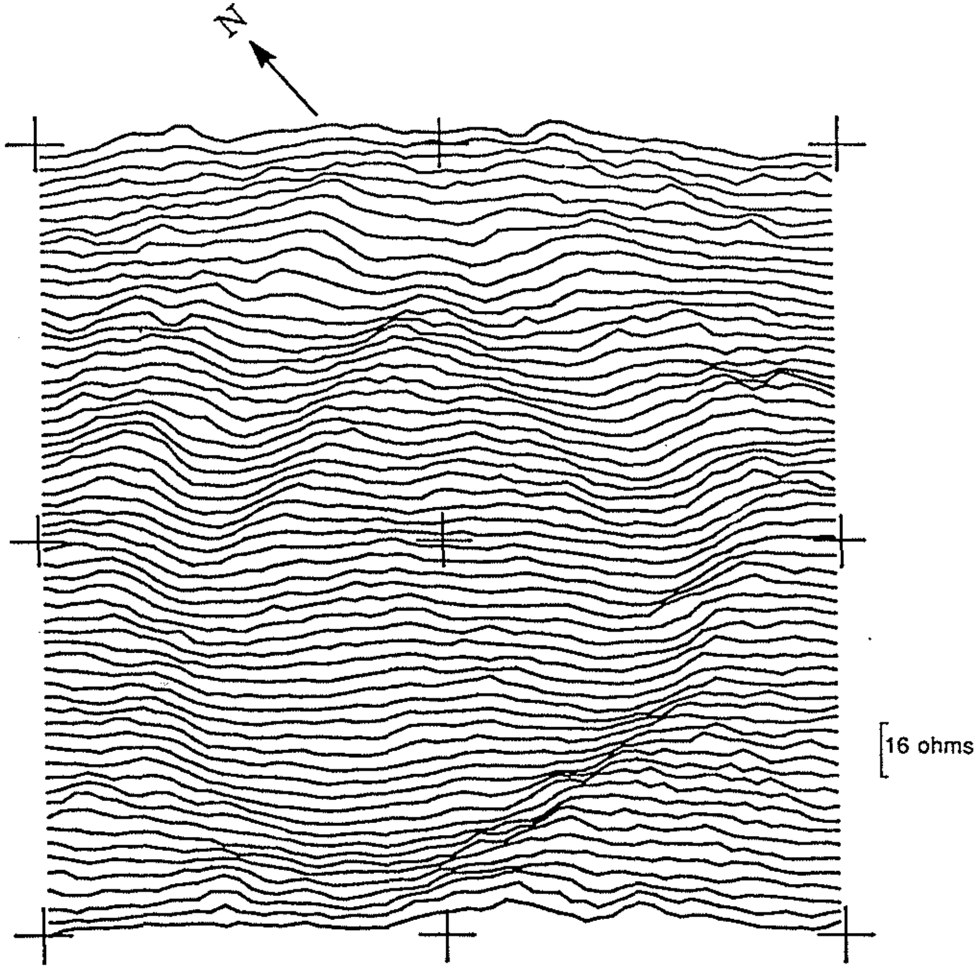
(display range: 0 - 7 nT)


