Analecta Praehistorica Leidensia 28 / Interfacing the past : computer applications and quantitative methods in archaeology CAA95 Vol. II
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ANALECTA
PRAEHISTORICA
LEIDENSIA 28

PUBLICATIONS OF THE INSTITUTE OF PREHISTORY
UNIVERSITY OF LEIDEN

INTERFACING THE PAST

COMPUTER APPLICATIONS AND QUANTITATIVE METHODS IN ARCHAEOLOGY CAA95 VOL. II

EDITED BY
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UNIVERSITY OF LEIDEN 1996

Graphic design: Henk de Lorm

Computer graphics: Peter Heavens

Copy editor: Marianne Wanders

ISSN 0169-7447

ISBN 90-73368-10-3

Subscriptions to the series Analecta Praehistorica Leidensia and single volumes can be ordered from:

Institute of Prehistory
P.O. Box 9515
2300 RA Leiden
The Netherlands

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Martijn van Leusen

Extending GIS Methods for Regional Archaeology: the Wroxeter Hinterland Project

1 Background

In September 1994 a 3 year research project to study the Roman town of Wroxeter and its hinterland was started at the University of Birmingham Field Archaeology Unit (BUFAU). The project is funded jointly by the University and the Leverhulme Trust, and aims to take forward many aspects of regional archaeological research in Britain, including the application of GIS and remote sensing in both the design and analytical stages, the close involvement of the local community, and the study of urban-rural relations. This paper, the first in a series that will describe the progress of the Wroxeter Hinterland Project, sets out our intentions and preliminary results, concentrating on innovative uses of GIS.

1.1 The research area

Wroxeter, located between the modern towns of Shrewsbury and Telford (county Shropshire; see fig. 1), was the Roman Civitas capital (named *Viroconium Cornoviorum*) of the Cornovii, an Iron Age tribe that is thought to have lacked a centralised structure before the arrival of the Romans in the mid-first century AD (fig. 2). Yet, at 64 hectares, Wroxeter has the fourth largest walled area in Britain and preliminary geophysics results have already shown it to be much more densely settled than was thought previously. How could such a large and, given the splendour of its public buildings, rich town develop and prosper in a region that was both economically and politically peripheral? What was its economic and social basis? These are questions that can only be answered by a study of the towns' hinterland, the area that must have contained some of the pre-Roman tribal elite, and must have formed the main economic basis for day-to-day life in the town. This hinterland must have extended at least as far as the nearest major natural boundaries and the next nearest minor towns - an area of some 30 by 40 km.

1.2 The archaeological evidence

A compilation of existing archaeological records has resulted in a database of some 1600 pre-Norman Conquest (AD 1066) 'sites', the bulk of which belongs to the Iron Age and Roman periods. Very little targeted surface archaeological research has been done in the area, the records consisting mainly of reports of chance finds and of crop or soil marks discovered by aerial archaeology (Whimster 1989). Site distributions may be heavily influenced by differential preservation and visibility effects, and reporter bias.

2 Use of GIS in the Project

The Wroxeter Hinterland Project is designed to study the settlement history and the various processes of Romanisation in the study area from the Later Pre-Roman Iron Age down to the sub-Roman period. The design incorporates GIS at a number of levels:

- as a data management tool, to hold data sets originating at multiple sources (from County records to satellite imagery) as a georeferenced map 'stack';
- as an image processing and mapping tool, to process and interpret non-invasive prospecting data ranging from surface geophysical surveys to airborne remote sensing;
- as a modelling tool for describing both the archaeological landscapes in the study area and our imperfect knowledge of those landscapes;
- as a spatial analysis tool, to study the contributions made to archaeological knowledge by a variety of non-invasive prospecting methods.

2.1 Data management

To keep on top of the data collected and generated by the project, GIS is used to collect, hold, and analyse all available archaeological records, vertical and oblique aerial coverages, a variety of geophysical and remote sensing data sets, and a number of maps representing environmental variables. This use of GIS is non-controversial and is now beginning to be accepted as the standard for regional archaeological research.

