ISAP News

the newsletter of the International Society for Archaeological Prospection

Issue No. 1, May 2004

Welcome to the ISAP and the first issue of **ISAP News**. I hope that you will enjoy reading it and find it informative – there hasn't been anything quite like it available before in our discipline. This first issue has taken a while to get finished but the next one is planned to follow in August. Thanks to all those who contributed and supported getting this newsletter started: I was pleased to receive such a variety of input.

The broad purpose of **ISAP News** is to keep the membership up to date with what's going on in archaeological prospection around the world and the current plan is to have four issues a year. Don't forget, it's your newsletter, so tell me what you'd like to see here and, even better, send me articles, news items, pictures, etc., about what you're all doing and what's important to you.

Anne Roseveare, Editor ISAP

Contents

Who's who on the Management Committee

Chairman

Joerg Fassbinder

Joerg Fassbinder graduated from the Department of Geophysics at the Ludwig-Maximilians Universitaet Munich. He joined Helmut Becker at the Landesamt fuer Denkmalpflege in Munich and in 1994 submitted his PhD thesis on "Magnetic Properties and Genesis of Ferrimagnetic Minerals in Soils". In particular, he has pioneered work on magnetotactic bacteria in archaeological soils. Using high-sensitivity caesium magnetometers he has carried out extensive surveys in Germany and overseas, notably China and Iraq.

Armin Schmidt

Vice Chairman

Chris Gaffney

My first geophysical survey was conducted 20 years ago and I worked as a freelance archaeological geophysicist between first and second degrees. My research, conducted under Arnold Aspinall at Bradford, was on the Schlumberger resistance array. Since leaving academia I have worked in the commercial sector. With John Gater I started the first successful independent 'archaeogeophysical' company in Britain, Geophysical Surveys of Bradford, which now trades under the name GSB Prospection.

The geographical location of my surveys has stretched from America through to Zimbabwe and my interests in archaeological geophysics are equally broad. I have been an Associate Editor, since the first issue in 1994, of *Archaeological Prospection*. I was part of the CBA Advisory Committee on Archaeological Science and I am currently a member of the steering committee for NERC's Geophysical Equipment Facility.

Although committed to being an applied geophysicist I have taught field courses to diploma, degree, continuing and professional education groups at a number of universities. I still have strong links with Bradford University where I am a Visiting Lecturer.

In my spare time I look at bridges and old postcards of bridges. I try and justify my behaviour by saying 'someone has to do it', but that is untrue! At least it stops me from thinking too much about football…. next year is going to be Newcastle's year. As an alternative to life in general I cycle. All in all I would rather be cycling.

Chris Gaffney

Honorary Secretary

Armin Schmidt

Although my earliest aspirations were to become an 'inventor' (a suitably broad job description), my fascination was always with history and ancient civilisations. Imagine a child being excited about the illustrated companion volume to C.W. Ceram's 'Gods, Graves and Scholars'. Well, that was me. The rather fearsome looking bog bodies were a bit worrying, but that did not restrain my interest. However, in the end the natural sciences got the better of me and in 1982 I began to study Physics in Munich (*Technische Universität München*). One of the key events for me during that time was a seminar given by Helmut Becker in which he described the amazing advances in

archaeological prospection using Caesium magnetometers. I was hooked. The lecture series on archaeometry had, for my taste, far too little geophysics in it and in the end I decided to do the one-year master's dissertation on electron mobility in liquid Argon at the *Max-Planck-Institut für Physik* (Heisenberg Institute). Thereby, I had entered the path of low temperature physics and continued with a PhD at the *Rheinisch Westfälische Technische Hochschule (RWTH)* in Aachen on the subject of magnetostriction on high-temperature superconductors. Very interesting (I still wish I had a cryostat at home for some minor experiments), but time had come for archaeological prospection.

When I looked round for the best place to go it became very clear that Bradford was the lead institution for archaeological geophysics. Initially I went for a year, but after a two-year Research Fellowship I was 'trapped' with a permanent Lectureship (now Senior Lectureship). Archaeological geophysics had been built up in Bradford by Arnold Aspinall and for me, like for many others, he was (and still is) a constant source of inspiration. Although retired, he is very active in undertaking experiments with different array geometries in our water tank and editing the journal *Archaeological Prospection*.

I have been involved in our *MSc in Archaeological Prospection* since its beginning in 1994 and the training of highly motivated students in this area has been very rewarding. Some have gone on to do PhDs and meeting one's 'academic off-spring' at international conferences is rather pleasant.

I have been involved with various research projects over the years. From the surveys of a twice-deserted Medieval Village in Yorkshire, England to the investigation of pre-Hispanic shaft graves along the Ecuadorian coast, they all have been exciting. But my favourite site is Lumbini in Nepal where we investigated the birthplace and childhood palace of The Lord Buddha during several UNESCO missions. A truly magical place and a wonderful country. In all these projects the interaction between archaeologist and geophysicist was crucial for the final interpretation of results and it is the challenge of working at an interdisciplinary level that makes these missions so rewarding. There has to be a willingness to listen to each other and accept that people have different expertise and research culture (think: 'developing a new type of magnetometer' *vs.* 'the investigation of 100 Roman villas'). My more geophysics-orientated research has concentrated on the development of new magnetometer techniques, and more recently on GPR. Masters dissertations are always a good way to undertake pilot studies for various topics, for example our recent investigation of the multi-frequency system GEM-300.

Archaeological prospection is a rich subject and it has never bored me (which isn't easy …). Joining this Society of like-minded researchers and practitioners is a good way of connecting the different strands and ideas. I am looking forward to seeing the discipline and ISAP flourish.

Armin Schmidt

Conference Secretary

Salvatore Piro

Salvatore Piro is Senior Scientist in the Institute of Technologies Applied to Cultural Heritages of the C.N.R. (National Research Council of Italy). His specialisations are development of acquisition, elaboration and interpretation techniques for archaeological and environmental prospection, using magnetic, geoelectric and ground penetrating radar (GPR) methods.

He has been a Senior Researcher at the ITABC (CNR) since 1995, where he has also been a Member of the Institute Committee since 2002. From 1992 to 2002 he was a Member of the Scientific Council of ITABC. Salvatore Piro is a member of the European Session of the EEGS, EGS, EAEG, Near Surface Geophysics Section of the SEG and now also the ISAP.

Some of the innovations obtained with his projects include:

- Location of archaeological structures using focused geoelectric arrays, gradiometric and GPR methods
- Improvement of S/N ratio using filtering methods
- Development of bidimensional cross-correlation techniques for geoelectric and magnetic methods
- Experimental tests for the characterisation of GPR antenna patterns
- Improvement of S/N ratio of GPR using seismic reflection acquisition techniques and data processing

- Development of integrated acquisition methodology using magnetic, GPR and geoelectric methods to locate archaeological structures
- Calculation of synthetic anomalies due to different bodies for geoelectric and magnetic methods.

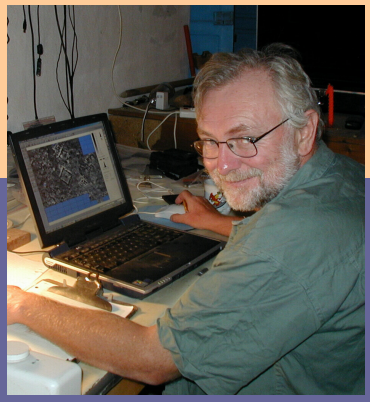
Salvatore Piro's ongoing research projects are:

- "Geophysical Integrated Investigation in the Archaeological Park of Maalga – Carthago (Tunisia) " supported by Italian Minister for Foreign Affairs
- "Integration of high-resolution prospection techniques to study archaeological sites and historical buildings" supported by ITABC
- "Integrated investigation to reconstruct the coupling between Ancient Tarquinia and its territory " supported by University of Milano.

Salvatore Piro has published and presented one hundred research papers in the national and international journals and conferences. In addition, he has organised workshops and conferences with the ITABC-CNR and convened sessions at EGS conferences. The 2005 Archaeological Prospection conference is being organised by him and his team.

Salvatore Piro

Vice Conference Secretary



Tomasz Herbich

Immediately after obtaining a Master's degree in Mediterranean Archaeology from Warsaw University (in the late 1970s) Tomasz Herbich joined the staff of the Department of Applied Sciences, Institute of Archaeology and Ethnology, Polish Academy of Sciences.

In the 1980s he worked mainly in central Poland (Holy Cross Mountains area), specializing in the application of resistivity methods to the study of Neolithic and Bronze Age flint mines. This work was published in a series of papers and presented during geophysical and archaeological conferences.