Coneybury Henge

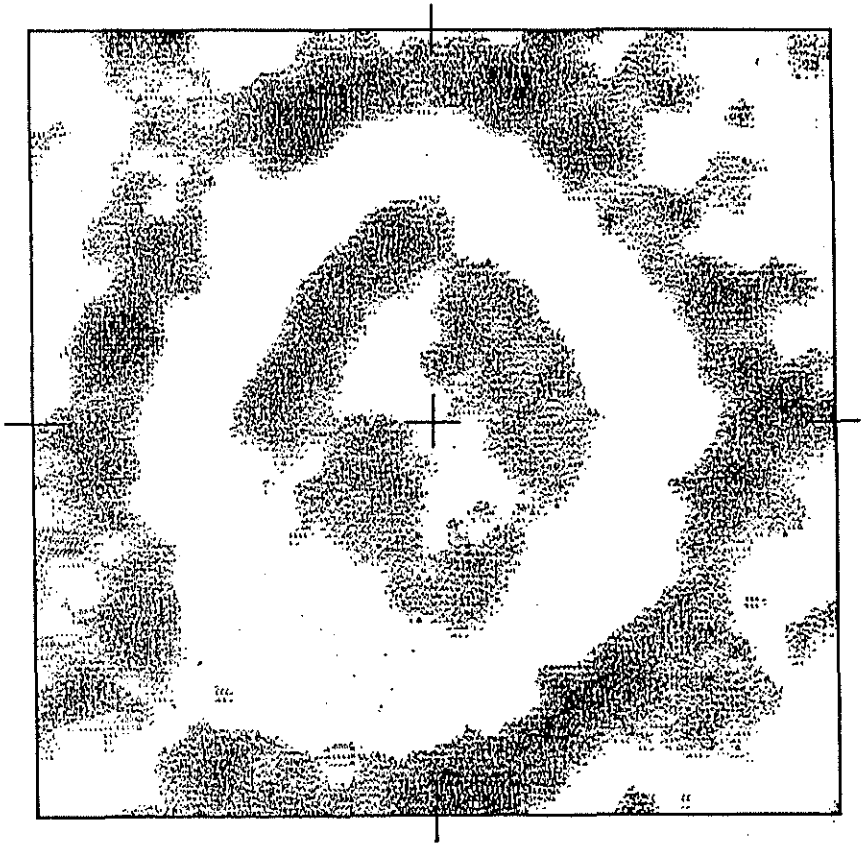
Magnetometer survey

A M Laboratory

A B




(i) Smoothed data



(ii) Smoothed and filtered data; positive anomalies

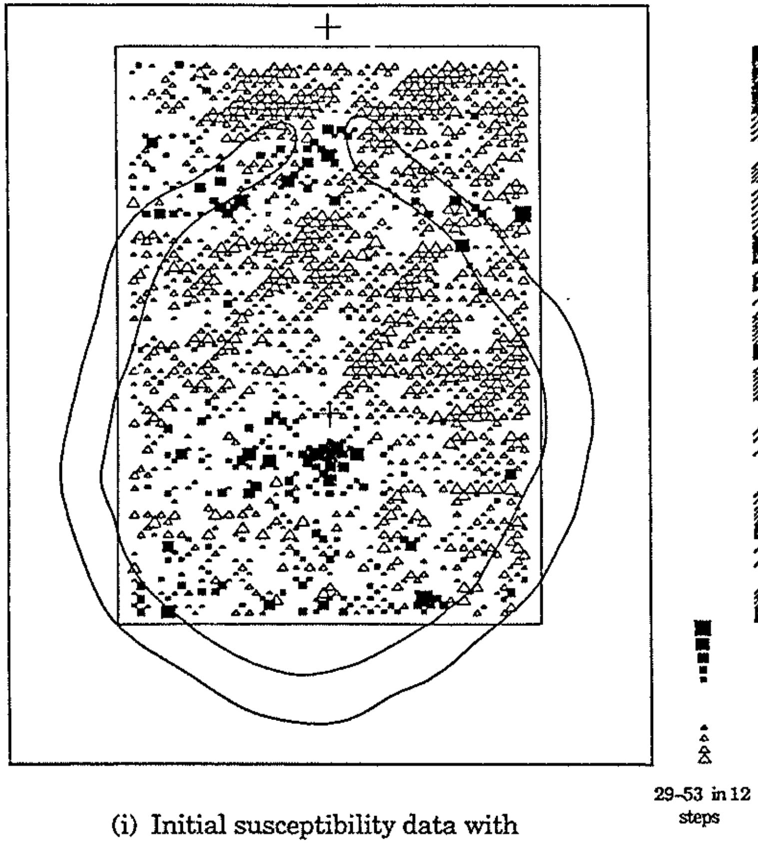
(display range: mean to mean + 2 sd)