2.2 Image processing

The WHP will have remotely sensed data covering the whole (Landsat TM) or part (airborne TM and CASI) of the study area, vertical and oblique air photographic data covering large parts of the study area, and surface

Figure 1. Location of the Wroxeter Hinterland Project research area.

Figure 2. Map showing approximate pre-Roman tribal territories in Britain (after Millett 1990: fig. 16).

geophysics data covering sample areas. Whereas the data for the hinterland will be used as a control on existing records, special high resolution imagery will be acquired for the town of Wroxeter itself in order to produce high quality mapping. Existing maps of the town (fig. 3) have been produced almost exclusively on the basis of air photographic evidence, and have not had the benefit of modern photogrammetric techniques for accurate mapping.

Evidence taken from vertical and oblique APs, from ground-based geophysical measurements and aerial remote sensing, and from excavations can now be collated, using GIS technology, to produce a georeferenced graphical database of Wroxeter and its direct environs (stretching approximately 500 meters outside the town defences). Processing this imagery with the GIS in preparation for mapping will involve algorithms ranging from stereo-DTM generation to orthorectifying transformations and enhancements in the spatial and frequency domain. The processed imagery will then be ready to be digitally mapped off screen.

By interpreting and mapping the archaeological features present in the resulting georeferenced and enhanced image database in both a topological, a functional, as well as a chronological sense, digital vector maps can be produced that represent the spatial structure, the functional structure, and the chronological development of the site. These might form the basis for a Digital Interactive Atlas of Viroconium, allowing users to query any of the Project data layers and to display the results.

2.3 Modelling

The authors, having written earlier about the pitfalls of current GIS applications (Gaffney/Van Leusen 1995; Van Leusen 1996), intend to develop innovative GIS solutions to the problems of modelling archaeological landscapes, both in the environmental and in the cognitive vein. We feel that GIS models should derive most of their use from either confirming or refuting theoretical constructs, and previous applications were lacking in that respect. Even more importantly, any model that is based on real archaeological data should explicitly deal with the biases that are inherent in such data, and we intend to use GIS to model such biases.

2.3.1 Linking Archaeological Theory and GIS

GIS modelling will be applied to our main research question, which concerns the impact of Romanisation on the late Iron Age tribal society of the Cornovii. Taking current models of this process by Millett (1990) as our starting point, we intend to extend GIS methodology into the largely uncharted territory of non-environmental data.

The problem of urban-rural relationships in archaeological research is a general theme within many periods and areas of study. Such analyses have a specific resonance within Roman studies where urbanisation, twinned with Romanisation, has long been a suitable topic for research. The reasons for this are not hard to discern, especially in those provinces — including Britannia — where there is an apparent lack of urban traditions or where pre-Roman trends towards urbanisation were weak, and the development of towns and cities is interpreted as only one variable in the process of Romanisation. The study of Wroxeter and its hinterland is just one example of this research theme in action, but it can also be neatly grouped with the recently growing number of regional or 'landscape' studies in archaeology.

There is a complex web of interactions between any urban centre and its (normally directly adjacent) rural hinterland. This complexity extends into the functional, geographical, and chronological domains: which activity grew up when and where, and why? Even modern towns are notoriously difficult to study as living organisms, and a dead town such as Wroxeter, for which evidence of any sort is patchy at best, would seem to present insurmountable problems. However, we should measure our efforts not against an ideal, but rather against current archaeological practice. Hypotheses about the origins of Roman towns in general should be tested against the evidence generated by the project, and refined.

Millett (1990; see tables 1, 2) has presented such hypotheses. In particular, his models of early Roman impact on native society and of settlement dynamics during the later Empire should be amenable to testing. In order to avoid a lapse into brute force implementations of environmental models, we will attempt to extract culturally significant and spatially referenced information from the existing archaeological records and compare this with the more traditional economic indicators.