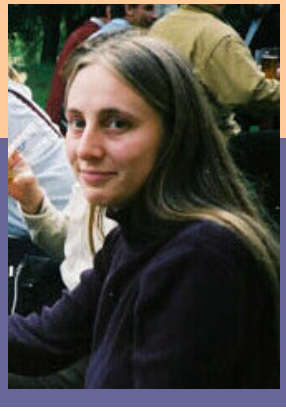
Throughout this period he carried out surveys at sites of different types and epochs, e.g. mediaeval cities in southern Poland (Sławków, Olkusz and others), Torcello Island (Italy). In the mid 1980s, he extended the scope of his experience to include work in Egypt, where he conducted geophysical surveys and took part in excavation work in Saqqara, Tell Atrib and in the Fayum Oasis. In the late 1980s, his department started a joint project with the Office for Preservation of Historical Monuments of the Baden-Wuerttemberg land in Germany. This required him to work on a series of surveys of Roman and Mediaeval sites in different areas of the country (Rottwiel, Constanz, Sontheim am Brenz, Ladenburg and others). The results of this prospection prompted the Office authorities to establish their own geophysical laboratory in Stuttgart (directed by Harald von der Osten).

In 1994 Tomasz Herbich received a rather unexpected offer to take up the position of Secretary General of the Polish Center of Mediterranean Archaeology in Cairo. This caused his temporary transfer to Warsaw University – and to Cairo, since his job was to coordinate the activities of Polish expeditions excavating in Egypt. After two years, having become sick of administrative work alone, he began persuading Egyptologists of the benefits geophysical prospection could bring to the study of the sites they were digging. This was no easy job, but after the first successes (prospection in Dakhleh Oasis and the sensational finds that Joerg Fassbinder and Helmut Becker had at Qantir) he was able to join forces with a number of expeditions. The results of these surveys, which were conducted in practically all the regions of Egypt and on sites representing the entire chronological spectrum in Egyptian millennia-long history, can be read in the opening article of the most recent issue of *Archaeologia Polona* 41 (2003).

In 2000, Herbich returned to Warsaw, back to his job at the Institute of Archaeology and Ethnology, but 90% of his surveying fieldwork continues to be in Egypt and recently also in other countries of the Middle East. Last year was the only exception, as he spent most of the year organizing the Fifth International Conference of Archaeological Prospection.

Tomasz Herbich

Editor



Anne Roseveare

My introduction to the discipline came in 1995, while I was still a Chemical Engineering student at Bradford University. Following two periods in industry, as a research engineer at Hoechst AG and in manufacturing for BP, I was intending to go into environmental work, such as assessing and cleaning up industrial sites. However, I discovered something fascinating in the Archaeological Sciences department next door: geophysical prospecting. Whilst I looked after the exhibitors' stands during a session of the 1995 Archaeological Prospection conference I had a good opportunity to find out more and my interest grew. I joined with Martin Roseveare and others in starting a survey company, ArchaeoPhysica, which was launched in 1998.

From the start, we have tried to make time for research alongside the survey work but it can be difficult! Areas I have a particular interest in include: total field magnetometry – methods and analysis; landscape development through medieval times to the eighteenth century; early industries; and where the best fish and chips can be found! I have been involved in developing the use of caesium magnetometers for routine commercial survey for five years. Also DGPS tracking for electromagnetic and magnetic data collection; designing and building chariots and sledges for equipment and testing of new equipment such as the GSSI GEM-300 electromagnetic meter and the Searchwell MPR50 radar. One of my current research themes is the analysis of "texture" in magnetic survey results: what happens in the background could tell us more about zoning and land use.

When I'm not looking for lost castles and chapels or mapping miscellaneous pits and ditches, I like to relax by heading for the Welsh hills. (That is, when I'm not putting together newsletter items ...)

Anne Roseveare

Auditor

Rob Vernon

Rob Vernon was born in Liverpool in 1945. He graduated in 1969 with a BSc (Hons) in geology from London University. Between 1969 and 1993 he held a variety of senior posts as a geologist in the British coal industry (deep mines), where he became familiar with downhole geophysical logging and seismic surveying. After leaving the coal industry, Rob gained an MSc in Archaeological Prospection from the Department of Archaeological Sciences, University of Bradford where he is currently conducting research on the geophysical responses produced by British smelting sites, for a PhD. He has published various papers on his PhD topic and recently edited an archaeological summary of the work conducted on the Myers Wood iron-smelting site, the theme of his last AP oral paper at Krakow.

Rob' s other interest is mining history. He has co-written a series of books on the lead mining history of the Conway Valley and the Llanengan area in North Wales. He was until recently the Deputy Chairman of the National Association of Mining History Organisations and has edited two editions of their handbook.

Rob Vernon

A Treasurer has been appointed (see the Noticeboard)

Ghost features
– A proposal for appropriate management and a forum for discussion

Norbert Schleifer Department of Earth Sciences, Institute of Geophysics, Palaeomagnetics and Petrophysics Working Group, Montanuniversität Leoben, Austria

The Archaeological Prospection Conference last year in Cracow (Poland) was something like the key-event for tabling the topic of "ghost features" in the International Society of Archaeological Prospection (ISAP).

Although there are already local publications and conference contributions about that topic (Fassbinder et al., 1998; Leckebusch et al., 2000; Linford, 2002; Fröhlich et al., 2003) the phenomenon itself is not very well known among archaeologists and geophysicists working in the field of archaeological prospection.

The analogy of *Albert Hesse*, that physics is able to distinguish between the liquids water and alcohol but the human eye is not, perfectly described the discrepancy that exists in the way archaeologists and natural scientists interpret their results. Archaeologists believe in what they reveal during excavation, natural scientists in what they can detect with their instruments.

Magnetic ghosts are archaeological features, e.g., ditches, pits and graves, which are detectable by magnetic prospection whereas they are optically not visible in the subsequent excavation.

Of course there are variations of this phenomenon as there are magnetically visible features that finally appear due to a change of soil moisture content (Fassbinder et al., 1998) but a conventional ghost feature will stay invisible (Leckebusch et al, 2000; Breitwieser et al., 2001).

The soil conditions that lead to an appearance of ghost features have not been completely understood yet and additional investigation of the interaction between the magnetic properties and the colour of the soil is needed.

One conclusion of the known case studies is that the decomposition of organic matter plays the key role. Whether we talk of organic artefacts or filling material in both cases the iron minerals stay whereas the organic matter disappears. In the case of Linford (2002) bones were dissolved in acidic sandy soils and it was hardly possible to recognise the graves structure due to an almost insensible contrast in soil colour. In the case of Breitwieser et al. (2001) the ditch of an Early Neolithic house disappeared within meters which concludes that also small scale variations of subsoil conditions can have a major effect on archaeological remains (Cook & Carts, 1962). A detailed investigation of the soil samples has been going on.

The decomposition of organic matter content is a complex process that is governed by several parameters like pH value, water content and/or aeration. Of course agricultural activity has an additional effect. As a result a complete understanding of magnetic ghosts requires the investigation of all these parameters.

Soil colour is mainly influenced by organic matter content and iron minerals (Bigham et al., 1991; Schwertmann, 1993). Whereas the presence of iron minerals has a direct influence on the magnetic properties, it is known from soil magnetic investigations (Thompson & Oldfield, 1986; Evans & Heller, 2003) that the organic matter content influences the occurrence of different iron minerals. A variation of the organic matter content between the structure and the undisturbed soil consequently leads to a measurable contrast in the magnetic properties. As a result the feature will be detectable by a magnetic survey.

As the brightness of the soil is also influenced by the organic matter content the archaeological feature will be easily recognisable in the subsequent excavation. This correlation between soil colour and magnetic property is one major reason for the great acceptance of this method among archaeologists. The aim of this article is to focus the attention of the ISAP on this topic.

Beside the fact that the knowledge of physical properties of archaeological features should be an essential concern of a geophysicist working in the field of archaeological prospection the necessity of an understanding of this phenomena is of further relevance because of the following reasons.

The archaeological background and/or pedological processes that result in an optical disappearance and mere "magnetic existence" yields additional information

about landscape changes, the isochronical appearance and the circumstances of the built up of archaeological remains. This has been proven in cases concerning the interpretation of unexpected magnetic behaviour of ditches (Fassbinder et al., 1998; Schleifer et al., 2001).

Without a proper understanding of the appearance of ghost features it will be impossible to convince archaeologists about the importance of a magnetometer survey concerning the evaluation of an archaeological site. The state of the art demands the proof of magnetic anomalies by excavation and thus by the archaeologist.

One possibility to convince archaeologists about the real existence of a ghost feature is to carry out a small-scale survey within a trench at the location where the feature is expected to be. Modern susceptibility meters are able to resolve sub-centimetre structures. Another way is to investigate soil samples out of the "invisible" feature and the surrounding undisturbed soil.

The advantage of both methods is that methodical errors due to the geodetic survey are eliminated and the shape of the sought feature can be determined more precisely.

Altogether the verification of the ghost feature should include six major steps:

1. Proof of geodetic survey.
2. Consultation of a soil scientist and/or geophysicist.
3. Verification of the existence of the feature within a trench using a susceptibility meter or by collecting soil samples that are later investigated in a magnetic laboratory.
4. Soil colour determination in the field and the laboratory (wet and dry samples).
5. Investigation and reconstruction of the pedological processes influencing the archaeological site, especially in the ambience of the ghost feature.
6. Combined interpretation of the results.