Coneybury Henge

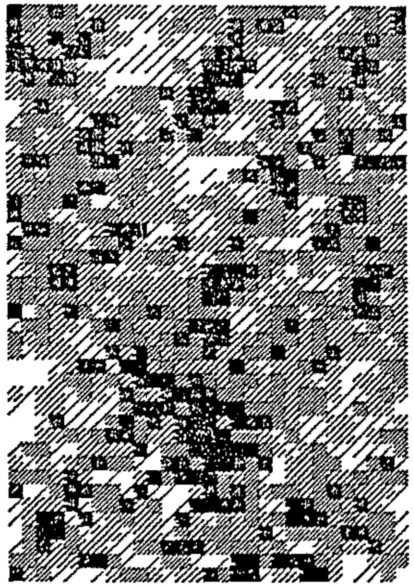
Resistivity survey

A M Laboratory

A B

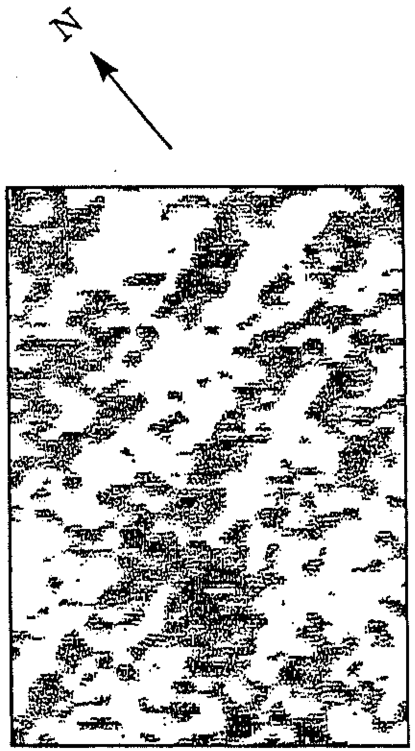



(i) Initial susceptibility data with interpretation of magnetometer survey
(after Clark, 1983)

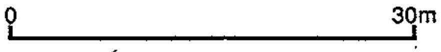


(ii) Smoothed data

(display range: mean - 2 sd to mean + 2 sd)




(iii) Smoothed data: positive anomalies
(display range: mean to mean + 2 sd)

