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Editorial

This is the second digital version of AARGnews and, apart from one dissenting voice, it is a resounding success. Digital AARGnews is a done-deal, and there is no going back. We were given a fairly spectacular pictorial start in the last issue thanks to the contribution by Lars Forseth that included some unusual crop-marked sites from an unexpected part of the world. We hope that colourful contributions will continue and that use of colour will help our comprehension of some maps, diagrams and perhaps even photographs. We tried to find a good cover photo for this issue. Toby sent some spectacular pics from Wales but they looked terrible with overwritten Contents, so I’ve thrown in a few mountains from somewhere.

This is perhaps the place to nag a little. There are still some members who have not kept our Secretaries updated with address changes, including email addresses. AARG in common with many Groups and Societies is now reliant on electronic communication, so it is vital that members take responsibility for ensuring that email addresses in particular are up-to-date. Otherwise, we will not be able to communicate with you. It is also worth noting that a printed AARGnews is not part of the membership package. Indeed, there was no AARGnews for the first ten years of AARG’s existence, and a subscription was paid for being members of the group. This holds true now, where membership benefits include early access to AARGnews through our website and reduced conference fees.

AARG 2007 Copenhagen

This was a memorable AARG thanks largely to the efforts of Claus Dam and his colleagues who’d found us a spacious venue and planned a splendid and varied social programme. Among the presentations were insights into the development and current work in Denmark using aerial information, and a useful first contact by Matt Abicht, a US colleague of Robin Standring, who gave us a really informative overview of the NARA material, especially that relevant to Baltic areas. The layout of the venue gave space for lunches and an innovative home-made bar at the end of the first day’s papers. These gave lots of time for us to talk to people as, apart from the cloud of smokers, we didn’t need to leave the hall during the day.

The field trip included Lejre, the Danish experimental centre, which was somewhere I’ve wanted to visit for years and gave the chance to see ground evidence of the early stages of decay – a process that is (for me) crucial to help understand what is recorded from the air and what it once may have been like. We had a beautiful day for the field trip, helped along by beer (and Lejre provided little beer trolleys so that it was easy to bring along the crates that mysteriously emerged from the coach) and explanations by Laurent Mazet Harhoff of parts of the site.

Hull visualisation meeting

The one-day meeting at Hull was attended by a capacity group of members including a dozen or so students that AARG had funded or assisted to be there. Some of the three-dimensional demonstrations were very impressive and some actually seemed of some use to explaining and understanding past sites and landscapes. The question of use or usefulness arose in conversation after with several people the event – just why, and how, was visualisation of use? Was it something that we were doing because we now could – in much the same way as

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the early GISers all produced viewsheds and the untrained satellite image ‘analysts’ now all try to use edge detection or other automatic processes to ‘find’ their sites? I think that ‘visualisation’ presentations can be useful but that we need to think carefully why we are using them before splashing them everywhere in archaeological publications. And we need to think more carefully about the backgrounds and foregrounds that we use in them. From examples shown at Hull I would pick those with the plainest backgrounds as most effective in showing sites in what may have been their contemporary landscape. Alison Deegan’s illustrations from a forthcoming Northants publication (details currently unknown – but it’s a Print on Demand volume from English Heritage) had perhaps the best use of simplicity over which to drape mapped information (meanwhile see a much-reduced example on the back cover of Populating Clay Landscapes). Worst, from the point of view of understanding, were those that pasted an oblique air photo over a background of colour vertical photos. In those I found the background overwhelmed the foreground and made the visualisation unnecessarily messy by inclusion of much modern detail such as fields, trees, hedges and buildings – although these may be good for site visits when they should help a user locate exactly where they are on the ground.

Anyway – if any of you fancy having a go at making your own Irwin Scollar has just written a first version of AirPhoto3D, a program that was inspired by a 3D illustration in the most recent Annual Report from RCAHMS and encouraged by conversation following the Hull meeting. See Cropmarks for more details.

Google Earth and similar web sites
A recent email exchange with Alison Deegan raised the question of how to refer to features identified on Google Earth, etc that are likely to later be replaced by another picture. Some of the England cover – now all aerial photos rather than satellite images – seems to be replaced in less than a year as was recently the case with some informative photos in and around Bedfordshire that included, for example, one of the clearest photos of Cardington causewayed enclosure that I’ve seen. Now they’ve gone, replaced with some boring green photos.

An immediate way of referring to this rapidly-changing source would seem to be to make a screen capture of any relevant parts of a layer and file it where it can be found. A reference should perhaps include the name of the copyright holder (but not the date displayed as GE seem to change these to the current year) and the date of accession, much as we do for web sites. Do any of you have other ways of referencing this material?

