WROXETER DEFENCES

A geophysical survey, 1989

By Alex Jones

Birmingham University Field Archaeology Unit (BUFAU) 1990

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1.0: INTRODUCTION

In August 1989 a team from Birmingham University Field Archaeology Unit undertook a small geophysical survey across the line of the north-west angle of the civil defences of the Roman town of Wroxeter, in Shropshire (centred on NGR. SJ 5678 0926).

The aims of the survey were:

(1) To investigate the response of resistivity survey to the anticipated man-made features in their natural surround, and

(2) To define the nature and extent of sub-surface features in this area.

Aerial photographs of the survey area appear to reveal cropmarks representing a line of small circular features immediately behind the defences, and following their alignment (Baker, 1970). These features have been interpreted as the post-holes for the timber uprights of a defensive bastion.

A small sample area (30m by 20m) was selected for survey in the plotted position of the cropmarks. Topographically the site occupies the lower part of a gentle north-east-facing slope. The area was formerly under intensive arable cultivation but reverted to pasture in 1989 under an English Heritage management agreement.

2.0: PRINCIPLES AND METHODS

2.1: Resistivity

A resistivity survey was considered to be the most appropriate technique of examination, given the nature of the subsoil and the features anticipated. Resistivity survey and crop-mark recognition alike depend on the detection of localised differences in soil constituents. These may vary considerably in resistivity depending on water-content, and provide either encouragement or hindrance to crop growth. Detailed measurement of ground resistance from place to place can detect subtle changes (anomalies) in the near subsurface, caused by natural processes or man-made features, such as walls, ditches and postholes. Water-retentive materials, such as clay, are of low resistivity, whilst stone-filled features have a higher resistivity, due to their low water content which impedes the flow of electricity.

The technique cannot distinguish between differing soils of similar resistivity, and anomalies may disappear or reverse during the climatic cycle. Small anomalies may not be visible because of the coarseness of the survey; or may be caused by poor electrical contact due to bad planting of the electrodes. Slight distortion of anomalies can occur along traverse lines.

All geophysical methods of examination provide only an indirect method of site investigation. They are incapable of the same precision and complexity in recognition or interpretation as a direct method of examination, such as excavation.

2.2: Field techniques

A Geopulse resistance meter was used in conjunction with a 0.5m dimension 4-electrode square array. The square array comprises a frame in which all four electrodes are positioned at the corners of a square (modified Wenner) array. Readings of resistivity were obtained by grounding the electrodes at 0.5m intervals along contiguous traverses 0.5m apart; the same electrode orientation was maintained throughout the survey. A 1mA current was injected into the ground through two electrodes, the potential difference or ground resistivity (alpha values only) being measured across the second pair. One measurement was made per point: little gain in accuracy was achieved here when averaging four cycles of measurement per point. During each cycle twenty samples (measurements) are taken while the current is flowing into the ground (ion), and ten measurements while no current is flowing (ioff). When combined, the ion, ioff samples, and number of cycles determine the shape and duration of the pulse sent out by the meter, and therefore the sensitivity of the meter to the particular conditions of each site. Data was logged directly onto a linked micro-computer and stored on disk on completion of the survey. The effective depth of investigation depends on ground conditions, and the separation of electrodes, here 0.25m (Edwards 1977).

2.3: Data processing

A menu-driven graphics package on an IBM-compatible micro-computer was employed to provide on-screen interpretation of the data, and the illustrations for this report in the form of dot-density plots. These computer-generated plots highlight the areas of anomalies, represented by darker shading in areas of higher-than-average resistivity, and lighter shading in areas of lower-than-average readings. The plots discriminate sensitively between slight variations in recorded resistivity, and permit analysis of the outline, strength and spatial distribution of differing values within each anomaly. Figure 2A emphasises the areas of higher resistivity by the use of a logarithmic progression in shading. The interpretative plot (Figure 2B) is an inverse dot-density plot, where most dots occur in areas of low resistivity. Both plots depict resistivity values above the mean average of background readings for the area, and extreme high readings have been partly truncated.

After recognition and definition, anomalies may be interpreted as either of natural or man-made formation. Interpretation relies on comparison with the surrounding topography and the shape, strength and sharpness of outline of the anomaly itself. Here interpretation of results was assisted by comparison with the plotted air-photographic evidence.