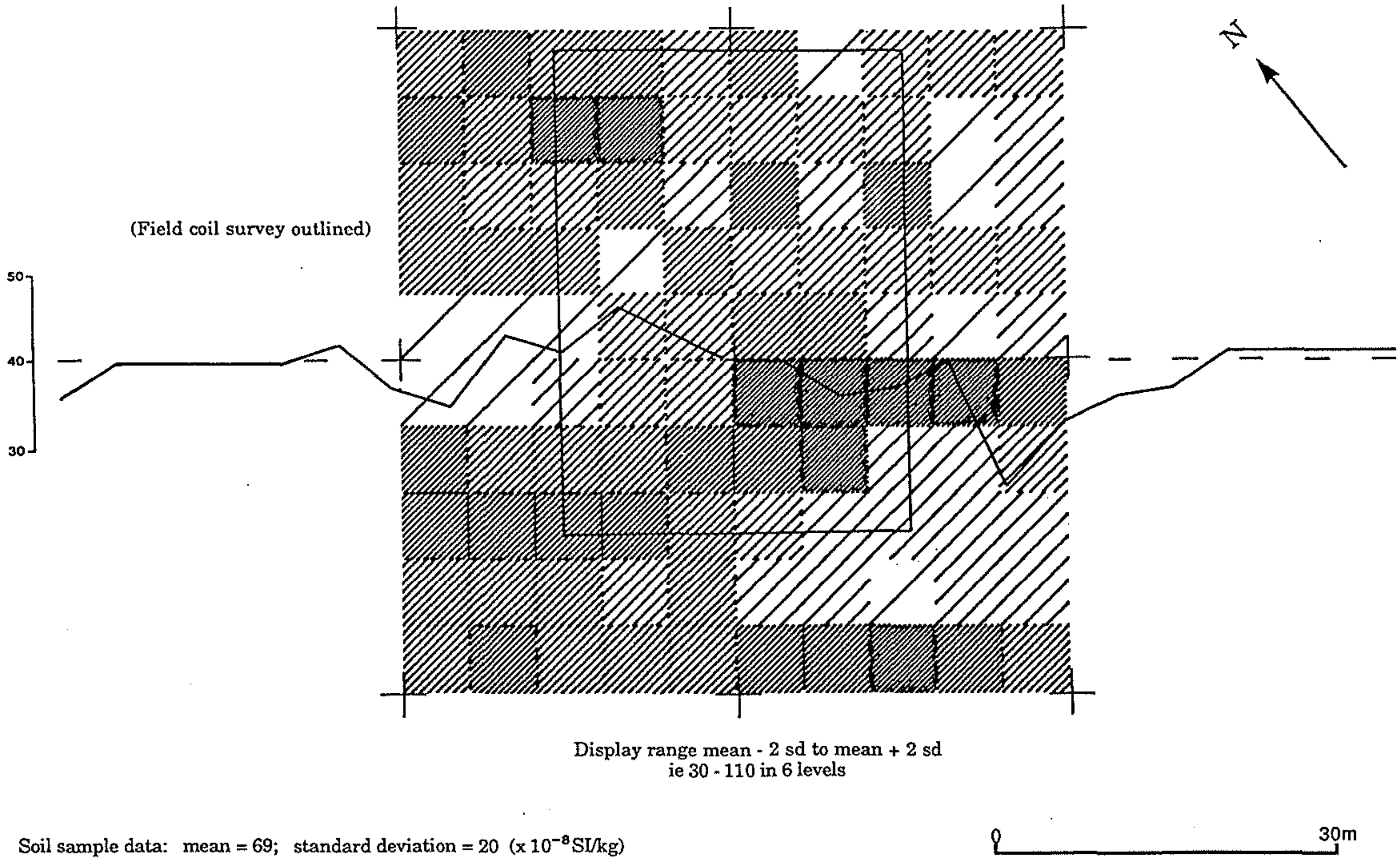



Initial data: mean = 37; standard deviation = 4 (x $10^{-8}$ SI/kg)

# Coneybury Henge
## Magnetic susceptibility survey

A M Laboratory

AB




Display range mean - 2 sd to mean + 2 sd
ie 30 - 110 in 6 levels

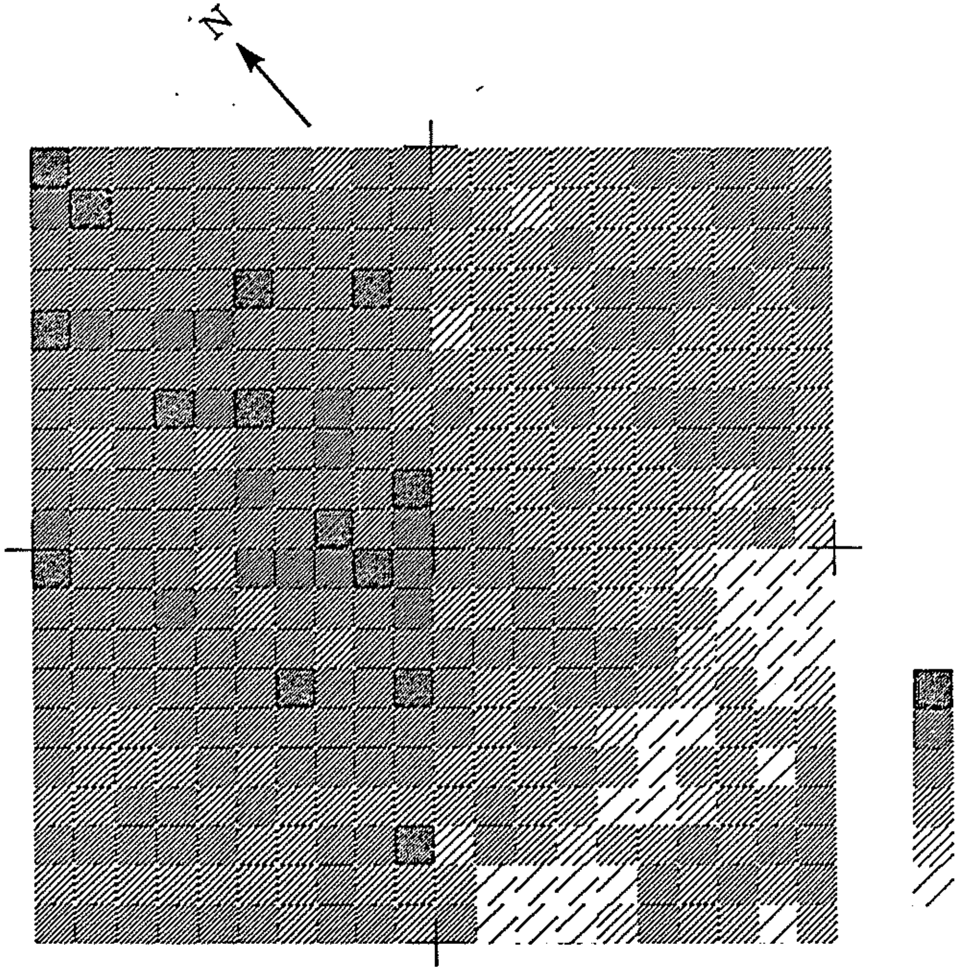
Soil sample data: mean = 69; standard deviation = 20 (x $10^{-8}$ SI/kg)