Students
Since last summer I’ve had a near-constant stream of students here. Alma Ziemele and Kristine Jansone from Latvia and then Ania Sokolowska from Poland. Alma began 1:10,000 mapping of a chunk of south Cambridgeshire that had been commissioned to provide context for several excavations. That project was completed by Ania before she helped with some of my 1:2500 work that got stupidly busy at the end of 2007. Kristine was given some money by Cambridgeshire County Council to get my commercial mapping and reports (1989 to 2006) into a common digital form that could then become part of the Historic Environment Record. This was not without its problems but was completed in the three months she was here. I mention these, not to show what a good bloke I am but because Ania was funded by an Erasmus Studentship. Until recently Erasmus funded only exchanges between universities and she was the first from Poznań to test the university-to-company exchange (see advert for
Erasmus elsewhere in this issue). We think that things went well and that she enjoyed the three months here. The downside is that Erasmus (or perhaps it was Poznań) seem to think that a student can survive for three months in the UK on £1000 which is not really possible.

**Control points**

Ania’s mapping of Cambridgeshire, using photos from CUCAP/ULM, led to an interesting observation. Many of the photos were early ones taken by St Joseph who, at that time, had a habit of flying just above the ground (I call them ‘standing-on-tiptoe photos’) which makes inclusion of more than one control point a fairly rare event. But Ania noticed a new element of deviousness which was to carefully place the strut along field boundaries or over intersections just to make mapping more difficult. Or perhaps it was to lose the modern context so that it was easier to visualise past landscapes? Whatever, it was a nuisance and made me wonder how any auto-recognition programs will cope with the wheels and bits of aircraft that feature in many of our oblique photos.

**Culture 2000**

The final meeting of C2000 participants was at the opening of the exhibition in Prague in October 2007. I seem to have lost the photos from that meeting (see Planning for your next computer disaster in this issue) but remember it being an enjoyable few days. The whole C2000 project seems to have been resoundingly successful thanks to the efforts of Chris Musson and has seen the completion of several projects as well as the expansion and consolidation of personal networks across Europe (see the report on the C2000 website: [www.e-landscapes.org](http://www.e-landscapes.org)). We’ve learned quite a lot about organising and running something of that scale and duration. If there’s to be a C3000 (or whatever the next one is called) there perhaps is need to include costing for administrative help and perhaps also something for Chris, as without someone as willing and ‘retired’ as he is it’s unlikely that C2000 would have got off the ground.

**This issue...**

...has been laid out in chunks of subject matter. After dealing with future and past AARGs there are three papers about aspects of computer use – a review of transformation programs, detail about some of the new image processing applications that have been added to AirPhoto, and a heartfelt piece about computer disasters. All three owe much to Irwin Scollar who, at about 79½ does more per week than most of us. Two papers show uses of aerial sources. First are some uses of archival photographs in Greece – a welcome contribution from a relatively unknown (by us) part of the world. And this is followed by uses of ALS as part of the Irish Discovery Programme. We hope the PDF resolution of those illustrations retains the superb detail of the original files sent to AARGnews. There follow contributions about education (Erasmus programme), collections of photos (TARA and Aerofilms) and the usual scraps of information that have come in over the past six months.

There have been a few queries about our restriction of AARGnews to about 50 pages. There are several reasons for this, among which is the need to keep the eventual PDF file sufficiently small for relatively speedy downloading. Without too many pictures, and using low-resolution conversion, this seems to work and there has already been some discussion within the committee about the possibility of lodging higher-resolution files on the website for any members who need to see detailed illustrations. Any thoughts on this?
Chairman’s Piece

Dave Cowley

Strategy
The AARG committee has been giving some thought to medium and long-term strategy and planning. This is vital if AARG is to continue expanding and maintain its relevance in the face of changing approaches to (aerial) archaeological prospection. The development of longer-term perspective is manifested in a number of ways. Firstly, we are planning conferences further in advance and I am pleased to inform you that the 2009 conference will be in Italy, hosted by the University of Siena (September 25-27th), with Romania in 2010. Discussions are underway that I hope will see us in Poland in 2011. Beyond that, please speak to a committee member if you have a desire to host a future conference. Secondly, the AARG/EAC working party on Aerial Archaeology connects us with the Heads of the State Heritage bodies of Europe, complementing AARG’s long track record in engaging with grass-roots workers, for example in training schools. This is important in promoting the appropriate use of aerial imagery at institutional levels across Europe. Thirdly, at the last committee meeting in February 2008, we co-opted Chris Musson on to the committee as ‘Development Officer’, with a remit to look at expanding AARG’s sphere of influence into new areas, and to coordinate projects and funding proposals, including looking at schemes that may replace the C2000 initiative. The experience that Chris has developed during the C2000 project uniquely qualifies him for this role, which I believe will be a key one for developing longer-term strategies.