The steps 1 up to 4 can be alternatively carried out by an experienced archaeologist in case there is no specialist available. For example, a case study from the multiperiod site at Bad Homburg, Germany showed (Breitwieser et al., 2001) that it is important that the sampling for the soil magnetic and pedological investigations is carried out simultaneously.

An appropriate management of ghost features assumes that archaeologists are aware of the existence of magnetic ghosts and that they accept magnetic prospection as an independent and equal method to excavation. The importance of the evaluation of this additional information sometimes might be the only possibility to reveal features who otherwise never will have been recognised.

The author recommends that the ISAP should be used as a forum for the definition of guidelines handed over to archaeologists. Perhaps the English Heritage Research & Professional Services Guidelines No.1 "Geophysical survey in archaeological field evaluation" can provide a basis for that. At the moment these guidelines are being updated.

As the appearance and investigation of ghost features can not be planned like a conventional research project I propose an ISAP forum called "magnetic ghosts" where case studies can be discussed. This forum can also be used to discuss archaeological features showing an unexpected physical behaviour.

A collection of case studies, or as one can say an exchange of our experiences, within the ISAP would be worthwhile and would lead to a better understanding and interpretation of our results.

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aarg Aerial Archaeology Research Group

NEOLITHIC STUDIES GROUP

BAYERISCHES LANDESAMT FÜR DENKMALPFLEGE

International aerial archaeology conference, Munich, Germany,

'**Aerial Archaeology – European Advances**' *A decade on from Kleinmachnow*

Sunday 5th to Wednesday 8th September 2004

To be held at:

Bayerisches Landesamt für Denkmalpflege, München, Deutschland
Bavarian State Department for Historical Monuments, Munich, Germany

The Aerial Archaeology Research Group is proud to welcome you to its 2004 annual meeting in Munich, Germany. In September 1994 the historic *Symposium zur Luftbildarchaology in Ostmitteleuropa*, '*Aerial Archaeology in Central and Eastern Europe'*, was held at Kleinmachnow, Brandenburg, drawing together aerial archaeology and remote sensing practitioners from across Europe following the fall of the Iron Curtain. Ten years on, the Munich conference will celebrate and investigate the progress of aerial and ground remote sensing in Europe and surrounding countries, addressing a number of key academic, technical, management, survey and archive issues over three main conference days. The conference will feature a special one-day session Revealing Neolithic Europe, to be followed on the third day by Aerial Archaeology and Remote Sensing – European Advances.

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Developing a magnetometer chariot to survive commercial survey

Anne Roseveare & Martin Roseveare ArchaeoPhysica Ltd., Shrewsbury, Shropshire, UK

Development work on and off over the last two years finally paid off last summer, when the time came to use our chariot on a routine commercial survey. We'd had some trial runs, which showed us where our designs had room for improvement, but the critical test was how well we could use the chariot in conditions we didn't have a choice about.

Firstly, we wanted to be able to run our usual caesium magnetometer on wheels, as we suspected there was a potential benefit to the data quality. (Low amplitude fluctuations in the measured magnetic field strength are introduced by the gait of the surveyor.) Secondly, a chariot opens up the possibility of a multi-sensor array.

The key factors influencing the design were:

- it had to be light enough for single-person operation and easy to manoeuvre
- it had to pack away into a short Land Rover van
- it had to be robust, for varied field conditions
- it had to be straightforward to repair.

Fig. 1 Early "gradiometer", 3x 1m-spaced sensors

After we had studied the few existing magnetometer chariots we decided on a wooden construction with large wheels for a smoother ride. Also, the power supply and electronics would be on board but kept away from the sensors to minimise interference.

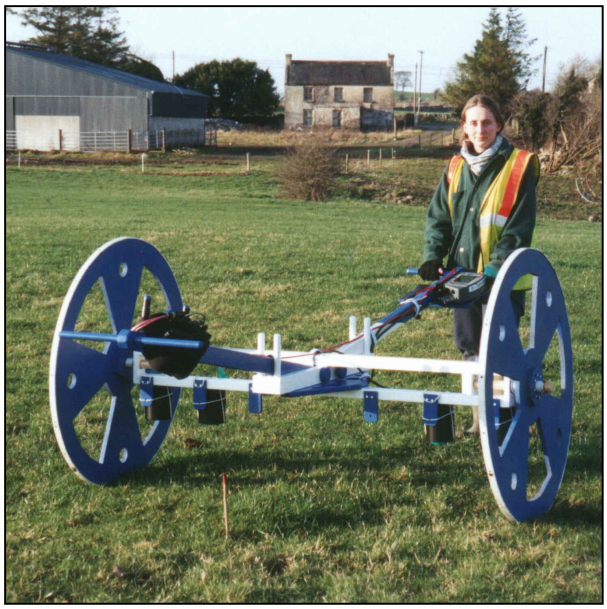

Fig. 2 "Sabrina", the current chariot (2x1m /4x0.5m)

The most difficult part of the design was the bearings, which had to run smoothly and wear well but still allow the chariot to be dismantled for transport. We redesigned the bearing assembly following weeks of survey in wet conditions in western Britain and Ireland: the axles had swollen and softened in constant rain. Now we're satisfied – our chariots have been used a lot since last summer and they're running well. Also, we appreciate the data quality and being able to use total field data more fully for analysis and interpretation.

What next? We're developing a towed array with a GPS link, though spatial accuracy and interference with the sensors currently limit how useful it is. Meanwhile, "Sabrina" could do with another coat of paint ...

Fig. 3 Conditions aren't always ideal! (Co. Galway)

Application of resistivity survey in the Mediterranean area

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[2] Dipartimento di Scienze e Tecnologie per l'Ambiente e il Territorio, Università del Molise, Italy

Abstract
In this paper we would like to show our activity in geoelectrical prospection applied to archaeological research in Italy and Cyprus. Three components of our work group were involved in resistivity survey (developing instruments, retrieving and analysing data), two others in topography and GPS.

Our aim was to develop a data acquisition and processing system encompassing all steps of resistivity survey. Data were acquired using instrument prototypes. Furthermore, we utilized a data recording procedure integrating differential GPS technique. Therefore, the geometrical points, representing each profile at the survey, were correctly georeferenced. Some data analysis was performed using probability tomography is also shown. This procedure is independent from the particular geometrical measuring system and terrain condition.

Key words: *resistivity method, tomography, GPS georeferencing*

Instruments

The first survey system consisted of an AC generator with multiple outputs for different current probes arrays, a laptop computer for acquisition and elaboration; pass-band filter and amplifier, a 16 bit AD converter and our acquisition and elaboration software (Figure 1). In collaboration with the Institute of the History of Material Culture of the Polish Academy of Sciences, we developed two instrument prototypes (Figure 2). The most recent prototype, ADD-01, was constructed by Leon Mucha.

The Differential GPS instrument in use is a 24 channel dual-frequency receiver Leica SR530 (centimetre accuracy), with RTK (Real Time Kinematics) on-board.

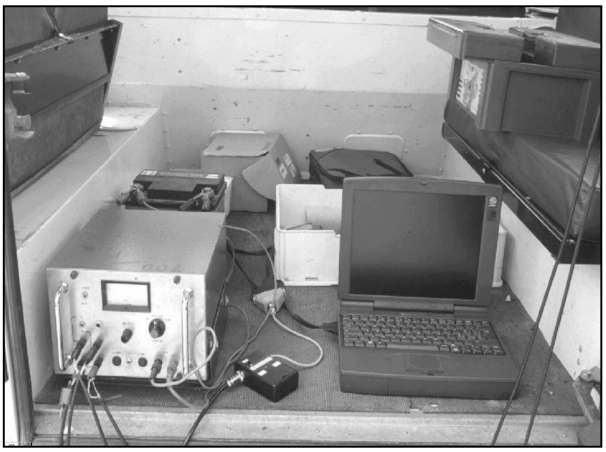

Figure 1. The AC generator is equipped with four current outputs: A1-B1, A2-B2.

This configuration is used to detect two measurements with two perpendicular current flows at each measurement point (i.e. rectangular array).

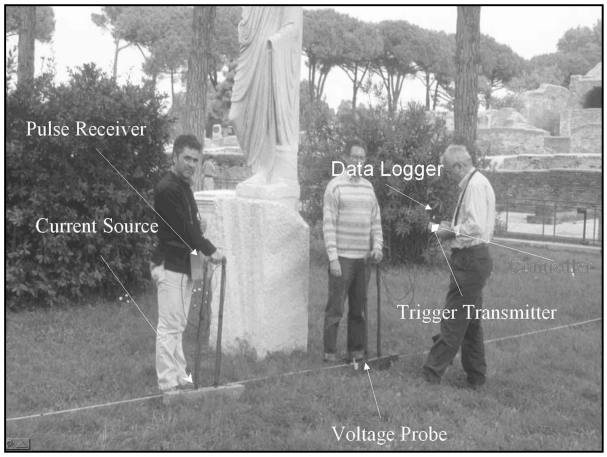

Figure 2. The most recent prototype.