# Coneybury Henge

Magnetic susceptibility survey (soil sample measurements)
+ Traverse across site (field coil readings)

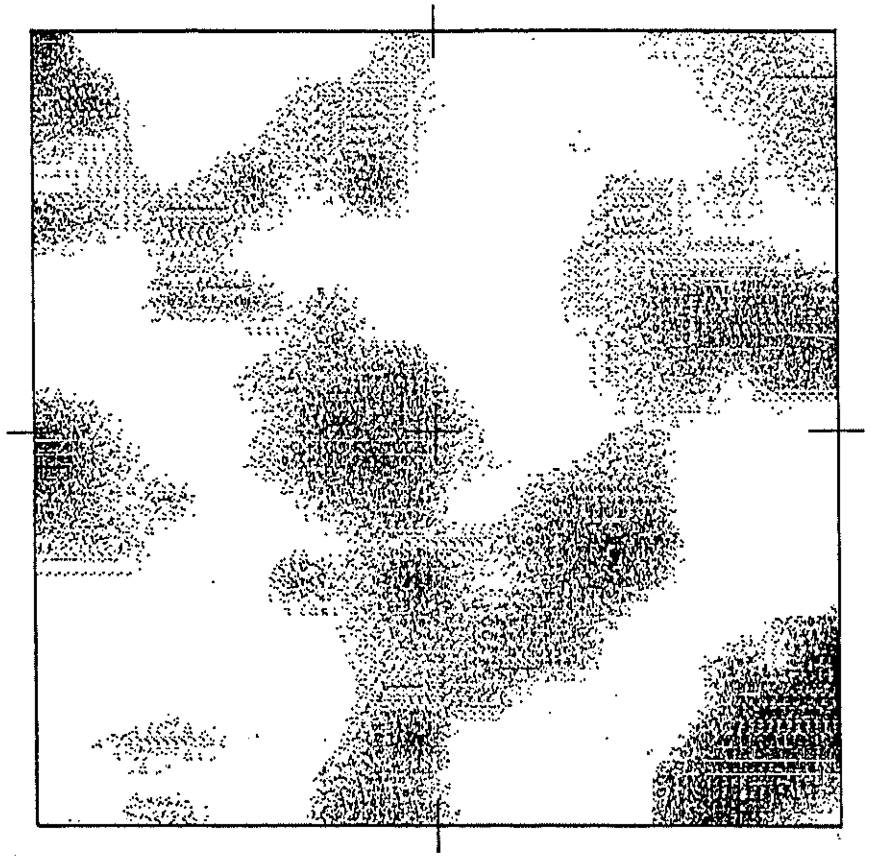
A M Laboratory

AB




(i) Initial data

(display range: mean - 2 sd to mean + 2 sd
ie 46 - 126 in 6 levels)



(ii) Smoothed and filtered data; positive anomalies

(display range: mean to mean + 2 sd)

Initial data: mean = 86
standard deviation = 20 (mg P / 100g)