Copenhagen 2007
I enjoyed our 2007 conference, and so it seems did many of you. The success of this event is a credit to Claus Dam and his colleagues in LAND (Luftfoto arkaeologisk Netværk Danmark; http://www.luftark.net/) and the Danish Heritage Agency. They were consummate hosts (crisps and beer appearing on cue) and for the AARG committee this was an excellent collaboration with ‘local’ hosts, and provides a robust model for us to develop in the future. The showcasing of Danish aerial archaeology (which included Bahrain in the Middle East!) was a particular high point for me in adding ‘local flavour’ to our conference and is something that I believe we must maintain. The Education debate session was a little too much ‘reporting’ and not enough ‘debate’, but this is a reflection of the hard work of the Education Working Party in during the months before the conference. It is something that we can give thought to in the future, especially with pre-circulation of paperwork, but is not something that should detract from the excellent work that the Working Group have done under Ioana Oltean’s able direction.

Hull workshop
On the 12th December 2007, The HIVE, a 3D visualisation suite at the Department of Computer Science, University of Hull, UK, hosted a workshop on ‘Aerial Archaeology, Computer Visualisation And Past Landscapes’. The idea for this came from Peter Halkon, drawing inspiration from the excellent 3D work presented at the Space 2 Place conference held in Rome in December 2006 and Hull’s excellent track record in this area (e.g. http://www.dcs.hull.ac.uk/simvis/). The Hull workshop was a successful collaboration

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between AARG and the SimVis Research Group, University of Hull, and I would like to thank Peter Halkon and Paul Chapman for ensuring that everything worked well. One of our key aims for the workshop was to attract as much student participation as possible and in the event we had 15 students out of the total 45 delegates (the maximum capacity of the venue). Twelve students received bursaries to attend, and for this we are grateful to the Association for Cultural Exchange in Cambridge (http://www.acestudytours.co.uk/) for a very generous bursary fund, without which student attendance would have been negligible (see below).

Integrating Aerial Archaeology
It is probably unwise to pick out a few papers from an excellent range of presentations at the Hull workshop, but my personal highlights were the papers by Anthony Beck, Keith Challis and Stefano Campana and the concluding comments from Dominic Powlesland. Anthony, Keith and Stefano highlighted how important integrated approaches to landscape are, where differing sources of information are interrogated to extract the maximum information. This was a theme that Stefano took up with a paper on ‘Total Archaeology’. The importance of this work to me lies in the application of an intensive approach to landscape pioneered by Dominic Powlesland in Yorkshire (see http://www.landscaperesearchcentre.org/) at a regional scale. This is important because it forces us to think about scale, and the integration of highly detailed, local information, with less detailed regional data. The integration of techniques, whereby the landscape archaeologist can draw on an extensive ‘toolkit’ of approaches was a keynote and a point that was reiterated in a typically ‘Dominic’ summing up. The ‘worlds’ of aerial archaeology/photography and remote sensing are on a convergent course and it is a credit to many of our members that they are routinely working in an integrated way, and this is something that, in promoting best practice in landscape-based work, AARG needs to keep at the forefront. It is with this in mind that a ‘Total Archaeology’ workshop is being planned in collaboration between the University of Siena and AARG to follow on from the 2009 conference. Here, general papers on approaches and techniques will be followed by small workshop sessions working with data, and field visits into the Tuscan landscape to explore the issues in the flesh. An exciting prospect, and one that can be extended into other areas as opportunities arise (or are created). Indeed, a symposium/workshop in Iceland, also in 2009, is under active discussion with the Archaeological Heritage Agency of Iceland and the Institute of Archaeology in Reykjavík.

Student and Young Researchers Bursaries
For many years now AARG has had a small fund to support student attendance at its annual conference. This has been supplemented over the last year by additional AARG funds and, for Hull, a very generous grant from the Association for Cultural Exchange (ACE – http://www.acestudytours.co.uk/). Between Copenhagen and Hull, we have supported students from Armenia, Austria, Denmark, Germany, Greece, Holland, India, Italy, Mexico, Poland, Sweden, Romania and UK. Our conferences are an ideal opportunity to keep abreast of new developments, and to make contacts and develop networks. There is also a long tradition of encouraging postgraduates to present their ongoing work in a friendly environment – providing the forum for exchange of ideas and approaches across national boundaries. The additional funds that we have been able to attract for the bursaries has allowed us to expand the remit from students to consider supporting young researchers who do not have access to funding to attend the conference. As importantly, from supporting at most 5 or 6 bursaries in the past, we are hopeful that 15-20 bursaries will become the norm if
we can maintain sources of funding. Details, as usual, are at the bottom of the conference announcement in this newsletter and on the website.

The generous support of the Association for cultural exchange in Cambridge allowed 12 bursary students to attend the Hull workshop, pictured here with Stefano Campana, the keynote speaker.