Case History

Etruscan Necropolis (Chiusi, Italy)
The first area investigated is located at Poggio San Paolo hill. The survey objective was finalised to discover a buried (probably religious) structure. During the excavation of June 2001, it was possible to verify the correspondence between a previously detected geoelectrical anomaly and an excavated layer containing bricks and tiles belonging to a collapsed structure (Figure 3).

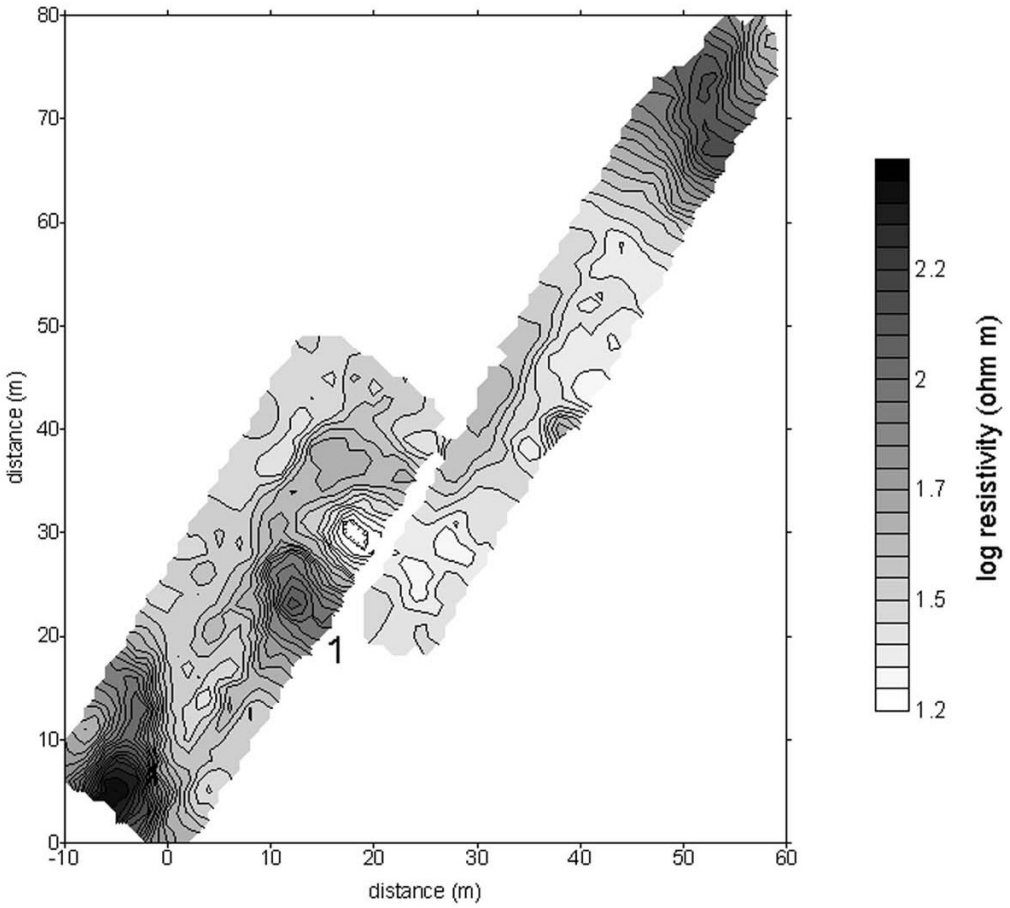

Figure 3. Dipole-dipole resistivity map obtained at Poggio San Paolo hill.

In the second area, the tomographic methodology was tested on two cavities belonging to the well known Scimmia and Pellegrina tombs at the Etruscan Necropolis of Poggio Renzo hill. Further measurements taken on the Necropolis area, show three anomalies parallel to the access corridors (dromoi) of the previously excavated tombs (Figure 4). The sampling step was 1 metre.

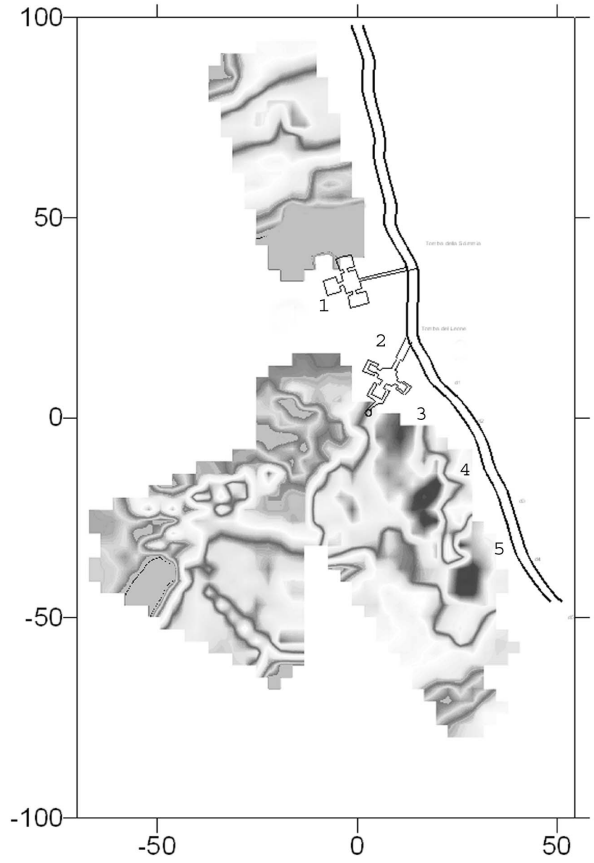

Figure 4 (right). Necropolis of Poggio Renzo hill. Horizontal section at a depth of 7 metres.

Ostia's Ancient Tiber bed (Rome, Italy)

The interpretation of the photo taken from a balloon in 1911 (Figure 5) shows the existence of buried archaeological structures resembling in total an amphitheatre near the ancient river Tiber, which changed its course and flow at the beginning of the 16th century AD. It is not possible to use modern aerial photos to detect buried structures because land ploughing after the 1950's obliterated any superficial archaeological evidence.

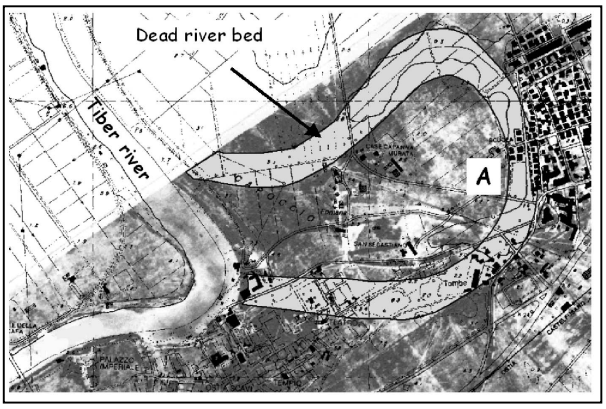

Figure 5. This figure shows the balloon photo of 1911 georeferenced using a Differential GPS (Leica SR530) and a 1990 cartography. The area investigated is indicated with the label "A" inside the 'dead river bed'.

The resistivity survey (partially accomplished) was an attempt to prove the existence of the structures hypothesised in the photo taken in 1911 (Figure 6). Also in this case the sampling step was 1 metre.

Pyrgos Mavroraky (Limassol,Cyprus)
In 1999, the ITABC-CNR archaeologist M. R. Belgiorno began the excavation of the prehistoric Early-Middle Bronze Age site of Pyrgos, located at 15 Km east of Limassol and 4 Km from the sea coast in a central inland position of Limassol Gulf.

Near the excavated area we performed a resistivity survey. Results are plotted in Figure 7. The sampling step was 0.5 metre.