We have argued elsewhere that patterning in 'cultural' data should be as amenable to GIS analysis as is economic patterning (Gaffney/Van Leusen 1995: 370-371). For example, we can conceive of Romanisation as the combination of a wide variety of spatially variable cultural markers distributed across the landscape. On this basis we should be able to use architectural, morphological and artefactual data to construct maps depicting the spatial dispersal of status and degree of Romanisation across the landscape. These can then be compared with maps derived on a purely economic/environmental basis, and the differences between them should provide us with pointers to the social processes at work in the town/hinterland relationship. Inversely, we will construct models of status distribution based on archaeological theory, and test these against existing and newly acquired data.

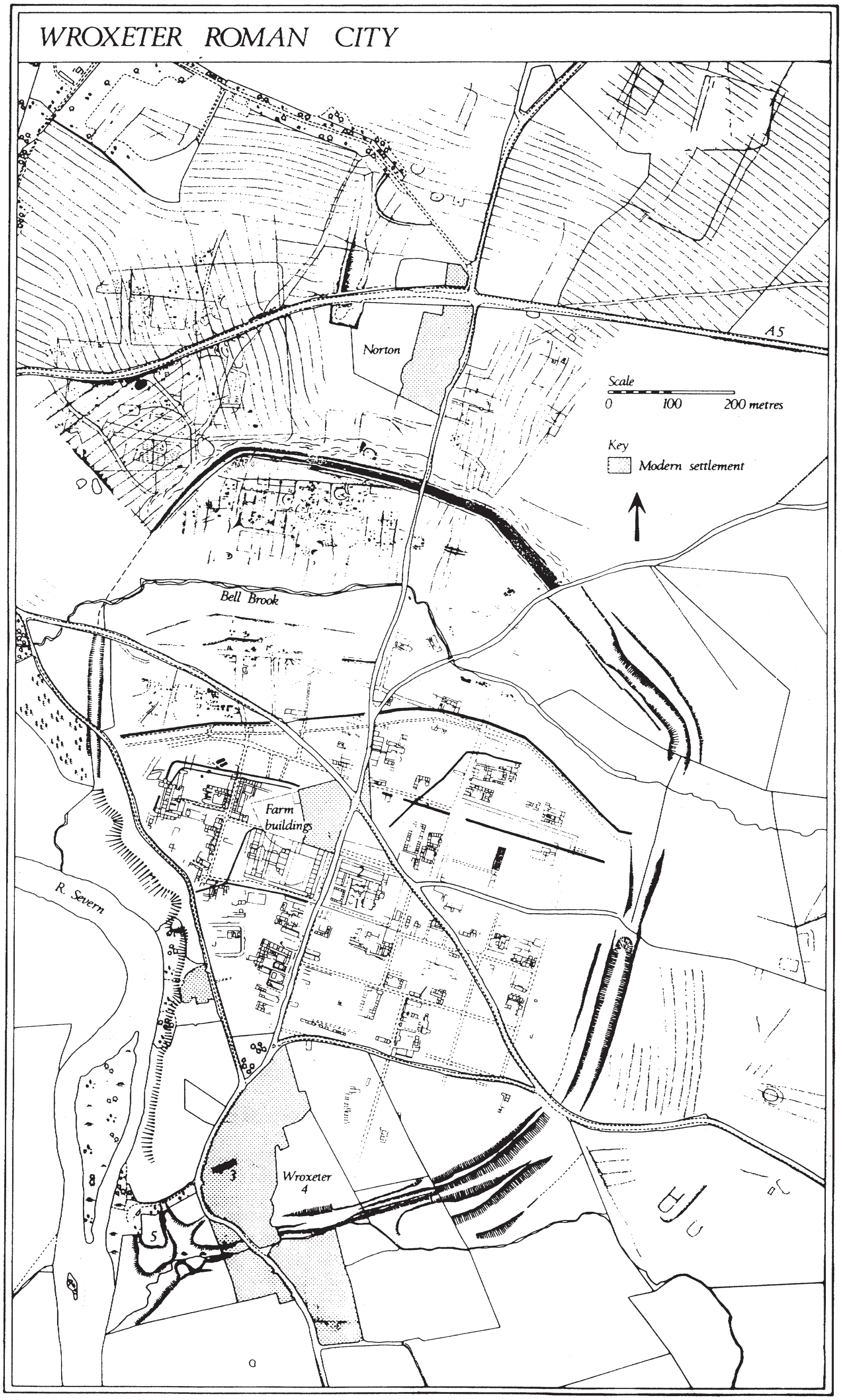

Figure 3. Topographic and archaeological features at Wroxeter, as mapped from air photographic evidence by D. Wilson (after Barker 1990: Fig. 3).

Type of LPRIA society	Nature of Roman impact	Type of Romanized society	
Centralized & hierarchical (e.g. oppida & coinage)	Reinforcing (i.e. élites adopted)	Successful towns & early villas	e.g. Catuvellauni
	Destructive (i.e. élites replaced or prolonged military occupation)	Poor urban growth & slow villa development	e.g. Iceni
Decentralized & egalitarian	Reinforcing (i.e. stimulation to nascent élite)	Delayed & limited, but successful towns & villas	e.g. Cornovii
	Destructive (i.e. prolonged military occupation)	Military zone with limited town & villa growth	e.g. Carvetii

Table 1. Simplified model of Roman impact on native societies (after Millett 1990: Table 4.3).

The seeming lack of highly romanised buildings ('villas') in the hinterland and the contrast with the relative opulence of the urban area is a case in point. It seems reasonable to assume that the Roman urban elite was essentially a continuation of the existing Iron Age elite. However, where are the original settlements associated with such groups? Emerging evidence for LIA activity within the town area indicates that the primary conduit for social display and development even then was via the urban