**AARG/EAC Aerial Archaeology Working Party**
The compilation of the work of the Education Working Group is continuing with a view to circulating for comment during the spring and early summer. Beyond this, we will need to give some thought to the products of the WG, which are likely to include web resources and a range of printed outputs. Work has not yet started on the Standards WG, and this will now be delayed until later in 2008, to allow the Education WG to be completed without too many competing interests – unfortunately there are only so many hours in a day! In early March, I will report to the EAC meeting in Romania on progress to date and raise with them the issues of products for the Education WG and the scope of the Standards WG.

**Networks**
The Danish LAND network has been an inspiration to many of our members. In Copenhagen it stimulated the formation of a Dutch network called DECARS (Dutch Expertise Centre for Archaeological Remote Sensing), with a stated intent is to promote the application of archaeological remote sensing (aerial archaeology, use of existing aerial photography and satellite imagery, etc.) in the Netherlands. A similar network is being planned in Germany (contact Johanna Dreßler – jodressl@students.uni-mainz.de), and is under consideration in Italy. Such networks are an excellent development and, I believe, complement AARG – we will be happy to do anything it can do to help encourage them. And on this note I will finish with a suggestion from Gianluca Cantoro, one of the student bursaries at Hull, which I feel highlights a great AARG strength – that our networks, whether as an international organisation or at a national level, really mean something: ‘Concerning AARG, I’d like to propose a change of name from AARG to AARF (Aerial Archaeology Research Family!). In the meeting I felt to be between friends, and I like it.’
**AARG 2008 LJUBLJANA : 9 - 11 September 2008**

**Proposals for sessions, papers and posters are invited**

**Session abstracts**

Provisional session abstracts are listed below. Suggestions for additional sessions should be sent to Dave Cowley with a short abstract, and if known a list of participants. Unless otherwise stated, all sessions will be organized centrally.

**Aerial Archaeology in the Mediterranean**

As the AARG annual conference has moved around Europe, sessions designed to showcase work in the host country or region have become an important component of the conference. The geographical focus for this session takes in countries in and bordering the Mediterranean, with its huge range of landscapes, ranging from maritime to alpine.

**New Projects**

This session is designed to allow for the presentation of work-in-progress, and also for projects at an early stage, where research design, methodology etc. can be presented for peer review and comment.

**Postgraduate research**

AARG has a long tradition of encouraging postgraduates and young researchers to present their research in a relaxed environment, and give them exposure to experts in their fields and provide an opportunity for necessarily incomplete research to be presented.

**Airborne Thematic Mapping/Airborne Laser Scanning**

Despite broadening horizons in recent years, ‘Aerial Archaeology’ is still, for some, synonymous with applications of traditional aerial photography. There is now a range of remote sensing platforms, ranging from LiDAR to multi-spectral sensors, that require exploration and development as part of the aerial archaeologist’s ‘toolkit’. This session will present recent research in these areas.

**An archaeology of natural places … from the air**

Session Organiser: Dr Kenneth Brophy – contact: k.brophy@archaeology.gla.ac.uk

What do we do when we see ‘natural features’ from the air, or on prints?

Participants in this session will be challenged to reflect on how natural features are filtered out through traditional aerial archaeological practice, whether in the air (the decision not to photograph), or on the photographic print (classifying cropmarks as ‘natural’ or ‘geological’ but not regarding these as of any significance). This mirrors the treatment of natural features found during excavations (tree throws, animal burrows, frost wedges, hollows, silty deposits and so on). These are partially – or not – recorded, usually not sampled, and generally treated as of little archaeological significance. Yet there is an increasing body of archaeological literature that suggests we should be taking an ‘archaeology of natural places’ seriously, or at least, as archaeologists we should be taking natural features more seriously. From ‘structured’ deposition in tree throws, to subtle topographic and soil variations associated with geomorphological features such as relict streambeds, these unmodified and ‘natural’ phenomenon may have played a part in the location, meaning and function of activities in the past.

Aerial archaeology is in a unique position to record, identify and map a range of small-scale and widespread topographic and environmental phenomenon, especially as these features show best as cropmarks in the same locations as our archaeological cropmarks. It is hoped that participants will discuss their experiences of cropmarks of natural features from across Europe, dealing with some key issues:

- How best should we record cropmarks and other natural features from the air?
- Where should we stop; indeed, is there any point at all?
- How readily are tree throws visible across Europe, and what work – if any – has been done on them?
- How are archaeologists across Europe using the aerial resource to move beyond the cultural boundaries of what we call ‘sites’?

**Aerial photography in context – recording landscape and urban areas**

As a routine archaeological aerial survey takes in non-archaeological subjects, including buildings and broader landscape character recording. This session explores the role of aerial photography in documenting other aspects of the cultural heritage, including landscape characterization, architectural recording and urban areas, with reference to both historic photography and current recording initiatives.