3.0: THE RESULTS (Figure 2A, 2B)

Readings of background resistivity in the survey area ranged between 15–35 ohm metres. In the western half of the survey a series of parallel, roughly linear bands of high resistivity (P) *ca.* 2m wide and *ca.* 2m apart may be defined, measuring 20% greater than background. A line of single point anomalies (A2) of low resistivity suggests the location of a quantity of buried metal or stone-free soil in these areas.

The main archaeological feature in the west area of the survey is a rectangular anomaly (A1), aligned north–south and measuring 4m across and 12m in length. A1 measures 45–60 ohm metres. It is less well defined against the linear bands of high resistance (P), but is more clearly defined against the areas of background resistivity.

To the east of the road further linear anomalies may be defined (A3, A4), in parallel alignment with the linear bands previously described (P). These eastern anomalies may be distinguished by their greater strength and markedly different outline.

A well-defined elongated anomaly (A3) measures 3m in width, containing values over 25% greater than the surrounding background. Within A3 the highest values of resistance are concentrated along its north-east edge. A4, parallel with A3, is a 2m-wide anomaly of low resistance, in the range of 30–40 ohm metres, and clearly defined outline throughout.

To the east of A4 are two anomalies of high resistivity, A5 and A6, roughly D-shaped in outline. They may be defined as areas of resistivity in the range of 40–60 ohm metres. A narrow band of higher values (A10) joins A5 and A6, but to the east values fall off gradually and its extent is difficult to define.

The most distinct anomaly in the survey is A9, aligned approximately north–south and measuring up to 7m across; it continues beyond the survey area. This is a band of low resistivity, irregular in outline, defined by values measuring 15–30 ohm metres.

Two anomalies (A7, A8), may be defined within A9. A7 is roughly oval, measuring 2m by

4m; A8 measures 2m by 3m but is more difficult to define spatially, or by its strength. A third area of higher resistivity enclosed within A9, south of A6, cannot be defined with clarity.

4.0: DISCUSSION AND INTERPRETATION

Care is required in the interpretation of results from such a limited area. A larger survey would allow the recognition and interpretation of wider archaeological and geological patterns of anomalies. The recognition of archaeological anomalies is also impeded by the comparatively narrow range of resistivity values represented here. It was not possible to auger the areas of anomalies to cross-check their physical composition.

However, it is possible to locate and define a number of archaeological features in the survey area. The pattern of alternate bands of high and low resistivity in the western area (P) may derive from ridge-and-furrow ploughing. Despite this plough pattern, also recorded in aerial photographs, a large, rectilinear stony feature (A1) has been located. This broad, stony feature may be interpreted as an area of hardstanding leading to an opening in the defences. A road has been identified from aerial photographs, but its alignment differs from A1. The anomaly A1 is located in an area where a series of post-holes has been located by aerial photography. Anomaly A2 may be interpreted as a scatter of metal, or possibly small stone-free features. Other single-point anomalies in the western area are caused by poor electrical contact, and should be disregarded.

To the east of the road the results exhibit some correlation with the evidence from aerial photography, and the plough pattern is not present. The broad, low-resistivity anomaly to the east (A9) may be interpreted as a defensive ditch, with a stone-free clay-silt fill. A7 and A8 are stonier areas within the ditch, possibly associated with the defences. A5 and A6, well-defined anomalies located on the edge of the ditch A9, and the narrow, linear anomaly (A10) may be evidence of components of a bastion platform jutting out into the line of the ditch, first located by aerial photography (Baker, 1970).

Behind A10 is an area of low resistivity (A4), possibly containing clays and silts, perhaps material from the excavation of the ditch; this may be the remains of the berm. A well-defined, broad band of higher resistivity (A3) west of A4 may be a stone-filled feature parallel with the line of the defences, an area of stone rubble, or the footings of the town wall.

5.0: IMPLICATIONS AND PROPOSALS

The results of this survey, albeit limited in scope, are of some significance to the further study of the defences and the town of Wroxeter. This exercise has demonstrated the usefulness of this rapid and non-destructive archaeological technique. Geophysics offers an exciting opportunity to investigate wider areas of the defences, town and vicus, as yet unexplored, except by aerial photography (for example Wilson, 1984).

Further, larger scale, geophysical survey, targetted intially along the line of the defences, would provide important, new and more detailed information, and allow for cross-comparison with the plotted aerial photographic evidence.