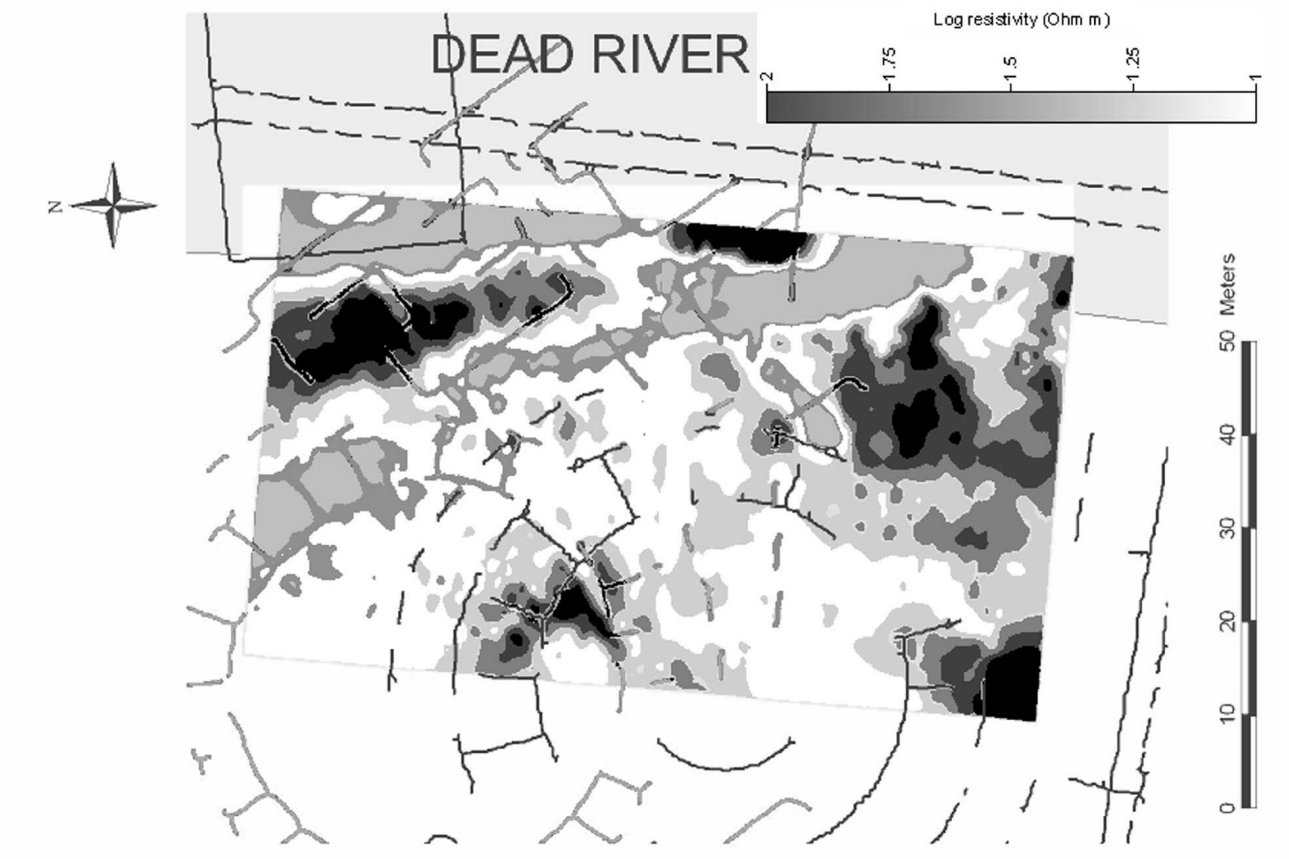

Figure 6. The left circle shows the aerial photography interpretation plotted on an older topography. The right circle indicates the same interpretation plotted on the new topographic map (1990). Dark-grey color indicates high resistivity values, light-grey color represents low resistivity ones.

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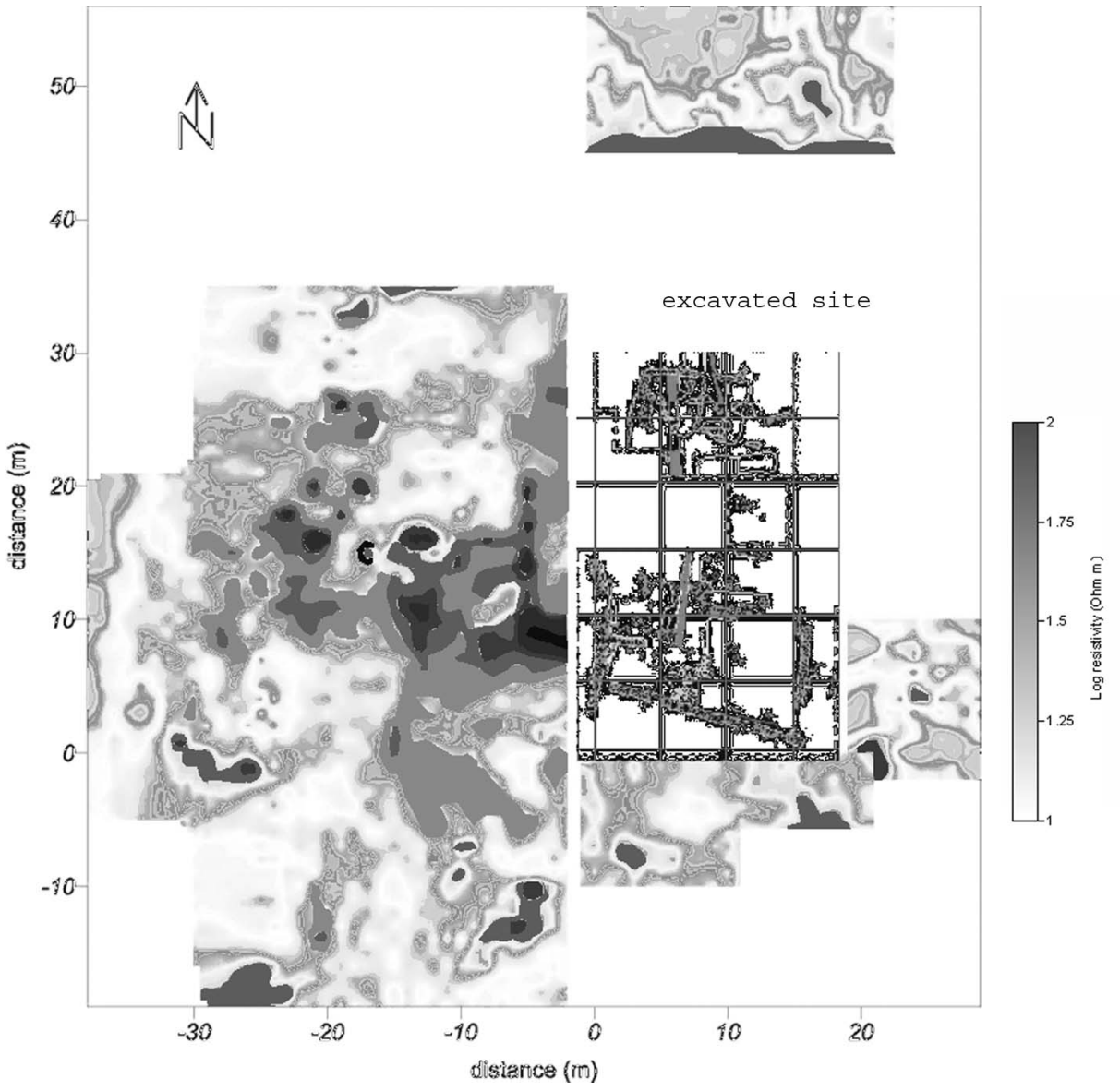


Figure 7. The prehistoric Early-Middle Bronze Age site of Pyrgos. Horizontal section at a depth of 1 meter.

English Heritage's caesium magnetometer cart

Neil Linford, Paul Linford, Louise Martin & Andy Payne
English Heritage Archaeometry Branch, Portsmouth, UK

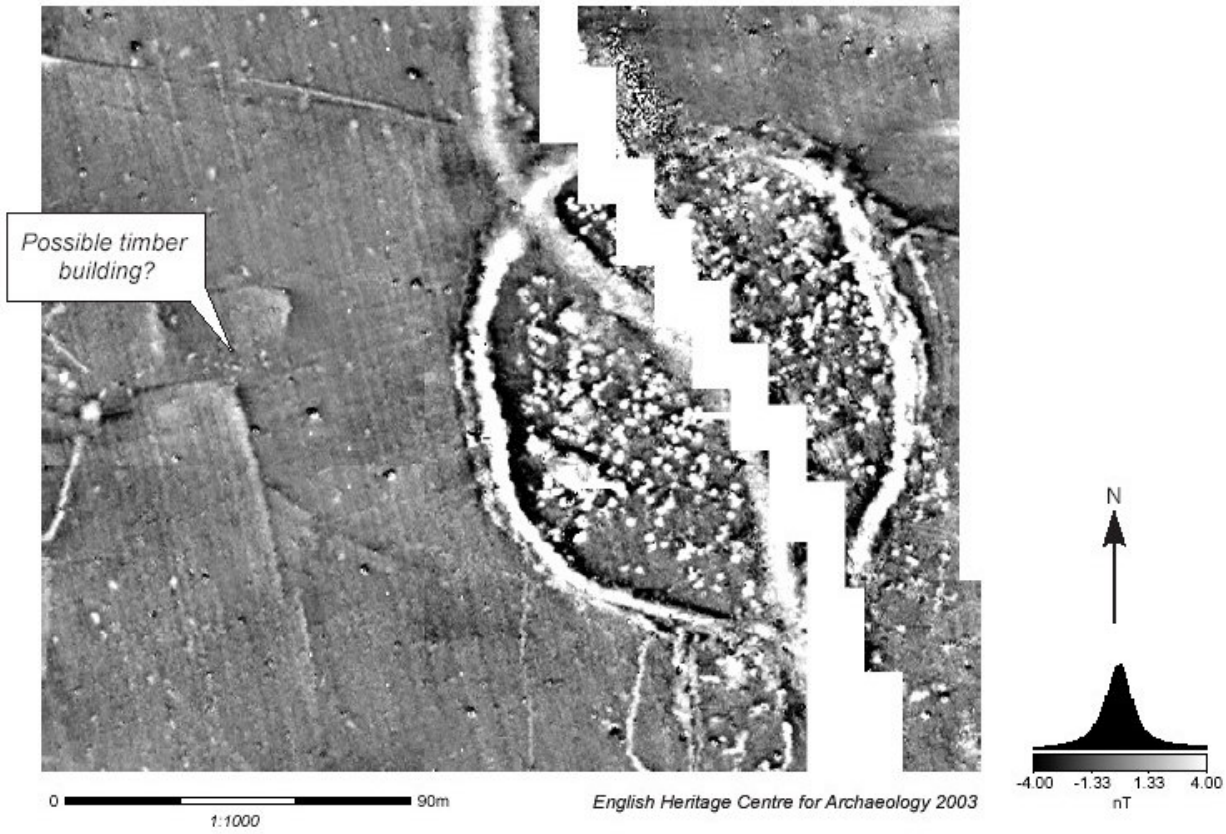
"It will never fly you know!" seemed to be the resounding pearl of wisdom we received whilst providing months of amusement to colleagues (both human and canine) trundling our prototype magnetometer cart over the parade ground at our base in Fort Cumberland, Portsmouth. Unfavourable comparison with Roman chariots and medieval devices of unspeakable torture were frequently referred to. But now, with great relief, we have a working, field tested system that even dismantles for transport to and from site in the back of the LandRover!