Email dave.cowley@rcahms.gov.uk
Report on the AARG Conference, Copenhagen 2007

Johannes Heinzel

I attended the AARG Conference in September 2007 as a PhD-Student from the University of Freiburg in Germany, funded by a bursary from AARG. As a geographer with my main research field in LiDAR remote sensing methods I have a special interest in archaeological and geoarchaeological applications. Through my geoscientifical works on different archaeological excavations in southern Germany I have developed an interest in combining this cultural aspect with my research. As my colleague Benoit Sittler, who works on detecting so called Wölbäcker, a kind of ridge and furrow field system, with LiDAR, asked me to join this conference, I found that it would be very useful to get a closer impression of the archaeological view on remote sensing.

The presentations and posters at the conference showed me that in general archaeological remote sensing is highly application and results orientated. That means that consideration of technical aspects is in most cases reduced. The typical and traditional method consists of the visual interpretation of aerial photographs with the background of a professional archaeological knowledge to detect and interpret relevant patterns. Within that, the technique that is most developed and applied is to get information from vegetation areas of a homogenous surface. Crop fields are especially suitable where, depending on buried objects and soil structures, growth features of the vegetation give an image of what is underground through crop marks. Several presentations and posters of the conference dealt with aerial photo interpretation in this area, for example VINTER, VENNERSDORF and HEWITT et al.

On the other side some presentations showed that there is also a certain usability and need for other remote sensing techniques. These refer to subsurface exploration with methods like geomagnetic survey (VOSS & SMEKALOVA) as well as to air- and spaceborne sensing. KAUPALIANZ & SITTLER showed examples for LiDAR applications, VLETTER for the usage of photogrammetry and CROSS undertook GIS analysis. Some of these techniques, like LiDAR, seem to be in their initial stages for archaeological applications. I think a closer cooperation between remote sensing experts and archaeologists could only be of advantage for both sides. Archaeology would gain a more direct knowledge of techniques and the development and applications of remote sensing techniques itself could be steered into a certain practical direction. As a LiDAR expert I see multiple and widespread application possibilities for this method. Most advantageous seems to be the fact that it is possible to get digital terrain models (DTMs) in centimetre resolution range even under forest and other vegetated areas. It is a rapidly growing technique which gives geometric information of higher precision than airborne radar.

In conclusion I can say that the variety of remote sensing methods seems to be an excellent tool for archaeological survey and many have been in use for a long time. On the other hand, an improvement of the technical details would probably lead to even more and maybe more precise information for large area surveys. Finally, a very personal impression for me was the realisation that it is possible to get the required information with very simple and therefore

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low cost techniques. Two years ago I was asked to accompany an archaeological research project in Peru and to carry out a photo flight with really simple methods and techniques. That time I rejected the offer because I thought it wouldn’t succeed. Also, the common opinion of my colleagues who are used to working with the highest precision equipment was that this undertaking would be unprofessional and would not produce any useable results. Meanwhile I’ve learned that this needn’t be true. In fact it is possible to get a photo series with common hand-held cameras and even orthorectify them with useable results - it all depends on what information and accuracy is required.

All references in text are to the: AARG Conference Copenhagen 2007, Book of Abstracts.

CROSS, E.  The monuments of Neolithic and bronze age Lincolnshire.
KAUPALIANZ, L. & SITTLER, B. LiDAR surveys of archaeological sites in the Upper Rhine Valley.
VENNERSDORF, M. Aerial archaeology and desktop survey on Bornholm – an overview of resources and results.
VINTER, M. Recent results of aerial survey and archive studies from the northern part of Jutland.
VLETTER, W. The discovery of a motte through the application of photogrammetry to archaeology.
VOSS, O. & SMEKALOVA, T. Aerial photographs and magnetic survey for archaeology.

The demise of NAPLIB

NAPLIB, the National Association of Aerial Photographic Libraries, agreed to dissolve itself on 12 February 2008. Formed in 1989, NAPLIB may be best known to AARG members for the two editions of the Directory of Aerial Photographic Collections in the UK.

There are various bequests, some to AARG, that will be made public in due course but of immediate interest may be the following offer.

NAPLIB is offering AARG members a free copy (while stocks last) of The care and storage of photographs: Recommendations for good practice by David Wilson.

In the UK: to receive your free copy, simply send an C5 self-addressed envelope with stamps to the value of 34p, for 2nd class return postage within the UK, to the following address: NAPLIB, c/o English Heritage, Kemble Drive, Swindon SN2 2GZ.