centre. What conditions both prompted and allowed such a development? The lack of similar change in the countryside is intriguing given that we must assume that agricultural productivity supported urban advancement. Will these contrasts permit us to isolate the pre-existing social relations that allowed one part of the community to invest in the town, apparently at the cost of other groups or, alternatively, are we seeing a 'resistance' to Roman culture by some indigenous groups? Or are we just being wrongfooted by the limited visibility of 'villa' structures in the current Shropshire landscape?

2.3.2 Bias modelling

Since both theoretically derived and data-driven models in archaeology are ultimately based on our knowledge of the archaeological record, keeping control over the quality of our basic data is of prime importance in the Wroxeter Hinterland Project. This control is achieved in two ways:

– by assessing and then compensating for biases in the text based and mapped data; and
– by providing independent mechanisms of control with which to test the validity and power of the models we develop.

The sources for our archaeological data — national and county records, previous studies and surveys — are of wildly varying quality. The archaeological record is 'filtered' by formation processes, visibility and reporting biases, and past and current recording practices. For example, enclosures identified from aerial photographs (largely undated but generally ascribed to the Iron Age on morphological grounds), give us high-quality mapped data, but at the same time we may be sure that differential visibility and recording are biasing the distribution of these data to such an extent that they cannot be used prima facie to build or test models on. By modelling the biasing factors (differential soil responses, geological processes, land use both past and present, accessibility) and using them to compensate for the bias, we hope to arrive at a more credible distribution map for these and other data.

To further assess the quality of our mapped archaeological data (acquired from both existing records and our own field work) we have instituted a programme of fieldwalking based around 3 transects centred on Wroxeter and cutting