Construction of the cart proved necessary for the operation of our Scintrex Smartmag caesium vapour magnetometers in a system similar to those that been most successfully deployed by our continental European colleagues for some time. Whilst the Scintrex sensors are capable of recording the most subtle of magnetic anomalies, for example the response to an individual timber post-setting, the instruments are equally sensitive to magnetic material surrounding them, such as the controlling electronics and power supply batteries. To overcome this, our magnetometers have been specially modified to increase the distance between the sensor head and the other magnetic components of the system that would interfere with the recorded signal.

Rather than carry all this heavy equipment by hand we constructed a cart to act as a mobile instrument platform. Obviously, the components used in the construction of the cart have to be entirely non-magnetic too and able to bear both the weight and mechanical shock associated with operating the system over typical archaeological terrain. Figure 1 shows Louise and Neil operating the cart over the Headlands Enclosure site near Silbury Hill during our first field outing in November 2003 whilst Andy and Paul struggled to keep the 100m survey lines laid out in front of us. The four caesium sensors are separated by

0.5m from each other in a line along the central axle of the cart, allowing multiple, 100m long instrument traverses to be collected simultaneously.

So what advantages does this system offer over more conventional fluxgate magnetometers? Well, we do seem to be getting better sensitivity to weakly magnetised features. But we are also finding that the increased sample density, speed of data acquisition and absence of walking induced "noise" observed with hand held instruments, all greatly improve the quality of the final data. Figure 2 shows an image of the data we collected from a survey over the Headlands enclosure near West Kennet in Wiltshire (survey resolution 0.5m x 0.25m). It illustrates both the resolution of that can be obtained over strongly magnetised features, such as the multi-phase ditches of the ovoid enclosure, and also the response to more subtle anomalies possibly arising from a timber building.



Logo competition
Would you like to be a regional correspondent?
What conferences are coming up?

... see the Noticeboard

EIGG archaeological geophysics meeting, London

EIGG
Environmental & Industrial Geophysics Group

Recent Work in Archaeological Geophysics

Day Meeting 15th December 2004

This will be the sixth meeting on this topic, to be held under the auspices of the Environmental and Industrial Geophysics Group (EIGG) at the premises of the Geological Society, London.

As usual contributors will present recent developments and case studies in archaeological geophysics. As well as oral presentations, there will be (limited) space for commercial and poster displays. Subsequent publication in the journal Archaeological Prospection is an option.

A charge will be made for commercial exhibitors and a modest registration fee will be payable at the door for those who are not members of the Geological Society.

In innovation this year, prompted by our shared interests, will be the option of attending a second EIGG meeting on the following day (16th December) devoted to **'Forensic Remote Sensing and Geophysics'**. The latter will hopefully include geophysics, aerial and satellite monitoring, non-destructive chemical surveying, laser scanning, GIS, data processing and manipulation, military, industrial and extraterrestrial applications, international monitoring, environmental law and human rights. Applications to criminal and international law enforcement will form the core of the meeting. The techniques used will be of use to archaeologists, historians, geographers and geologists (especially those mapping landforms and involved in oil, gas and mineral exploration).

A reduced registration fee will probably be available for those who would like to take advantage of attending both day meetings.

Those interested in contributing to **'Recent Work in Archaeological Geophysics'** are warmly encouraged to contact the convenor, Andrew David, no later than the 31st August 2004:

Andrew David,
English Heritage,
Fort Cumberland,
Eastney,
Portsmouth PO4 9LD UK
Tel.: + 44 (0)23 9285 6764, Fax.: + 44 (0)23 9285 6701, Email: Andrew.David@english-heritage.org.uk

For further information on, or offers of contributions towards **'Forensic Remote Sensing and Geophysics'**, please contact that meeting's convenor, Alistair Ruffell. Information on both meetings will be circulated to all those showing an interest.

Dr Alistair Ruffell,
School of Geography,
Queen's University,
Belfast,
N. IRELAND BT7 1NN
Email: a.ruffell@qub.ac.uk

Recent student projects at the University of Bradford

Compiled by Armin Schmidt, Course Manager for MSc in Archaeological Prospection (A.Schmidt@Bradford.ac.uk)
Department of Archaeological Sciences, University of Bradford, West Yorkshire, UK

The following list gives an overview of some of the projects students have undertaken as their dissertation for the course MSc in Archaeological Prospection at the Department of Archaeological Sciences. The projects normally address geophysical and archaeological research questions, albeit with varying emphasis. Research starts in the second semester of the course and is then completed over the summer vacation. In addition, many other projects have been carried out over the years and some form the basis of further investigations.

The magnetic detection of buried mudbrick walls and the potential for the application of geophysical techniques in archaic Euesperides - Alette Kattenberg

Geophysical surveys were carried out on the tell site of the archaic Greek city of Euesperides, northern Libya in April/May 1999. The aim of the surveys was to determine whether buried mudbrick features could be detected by means of magnetic prospection methods and to assess if there was a potential for the application of geophysical methods on the site in general.

In a high resolution fluxgate gradiometer survey over an excavated trench the magnetic signature of a mudbrick wall could be identified. Soil samples were taken for magnetic susceptibility analysis. This analysis showed that there is a magnetic contrast between the mudbrick walls and the surrounding deposits. It was calculated that this contrast is sufficiently high to distinguish between the different deposits in a magnetometer survey.

In non-excavated areas problems were encountered in the magnetometer survey due to the presence of metal objects and the intrusion of modern graves into the archaic layers. In a trench currently under excavation, linear features that probably represent mudbrick walls were distinguished in the data of the magnetometer survey. It was found that these features could only be identified in a magnetometer survey with a spatial resolution of 0.25m $\times$ 0.25m or higher and a sensitivity of 0.1nT for the instrument.

Overall, the potential for the application of geophysical survey techniques on the archaic site proved to be low. Soils were too dry to carry out an earth resistance survey, and the results of the magnetometer survey were of poor quality due to the presence of metal and modern graves in the survey area.

The impact of fluxgate gradiometer data collection strategies - Heather Gimson

This project examined and assessed the impact of different data collection regimes. This was undertaken through the repeated surveying of two sites, each survey corresponding to a different data collection variable. Consideration was given to the usability and effectiveness of the different variables as well as the time needed to implement them.

It was possible to assess the impact of magnetic scanning as well as the variables within data collection strategies, instrumentation height and orientations. Time lagging was also investigated over highly magnetic features, due to the instrument requiring more time to record a data point.

The large amount of collected data used within this project also provided an opportunity for interpretations to be gained for the selected sites, enabling an enhancement of the archaeological record. Earth resistance surveys were therefore also undertaken to improve the interpretation of the sites.

A sequential approach to site evaluation utilising Ground Penetrating Radar: A case study at Dolbelidr, Denbighshire - James Adcock

It was proposed that Ground Penetrating Radar (GPR) could be introduced as a more mainstream tool for archaeological prospection when used as part of a sequential approach to site evaluation. The dissertation tested this idea by investigating Dolbelidr, Denbighshire (a low-lying river valley site) in search of archaeological remains associated with the house. The methodology involved coarse resolution earth resistance (twin-probe [Geoscan Instruments RM15]) and magnetometer (fluxgate gradiometer [Geoscan Instruments FM36]) surveys (at 1.0m $\times$ 1.0m and 1.0 $\times$ 0.5m reading intervals respectively). The data from these surveys were processed and the site interpreted as being predominantly glacio-fluvial with some overlying

archaeology - possibly building platforms. A series of 6 targets were chosen to conduct high-resolution GPR surveys (225Mhz and 450Mhz [Sensors and Software's PulseEKKO 1000]) in order to clarify the initial findings. The radar data were inspected using both vertical sections and time-slices.

A number of Palaeo-river channels (up to 10m wide and 1.5m deep), banks and islands were discovered as well as a distinct building platform (at least 20m x 20m) with a marginally less well defined, slightly smaller structure to the west of it. Associated with these buildings appeared to be some form of landscaping. Other features included ancient field boundaries and pipes. It was concluded that the use of a sequential strategy not only increased radar's efficiency, thus making it a more justifiable technique, but allowed the user to take advantage of the powerful three-dimensional imaging capabilities.