Outside the UK: please contact Dave Cowley (dave.cowley@rcahms.gov.uk) who will arrange to get a copy to you.
A Beginner’s Guide to Transformation Programs

Compiled by Irwin Scollar, Rog Palmer, Michael Doneus, John Haigh, Kevin MacLeod and Dave Cowley

The following Table – largely designed and compiled by Irwin Scollar and with input from John Haigh – was produced following a request for information to Dave Cowley (who wrote the following introduction) asking about the current range of transformation programs.

‘Bloody good maps’ (© Rog Palmer) should be one of the primary outputs of any aerial survey work. Mapping is a process that obliges you to observe closely, to make interpretations and to piece together often-disparate bits of information. In mapping we create shapes and pattern – both attributes that underpin the contribution of aerial survey to understanding the past. Morphology allows us to group sites and compare them, while the spatial dimension creates the basis to look beyond sites at landscapes. This is the bread-and-butter of aerial survey and is simply not possible without ‘bloody good maps’.

Leaving aside true photogrammetry, which is beyond the reach of many, either because of costs or available photographs, this review presents the available software to transform the oblique view that we all love (!) into a true, undistorted plan view. We are aware that available software has developed over many years and the available statements of capabilities are now well out-of-date (Haigh 1996; 1998; 1999; Scollar 1998; 2002. See also Palmer 2000 in which the development of programs is summarised and, for anyone wanting to see the maths behind the transformations and illustrations showing how different algorithms transform the same photo, Scollar et al 1990). Developments continue apace and to maintain the currency of this piece it is linked to the AARG website, which will be updated as necessary.

The Table includes the two low-price purpose-written programs – Aerial and AirPhoto – two free programs – PerCor (a mini AirPhoto, but different) and ILWIS GIS (a GIS that includes a considerable amount of image processing and transformation facilities) – and the costly Leica Photogrammetry Suite and Erdas Imagine. They are compared using a set of headings that isolate general aspects or functions of the programs, and within those are further divided into specific characteristics.

Details of programs in the Table and downloads where appropriate are at the following sites:

Aerial
jghaigh@aerial5.co.uk

AirPhoto and PerCor
http://www.uni-koeln.de/~al001/airdown.html
http://super5.arcl.ed.ac.uk/baspmirror/airdown.html
http://www.baspsoftware.org
http://wings.buffalo.edu/anthropology/BASP/airdown.html

ILWIS GIS
http://52north.org

Leica / Erdas Imagine
http://gi.leica-geosystems.com
To help any of you who are not familiar with some of the terms in the Table, Irwin Scollar has extracted many of them and compiled a six-page glossary. This, along with the Table, has been placed on the AARG website.

Specific questions about individual programs (but not Help lines) may be addressed to:

Aerial: Kevin.MacLeod@rcahms.gov.uk
AirPhoto: rog.palmer@ntlworld.com

References
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<td>Feature</td>
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<td><strong>Zoom &amp; Pan</strong></td>
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<td><strong>Basic Operations</strong></td>
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<td>LM automatic minimization of reprojection error</td>
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<td>Graphic simulation prior to transformation</td>
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<tr>
<td>Perspective, DLT with DTM</td>
<td>Perspective, DLT with DTM</td>
<td>Fischler-Bolles resection</td>
<td>Homography in homogeneous coordinate system. Optional radial lens correction, 2nd Order</td>
<td>Affine, Polynomial Perspective, Direct Linear Transformation with DTM</td>
<td>Perspective (LPS) Affine, Rubber Sheeting, Polynomial, etc (Erdas)</td>
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<td>Fischler-Bolles resection</td>
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<td>Vector, Raster, Digitizer</td>
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<td>Yes, Burt-Adelson seam blending, White point equalization.</td>
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<th>Optimization Methods</th>
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<td>Singular Value Decomposition</td>
<td>Singular Value Decomposition, Levenberg-Marquardt minimization of reprojection error in multiple images</td>
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<td>ILWIS GIS</td>
<td>Leica Photogrammetry Suite, Erdas Imagine</td>
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</table>

**Miscellaneous**

**Extras**

- Digitized coloured overlays on rectified image.
- Anaglyph programme, LiDAR data import, under development
- Luminance, Retinex, Wallis, ACE Colour processing, 3D Flight simulator, Aerial RDA import/export
- N/A
- Stereo-Pair Anaglyph Stereogram-Epipolar on overlapped area in two images

**Automatic Mosaicing, Ortho Radar, Stereo Synthetic Aperture Radar, Classification, 3D Virtual GIS, Atmospheric Corection, Assisted Feature Extraction, LIDAR Terrain Extractor**
Locally Adaptive Tone Mapping for Colour and Exposure Error Correction

Irwin Scollars

A large number of colour and greyscale images made on film material, and a considerable number made with digital cameras have both colour, brightness and contrast problems which make archaeological features difficult to see or reproduce adequately on a display or a printer. Many methods are available for correction in conventional photographic software packages, but often these require a lot of hand labour.