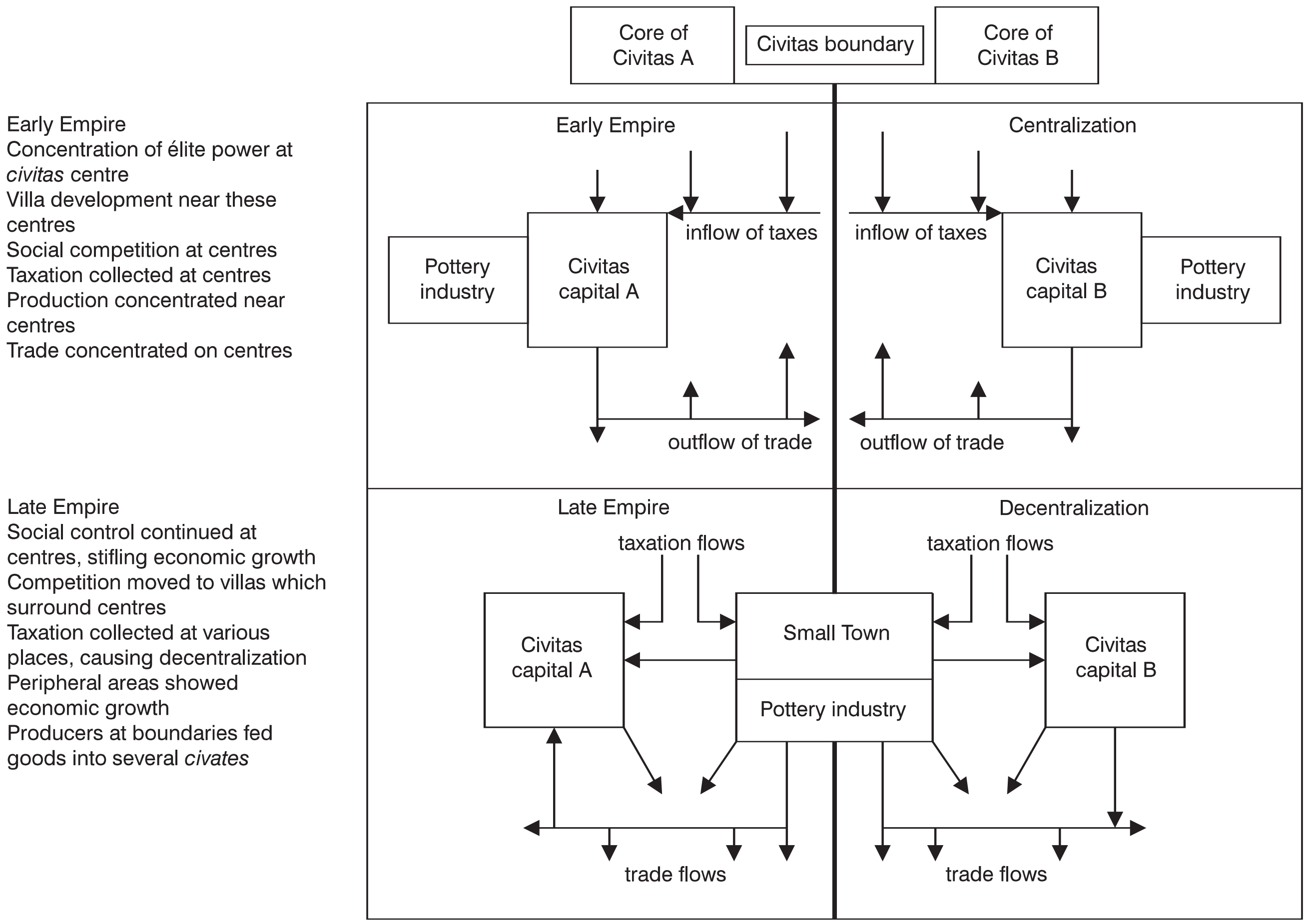

Table 2. Simplified model of the influence of taxation on settlement centralisation (after Millett 1990: Table 6.3).

across the study area's dominant topographic features (fig. 4). The choice of transect and orientation was dictated by the need to study the variation of activity (as opposed to simply settlement) with distance from the urban centre (Gaffney *et al.* 1985). Using a continuous grid retrieval system based on the UK national grid it will be possible to sample circa 10% of the transects' area. This should allow the team to study distance dependant site and non-site activity within the transects.