Complementing Ground Penetrating Radar with resistivity pseudosections - David Elks

The problems with the application of ground penetrating radar (GPR) in archaeology are well documented. This study addresses the problem related to the near field zone of the GPR transmitting antenna, whilst concentrating on depth analysis.

The near field zone occurs because of the curved shape of the emitted electromagnetic wave front, it can have the effect of masking out responses from shallow objects, leaving them undetected. In an attempt to aid the interpretation of shallow features this investigation has gathered both GPR data and resistance data over two archaeological sites.

Both GPR and resistance data are converted to map and cross section form. These have been interpreted separately and compared qualitatively. The data have also been processed to a common format, which allows them to be combined together. The GPR data that are recorded in the near field zone have been removed and replaced with resistance data from the corresponding depth. This technique allows a single cross section to be produced, which has the advantage of the increased resolution of GPR, with the added benefit of being able to detect the masked-out shallow features.

The test sites used are the Roman Villa at Beadlam and the Late Neolithic/Early Bronze Age henge complex at Thornborough, both in North Yorkshire.

An archaeo-geophysical assessment of the GEM-300: a new electromagnetic technique - James Bonsall

This research examines the performance of the GEM-300, a new multi-frequency electromagnetic geophysical instrument, upon a series of archaeological sites in the north of England, with emphasis placed upon its ability to detect subtle archaeological features.
Field data were compared and contrasted with the established techniques of earth resistance and magnetometer surveys. It was found that the EM in-phase data may improve the resolution of magnetic data with respect to ferrous material, and that great success may be achieved for the location of conducting features with the quadrature data. The simultaneous collection of multi-frequency data has provided two new methods for the examination of three-dimensional geophysical data; the EM frequency slice and the EM pseudosection.

A variety of survey procedures have identified ideal parameters for the collection of EM data despite the serious shortcomings of the instrument (e.g., drift, instability). However attempts to calculate apparent conductivity and apparent susceptibility data for direct comparison with earth resistance and magnetometer data were unsuccessful due to these shortcomings.

The use of low frequency electromagnetic methods in archaeological prospection - Frances Williams

Beadlam Roman Villa, North Yorkshire and Thornborough Southern Henge, North Yorkshire were surveyed with fluxgate gradiometers (Geoscan FM256 and FM36), an earth resistance meter (Geoscan RM15, twin probe) and a number of electromagnetic (EM) prospection instruments; Geonics EM38B, White's TM808 metal detector, Bartington MS2D field coil and a Pulsed Induction Meter (PIM). The results from each survey method were analysed and compared with each other to determine how useful such EM methods are in archaeological prospection. The data from each method were also used together to complement the other's findings to give a better archaeological understanding of each site. The coefficient of magnetic viscosity was calculated using PIM and MS2 data by calibrating the PIM and combining the two datasets.

The EM instruments were useful in finding anomalies not found in regular methods but, due to ease of surveying, data handling and interpretation, it was concluded that the fluxgate gradiometer and earth resistance survey methods should be used over EM instruments for normal archaeological sites, and EM

instruments should be used on sites where traditional methods do not work so well. These include sites with very hard soil or rock where EM instruments can measure the conductivity without probes, or sties with highly magnetic geology where EM instruments can measure the magnetic susceptibility of the archaeology rather than the remanent magnetic field produced by the geology.

Archaeological assessment of urban and brown field sites by geophysical prospection - Kenneth Hamilton (PhD thesis)

The project aims to develop a methodology for the investigation of urban and brown field sites, using those geophysical techniques that are most commonly available to commercial field archaeologists. Several case studies in Bradford, Leicester, Carlisle, Keighley and Libya were used to investigate the aims and objectives of this project. The project found that the interpretation of magnetometer surveys in urban areas was complicated by the effects of large iron objects on the surface, which produced extended ferrous anomalies, masking smaller archaeological anomalies. Ground Penetrating Radar was found to be adversely affected by the ground conditions on urban sites, with depth penetration greatly reduced, and interpretation very difficult due to the complexity of results. Sampling strategies were derived for the investigation of urban and brown field sites, utilising high-resolution surveys.

The project examined integrated prospection strategies and confirmed the importance of complementary techniques, as well as the inclusion of as many non-geophysical data as possible in the interpretation of a site. In particular, documentary evidence was found to be particularly helpful when examining industrial archaeology sites. The project examined the possibilities of data processing. Most currently available processing methods were found to be inadequate for processing data from urban and brown field sites, because of a combination of the amplitude of unwanted anomalies and the similarity between anomalies of archaeological interest and unwanted anomalies. Time slices were found to be a particularly effective method of displaying and examining Ground Penetrating Radar data. The possibilities of animation as a method of displaying complementary data and ground penetrating radar time slices were examined.

Update from the Near East

Tomasz Herbich Institute of Archaeology and Ethnology, Polish Academy of Sciences, Warsaw, Poland

In September/October 2003 Tomasz Herbich carried out for the Polish Center of Mediterranean Archaeology a magnetic survey in Jiyeh (Lebanon), a Roman and Byzantine town north of Beirut. The prospection was carried out on a necropolis endangered by the building of a hotel complex on the outskirts of the town. Unfortunately, bulldozers had already destroyed most of what could be found in the cemetery. In the town area, the survey detected the remains of a basilica. Geophysical prospection in archaeology may soon become a commonplace thing in Lebanon as the local antiquities office has established a well-equipped geophysical laboratory including equipment for magnetic, electric resistivity, electromagnetic and radar surveying, everything with appropriate state-of-the-art software and trained personnel (!). Japan has provided sponsorship for purchasing the required equipment.

In October 2003, Herbich went back to Saqqara to conduct a survey this time for a Louvre Museum expedition. Prospection covered an area next to the causeway of the pyramid of Unis, to the southeast of Djeser's enclosure. Work was hampered by disturbances and rubbish on the surface, both the effects of earlier excavations in the area. Even so, the results brought to light an interesting structure (possibly a mastaba), to be verified archaeologically in the coming season.

In January 2004, Herbich participated in the work of an American-British mission in Khargah Oasis. Magnetic prospection of two Roman-period settlements brought to light in one of them (Muhammed Tuleib) a complex of furnaces.

Archaeological trials of the University of Leicester Multi Sensor Platform

Chris Leech Geomatrix Earth Science, Hockliffe, Bedfordshire, UK

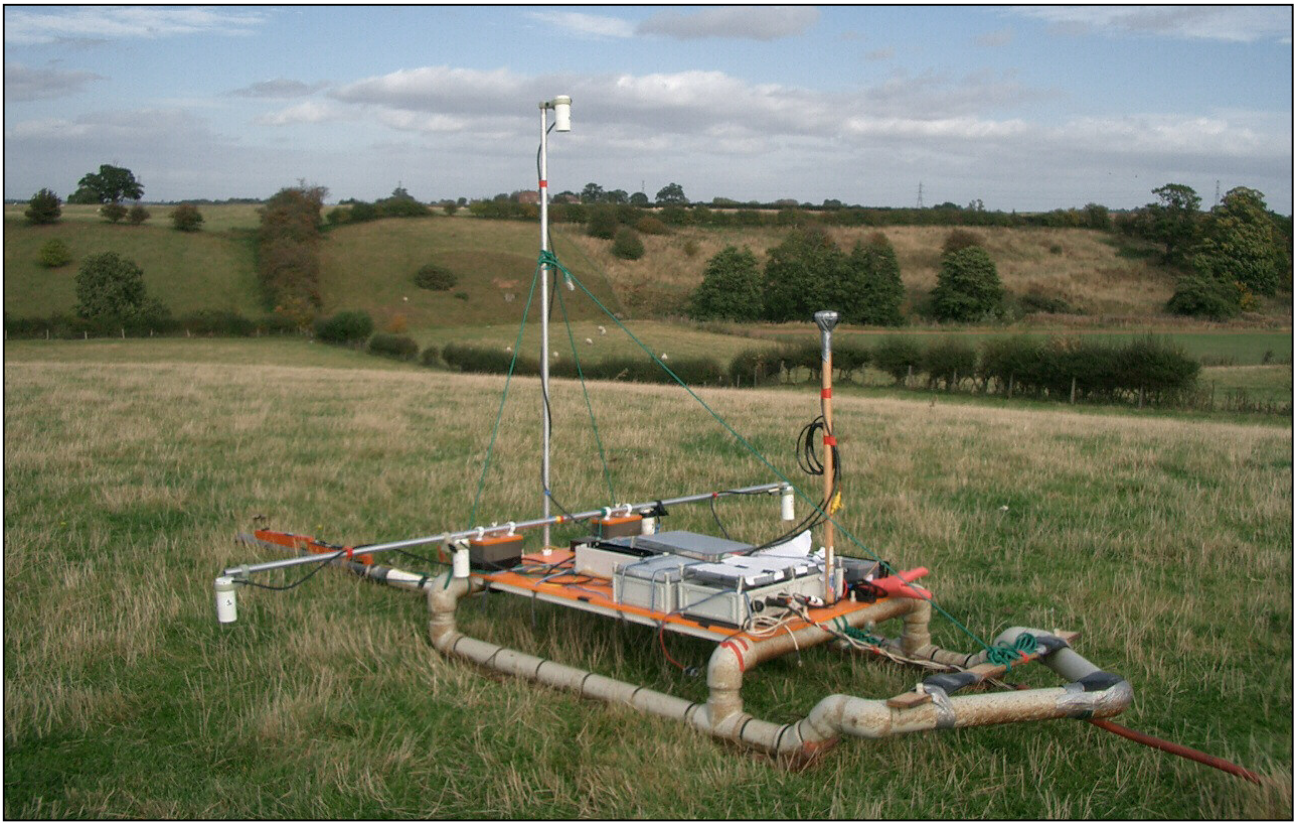
Dr. Ian Hill and Tim Grossey of the University of Leicester's Geology Department ran a series of tests at Wroxeter in October 2003 with the department's Multi Sensor Platform (MSP) towed by a small all-terrain vehicle.