Fully automatic correction techniques are not possible, given the variation in image sources and data obtained under all imaginable conditions, but a number of methods are available which can be of great assistance.

First, a brief review of image production compared with the working of the human visual system is offered. Then, some of the methods chosen are reviewed, and finally, a number of results are presented.

Sensors:

Figure 1 Luminance range of natural scenes

From a night sky to direct sunlight, the luminance of a natural scene can range from 0.0001 to 10,000 candelas per square meter. Human vision is capable of adapting to large portions of this enormous range, with reasonably constant colours perceived. Images made with digital or film cameras do not have the adaptation capabilities of the eye and brain. Colours or greyscale values either saturate at high luminance levels or are indistinguishable at low values. Output devices including printers and displays have a far lower dynamic range than film, digital sensors and human vision, so means of mapping the data from the sensor which reduces the dynamic range without losing information are required.

Figure 2 Bayer colour filter array

The silicon digital sensor used in most digital cameras contains a uniform array of CCD or CMOS pixel sensors covered with a filter invented by Bayer at Kodak in the 1970's and which bears his name. These filters limit the spectral response of each diode to either the red, green or blue region. Exceptions are the Foveon sensor used in Sigma cameras which has the elements stacked vertically, or in the Fujifilm S5 Pro which has sensors of two different sizes and sensitivity in order to increase the dynamic range. The Bayer pattern may differ slightly between various sensor manufacturers, but there are usually more green than red and blue sensors.

al001@uni-koeln.de
Figure 3 Micro-lenses + Bayer array, Spectral Response

Each sensor element is covered by a micro-lens which concentrates the light coming from the camera lens. The colour of a pixel of the output image in consumer-grade cameras is a weighted combination of the response of all the sensors in a small area and transformed by the camera's internal processor into JPEG output. So-called RAW output from professional cameras contains the values of the individual sensor response to the colour of the filter above it and processing is done by external software usually to make a file with Tiff format.

At high light levels, sensors saturate and produce no further output. At low levels, statistical fluctuations in the number of photons intercepted by the sensor limit the accuracy of the necessary conversion to digital form. The larger the physical area of the sensors at each pixel, the more photons can be intercepted and the effect of fluctuation is reduced. Hence the ratio of output signal to photon fluctuation noise and the resulting dynamic range of the sensor between high and lowest light levels depends on the physical area of the CCD or CMOS array divided by the total number of pixels. For constant physical sensor size, larger numbers of pixels (the megapixel number) reduce the dynamic range available. Smaller sensors are cheaper to produce so consumer-grade cameras have much smaller sensors than do professional cameras. Hence their dynamic ranges are lower, and in dark areas, information is not recorded.

Figure 4A Transparency film layers

Modern colour films have a complex structure of nine or more layers containing blue, green and red sensitive silver halide crystals and dye couplers along with filter and antihalation layers. The sensitivity to light of a given layer depends upon the grain size distribution of the crystals, the larger ones being able to intercept more photons and thus respond to lower illumination levels. Some films
even have two layers for each color with different grain size distributions in order to increase their
dynamic range. The signal to noise ratio depends on the graininess of each layer. As a rule, the
dynamic range of film is less than that of a professional grade digital sensor. However, saturation at
high light levels is also less so that the total light range covered may be greater, but given the signal to
noise ratios, the total dynamic range after digitising is nonetheless lower.

Figure 4B Comparison of dynamic ranges of a high-end camera and a professional film

Films must be scanned if used for digital processing, and the optical and geometric properties of the
scanner used introduce some additional limitations on the resolution and dynamic range of the
resulting images. Optical enlargement and chemical paper printing introduce further reduction in
dynamic range.

Figure 5A & 5B Cross-section and front view of an idealized retina

Considered as a sensor, the retina is composed of two main layers, the inner plexiform layer (IPL)
which is the location of the synaptic triad of cone, horizontal, and bipolar cells, and the outer plexiform
layer (OPL) where bipolar, amacrine, and ganglion cells communicate. In these layers, horizontal and
amacrine cells have a role of horizontal connectivity, where bipolar cells transmit signals from the IPL to OPL. Cones sample light and ganglion cells transmit information to the visual cortex. Along with the contraction and expansion of the pupil which alters the light coming from the lens, this complex structure can adapt to different light and colour levels far more subtly than any film or digital sensor.

**Algorithms for locally adaptive processing of high dynamic range (HDR) images:**

The following HDR algorithms are based on human visual system models which simulate the local adaptation that occurs while the eye views a scene.

**Classical Retinex:**
The earliest dating from 1964 is due to Edwin Land, the inventor of Polaroid, which he named Retinex, combining “retina” and “cortex”. He tried to understand how the human visual system achieves colour constancy over such a wide range. In the Retinex model, the ratios of the relative intensities in the colour channels are kept constant under changes in illumination.