Equally, the mapped environmental data which is normally used in regional GIS models and which is largely based on the availability of printed map sheets of variables such as soil types, geology, hydrology and land use, suffers from a number of flaws including ignoring small-scale variation in the landscape, and employing cartographic conventions such as choroplethe mapping to represent data that vary continuously across the landscape. These biases we hope to compensate for by returning to the original field observations on which the maps were based, and constructing higher-quality maps from these.

2.3.3 *Project management*

GIS models will also be used to steer project development, for instance in determining our programme of test excavations of enclosures — the major archaeological feature in the area, about which little is known for certain. Several hundred enclosures exist in the project area, over one hundred of which have been classified on morphological grounds by Whimster (1989). We expect these features to reflect some of the upheaval caused by the advent of the Romans and the growth and eventual decline of Wroxeter, and will use GIS to study their distribution and to target specific enclosures for excavation.

2.4 Spatial Analysis

One of the aims of the Wroxeter Hinterland Project is to provide a laboratory for research into non-invasive prospecting methods. In general, not much is known about the precise relations between non-invasive prospecting data, such as magnetometry, and the underlying archaeology, or

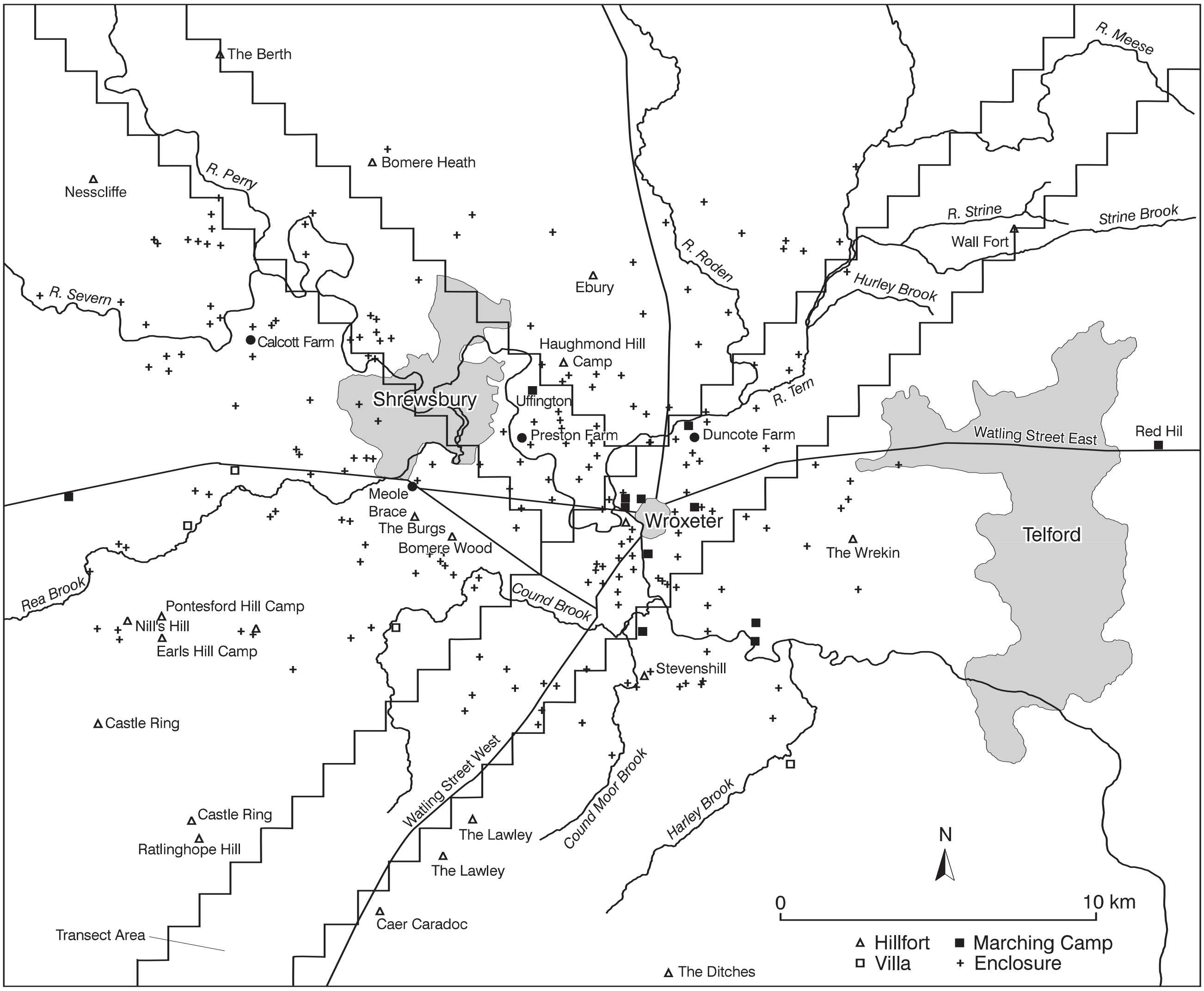

Figure 4. Field work and remote sensing transects for the Wroxeter Hinterland Project are used to collect control data across the main geological axis of the terrain (NE-SW) and along the Severn Valley (NW from Wroxeter).

about the relative contributions to archaeological knowledge of the plethora of non-invasive techniques that are currently available (David 1995). We intend to explore these questions in collaboration with Dr Kenneth Kvamme (currently at Boston University), by conducting extensive testing and multivariate analysis of techniques ranging from ground based resistivity, gradiometer, GPR and seismic to airborne photography, multispectral scanning, and thermal imaging. We expect multivariate analysis of properly georeferenced data to tell us how various techniques are correlated to each other, and how much information they contribute to the final picture. This should allow us to make some practical decisions as to which technique will be the most efficient in the given circumstances.

3 Regional Archaeology and the Local Community