It is proposed that this further non-destructive academic study be combined with a training programme for students of archaeology, under professional supervision. Further geophysical survey of the defences should ideally be accompanied by limited excavation (for a research design see Baker 1990). This will allow the indirect evidence from the wider geophysical survey and aerial photography to be 'controlled' by the direct evidence obtainable from excavation.

6.0: ACKNOWLEDGEMENTS

We are grateful to the landowner and Mr Jeremy Milln of the National Trust for permission to carry out the survey. Mr Arnold Baker advised and assisted on site. Simon Buteux managed the project and edited this report, and Tony Clarke asssisted with the fieldwork. Geophysical survey equipment was lent by Campus Geophysical Instruments, Birmingham University. We are grateful to Philip Barker and Mike Corbishley (HBMCE) for their interest in the project.

6.0: REFERENCES

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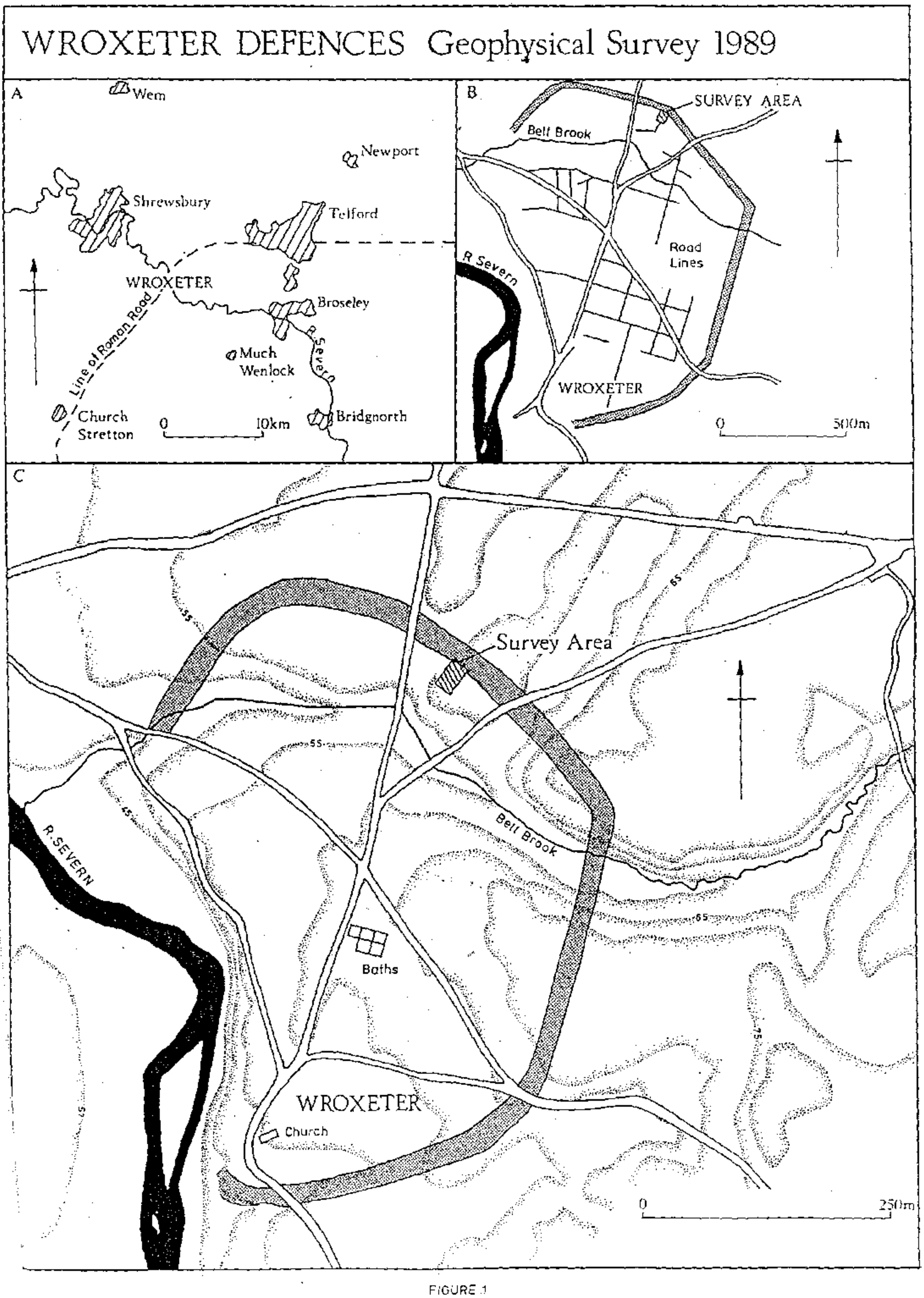
WROXETER DEFENCES Geophysical Survey 1989
A
Wem
Newport
Shrewsbury
Telford
WROXETER
Line of Roman Road
Broseley
R Severn
Much Wenlock
Church Stretton
0
10km
Bridgnorth
B
SURVEY AREA
Bell Brook
R Severn
Road Lines
WROXETER
0
500m
C
Survey Area
55
65
R.SEVERN
Bell Brook
Baths
WROXETER
Church
75
0
250m