The idea is to determine if a rapidly moving platform such as this can produce good enough quality archaeological data from multiple sensors to be of use for archaeological prospection on large surveys whilst also being applicable for mineral and site exploration purposes. The sensor arrays deployed can be tailored towards the application and the MSP is towed at approximately 7kph, though this can be reduced.

Up to 30 line km have been traversed in a single day with the MSP, which translates to 180 line km of data in the case of six caesium vapour magnetometer sensors mounted transversely at 1m spacing. Different sensor arrays have been experimented with, and the data is still being processed at this time, so we cannot say yet which array type and sensors give the best results.

The photo below shows the MSP carrying four caesium vapour magnetometer sensors with one on a mast as a compensating sensor, also the Geonics EM38 and a differential GPS.

Dr. Ian Hill is a Senior Lecturer in Geophysics; Tim Grossey was a Geophysics Research Student and has now moved into the commercial world.



International Conference on Remote Sensing Archaeology, Beijing

18-21st October, 2004

Venue: Beijing Friendship Hotel, China

Organized by: Chinese Academy of Sciences; Ministry of Education, PRC; Ministry of Science and Technology, PRC; Ministry of Culture, PRC; National Bureau of Cultural Relics, PRC & the National Natural Science Foundation of China.

Hosted by: Joint Laboratory of Remote Sensing Archaeology, in affiliation to the Chinese Academy of Sciences, Ministry of Education, PRC; and National Bureau of Cultural Relics, PRC.

Conference Themes and Main Topics:
The theme of the conference is **"Understanding Historical Cultural Heritage with Space Technology"**. As the acquisition of spatial information is advanced dramatically in today's digital era, more and more high spatial and spectral resolution remote sensing data as well as multi-frequency and multi-polarization SAR images are available for archaeological research, and the application of space technology are becoming an important component in world heritage conservation. The conference of "Space Applications on Cultural Heritage Conservation", held in November 2002 in Strasbourg of France in dedication to commemorating the 30th Anniversary of the UNESCO World Heritage Convention, marks the importance of spatial information for understanding the past of our history. Therefore, the conference with this specific theme will bring experts to present and discuss their latest research results in archaeological applications of spatial information, non-destructive detection techniques, and virtual heritage techniques to world heritage conservation in the historical and the capital city of China, Beijing. It is anticipated that the conference will add more knowledge to our understanding of historical cultural heritage through the applications of space technology and other cutting-edge digital technologies.

Main Topics:
- Sensors and Platforms for Archaeological Prospecting
- Techniques and Methods for Remote Sensing Archaeology
- Image Processing Techniques for Archaeological Information
- Integrated Technology for Archaeological Investigation
- Spatial Analysis of Archaeological Information
- Palaeo-Environment Re-Construction
- GPR and other Non-Destructive Prospecting Methods for Archaeology
- Virtual Archaeology and Virtual Heritage
- Cultural Heritage Conservation with Digital Technology
- Education Prospective for Digital Techniques on Archaeology

Submissions:
- Deadline for Submission of the Abstract: June 30th, 2004
- Notification of Acceptance: July 31st, 2004
- Deadline of Submission of Full Papers: August 31st, 2004
- The abstracts of 250–500 words in length should be written in English and must include: title, author(s), affiliation, address, tel/fax numbers, e-mail address. Submission of an Electronic file in text, word or pdf file format is strongly recommended. The Author(s) can send Abstract(s) by email to wcl@irsa.irsa.ac.cn

Contact:
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Useful website: http://www.rsarch.cn

Noticeboard

Competition!

Could you be the designer of the ISAP logo?

A prize of free membership for 2005 is being offered for the best design, which will be chosen by the Management Committee and adopted by the Society. It will appear on the newsletter, web site and various other places.

The deadline for entries is 31st July 2004: to enter, send your design by email or on disk/CD to the Editor (for address see below). Please provide the logo in a standard format and ensure you've included your contact details.

The winner will hopefully be announced in the next issue of **ISAP News**.

Treasurer appointed

Chris Leech has been appointed the Treasurer of the ISAP and has been busy organising important things such as the Society bank account.

Chris graduated with a BSc in geophysics and has been actively involved in the shallow geophysics industry for 25 years. He has carried out geophysical surveys of all types in Africa, India, Australia as well as the UK and mainland Europe. He has expertise in magnetic, seismic, EM and resistivity methods.

Chris is currently a director of Geomatrix Earth Science and is an active member of EAGE and EEGS; he is also secretary of EIGG, a sub-group of the Geological Society of London. Recently he has been involved with testing of a Multi Sensor Platform for geophysical survey at Wroxeter Roman City, Shropshire, UK (see page 20).

AP2003 Cracow conference web site

Tomasz Herbich would like to remind everybody that the Conference web site has been updated with news and photos taken during the Fifth International Conference on Archaeological Prospection, Cracow.

Other conferences and events

This is a brief listing of topical conferences and events coming up around the world – if there's something happening you think we ought to know about, send me the vital information for inclusion here.

AARG Munich, September 2004 – see notice p8

CIPEG International Association of Egyptology 9th Annual Congress, Grenoble, 6–12th September 2004

Contact: Krzysztof Grzymski, Secretary of CIPEG, Egyptian Department, Royal Ontario Museum,
100 Queen' s Park, Toronto, Ontario M5S 2C6, Canada.
Fax: +1 416 586 5877
E-mail: Krzysg@rom.on.ca

There is to be a Panel on "Remote sensing in Egyptology". This will cover geophysical prospection, the uses of satellites and surveying strategies. *Sarah Parcak*

EAGE Near Surface 2004, Utrecht, 6-9th September

Near Surface Division annual conference, European Association of Geoscientists and Engineers. Has a couple of sessions on archaeological subjects.

Web: www.eage.nl/conferences

EIGG "Recent work in Archaeological Geophysics" and "Forensic Remote Sensing and Geophysics", London, December 2004 – see notice p16

ISPRS "Geo-Imagery Bridging Continents"

XXth Congress of the International Society for Photogrammetry and Remote Sensing, Istanbul, Turkey, 12-23 July 2004

Web: www.isprs2004-istanbul.com

International Conference on Remote Sensing and Archaeology

Beijing, October 2004 – see notice p21

Membership

The **ISAP web site**, www.archprospection.org, is currently hosted by the University of Bradford.

The **members' mailing list** is an e-mail discussion forum for anything and everything ISAP. (It would be a good place for feedback on the newsletter, among other things ...)

Your **subscriptions for 2004** are due – thanks to those who have paid already. For enquiries about membership and subscriptions, go to the ISAP web site or contact Hon. Secretary Armin Schmidt (e-mail A.Schmidt@Bradford.ac.uk).

In case you needed reminding, it's amazing value at only £7 or ∈10 a year! Current benefits include access to the mailing list, the newsletter and a reduction in the subscription fee for Wiley's *Archaeological Prospection* journal.

Contributors to ISAP News

The Editor wishes to thank those who contributed to this issue:

R. Gabrielli et al.; Chris Gaffney; Tomasz Herbich; Chris Leech; Neil Linford et al.; Salvatore Piro, Martin Roseveare; Norbert Schleifer; Armin Schmidt and Rob Vernon.

Regional updates in ISAP News

Tomasz Herbich has proposed that a series of regional summaries co-ordinated by particular correspondents would be a good way to include an up to date overview of work in progress. He has volunteered to look after the Near East, where much of his work goes on, providing brief summaries of projects (see p19).

The Editor proposes to look after Britain and Ireland: other regions could be areas of Europe, the Americas, Far East, etc., or individual countries.

If you would like to be a regional correspondent, please contact the Editor.

The next issue of ISAP News

Issue 2 of the newsletter is planned for an August release - the **deadline for items is 31st July 2004**. Contributions of all types are welcomed, including articles, updates on your activities, reviews, letters, conference notices ...

Please follow these guidelines for contributions:

- text as MS Word document
- pictures as .jpg or .gif
- label e-mail attachments clearly, try to keep the size reasonable and zip them if possible.

Thanks, I look forward to hearing from you.

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