It is an unfortunate fact that, in Britain at least, it has become increasingly difficult to allow the close involvement of the local community in major archaeological research projects. Places for field work are generally taken by students that need the experience, and requirements of efficiency and planning have made it increasingly difficult to use volunteers for any but the most circumscribed work. The Wroxeter Hinterland Project is changing that by stressing the importance of involving the local community, not only in field work, but also in finds and computer processing and generally assisting the research team. Since all its field work is funded by charities, it is remarkable that, one year into the project, we have over 200 volunteers working for us as field workers, map digitisers, office staff, geophysics teams, and even as a pilot. These people are mostly untrained but are very keen to learn, and it is possible to work with them throughout the year — not just when term time has ended.

We try to keep these volunteers up-to-date by issuing a bimonthly newsletter and by organising regular meetings and open days at which volunteers mix with project staff and each other. The success of this strategy leads us to think of extending volunteer involvement to conduct a full scale Parish Survey of the area, a huge task which would be impossible to contemplate with just two project staff available.

4 Concluding remarks

The Wroxeter Hinterland Project is an ambitious undertaking and is unusual in a number of ways. It is attempting to study one of the more arcane, and hotly debated, social processes — Romanisation — using technological and theoretical approaches in a manner never previously attempted. The project incorporates a complex group of data sources within a single 'critical' database, some of which have never been used in an archaeological context before, whilst others have rarely been integrated in such a comprehensive manner. Finally, the project, despite its highly technical and academic base, is being carried out with the explicit aim of encouraging public participation and aims to involve local communities at every level.

There is obvious risk in such an innovative approach, and we cannot expect to be fully successful on all counts, but preliminary results have been extremely promising and we hope to be able to confirm this at the 1996 CAA conference.

5 Envoy

The project team maintain World Wide Web pages at *http://www.bham.ac.uk/BUFAU/Projects/WH/* which provide an up-to-date review of activities and a means of directly contacting the authors.

Acknowledgements

The authors would like to thank the British Academy and the CAA organisation for their financial support.

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