FIGURE 1

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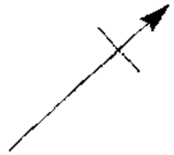
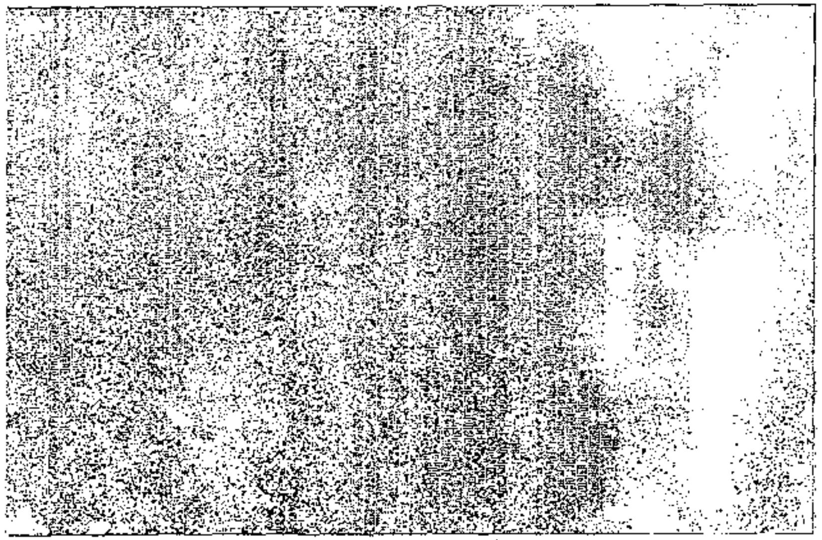
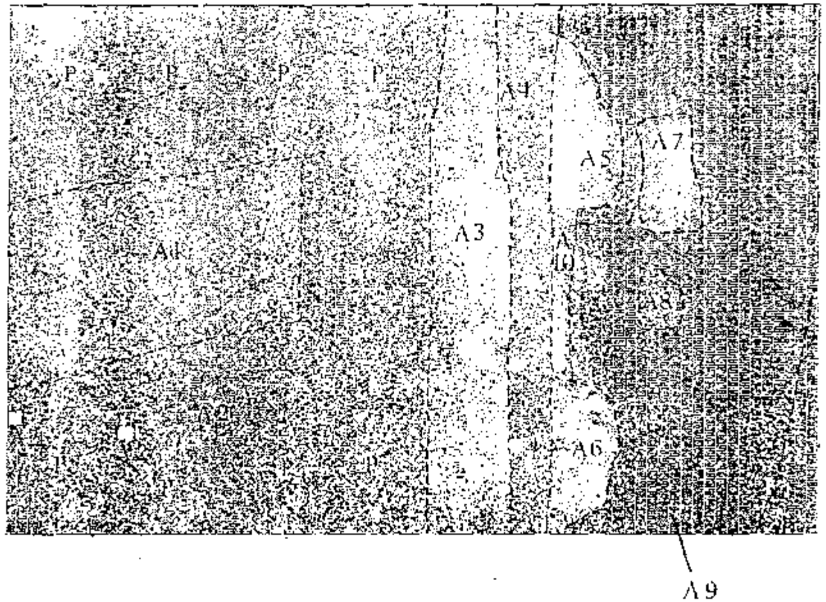
Dot Density Plots of Resistivity



a



b Interpretation: Inverse Plot



Key

A 1-10 Archaeological anomaly
P Plough patterns

FIGURE.2.