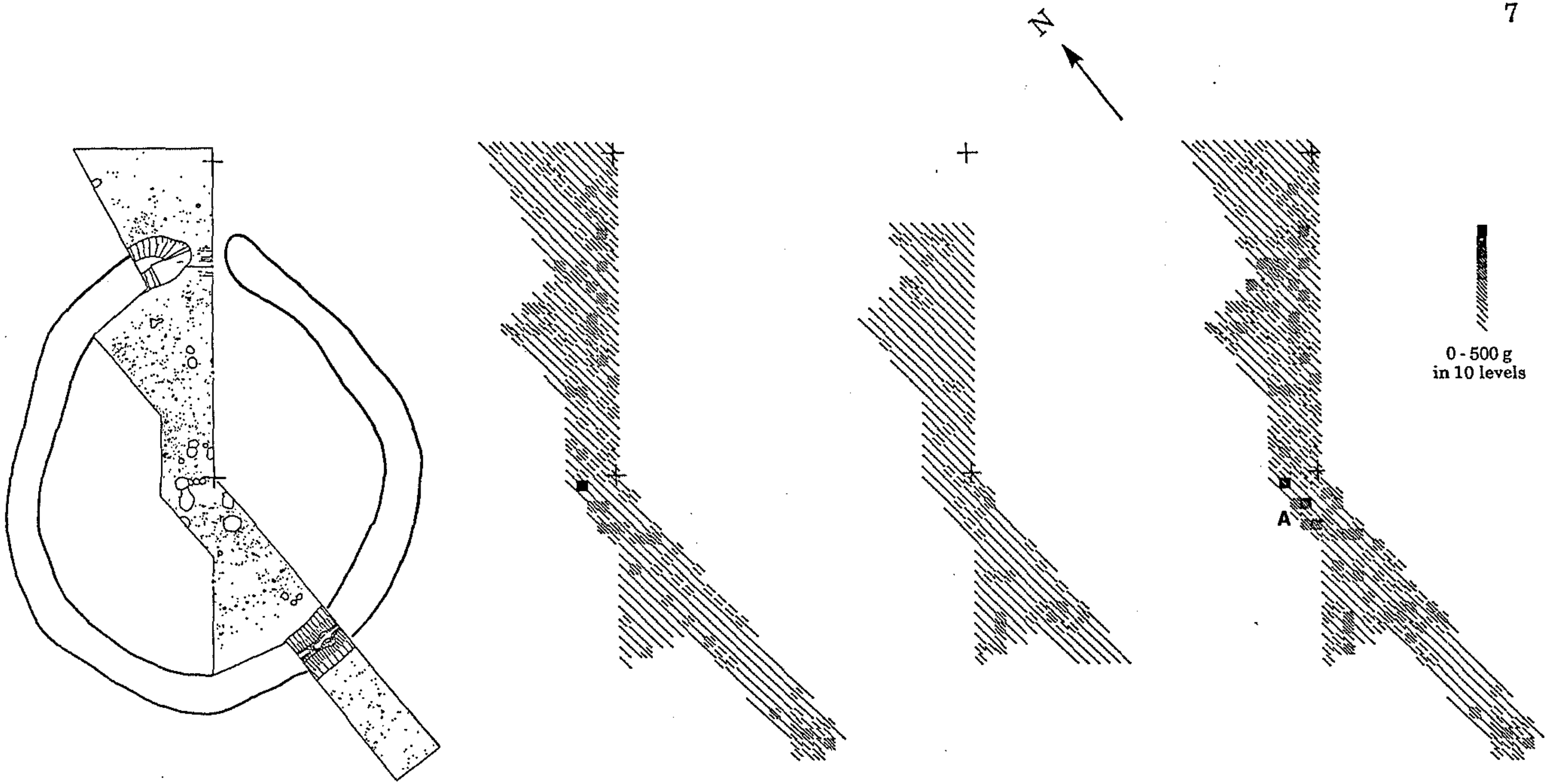
0 30m

Coneybury Henge
Phosphate survey

A M Laboratory

A B

7




(i) Excavation plan (ii) Topsoil flint (iii) Subsoil flint (iv) Total flint

(outline of ditch traced from magnetometer survey)

(Weight g/m²)

0 30m

# Coneybury Henge

Excavation plan and
Distribution of burnt flint

A M Laboratory

A B