**Multiscale Retinex:**
Introduced by Thompson, Rahman, and Park in the 1990's, this improved model uses two intensity surrounds for each pixel and is fairly quick to calculate, but it introduces artefacts at the edges of large constant areas and saturates at high luminance levels. It is used in a number of commercial picture processing programs.

**Adaptive Brightness/Contrast:**
A simple model based only on local brightness and contrast was introduced by Wallis in the mid 1970's which, given the slow computers of the day, was much easier to calculate. It too introduced computational artefacts at sharp edges, but its computation is the fastest of all methods for very large images. Some unavoidable sharpening is also introduced.

**Automatic Colour Equalization:**
Rizzi, Marini and Gatta published a much more complex model for Automatic Colour Equalization in 2003. ACE is an algorithm for digital image enhancement with simultaneous local and global effects. It uses a lateral inhibition mechanism as well as a local global contrast in order to approximate the visual appearance of a scene.

The model tries to combine those two mechanisms. Within the model, each basic principle is considered as part of a unique adaptive behaviour involving the contribution of each mechanism to the final result. Each mechanism has a local and a global effect resulting from simple local interaction between pixels within the image. In fact, the model performs a lateral inhibition mechanism, weighted by pixel distance resulting in a local-global filtering on the image. This requires considerable more processing time compared with other methods in exchange for very good results.

**Adaptive Tone Mapping (MAS):**
Meylan, Alleyson and Susstünk published a locally adaptive algorithm in 2007 which is based on a simple model of retinal processing, consisting of a mosaic of chromatic samples on which they apply two nonlinear adaptive processes representing the IPL and the OPL. In the program Luminencor, the author applied it only to luminance, and using fast methods for the two smoothing steps made it even faster to calculate for large images. It produces results which are almost as good as the ACE method. It does not introduce any computational artefacts, but it does require subsequent gamma and saturation correction, both of which are very quickly calculated.

**Programs:**

All four algorithms are implemented in the author's CastCor (version 1.12 or later) and AirPhoto (version 3.28 or later) programs. His Luminencor program has the MAS method in a convenient stand-alone framework. This new method will be described here in greater detail.
Either RAW or data from camera processed JPEG, TIFF or other formats is first separated into luminance and colour components. The luminance component is smoothed with a fast Gaussian blur algorithm and then an unusual non-linear operation is applied.

This nonlinear processing step is based on an analysis made by Naka and Rushton of the response of a fish retina to different luminance surround levels. For high luminance in the immediate surrounding area, X₀, the response is almost linear whereas for lower luminances in the surrounding area the output is more and more non-linear. This enhances the data at low luminance levels as a function of the immediate neighbourhood of each pixel.
Two applications of Naka-Rushton following the Gaussian filtered luminance with different degrees of blurring are calculated. The result is then recombined with the original colour after giving it a fixed gamma correction. Finally, additional gamma correction may be applied followed by saturation correction at the user's discretion.

**Pre-treatment, white point correction and global brightness and contrast change:**

Pre-treatment for most images is usually helpful for all four methods. Unlike digital cameras, film cameras do not correct for unwanted displacement of the white point of an image. Sometimes the automatic white point correction in a digital camera will be insufficient if lighting conditions are extreme.

Badly underexposed images may require a global shift in brightness in order to bring the colour components into processing range to prevent clipping at low values. Some subsequent global contrast enhancement may also be helpful. These steps may also be applied to greyscale images, and the adaptive enhancement techniques are usually quite effective with them too.

**Figure 8 Original left, auto-white point right**

Some results:

A Kodachrome slide duplicate of the site at Conchil-le-Temple in the Somme valley from Roger Agache dating from the early 1970’s had darkened considerably, and the original was somewhat underexposed. It was scanned using a Microtek ArtixScan 4000T 35mm film scanner with automatic white and black point contrast correction. Applying an additional automatic white point correction as pretreatment in CastCor restored some of the original appearance. The original from the scanner is shown on the left, the improved image on the right in the figure.
Using the multiple cumulative processing facility of CastCor which can apply a sequence of operations to a small image before applying them to the full scale image, a Wallis locally adaptive brightness and contrast correction step was applied to the result of the previous figure. The result is better than white point correction alone. The Wallis method does not modify colour.

Instead of the Wallis Algorithm, the Meylan-Alleyson-Susstrünk (MAS) method was used. This greatly enhances the visibility of the archaeological features without making the appearance unnatural.
FIGURE 11 MULTISCALE RETINEX ON RGB COLOURS

Application of Multiscale Retinex on all three colour components without white point correction flattened all the histograms but introduces an unpleasant bluish cast.

FIGURE 12 MULTISCALE RETINEX ON LUMINANCE ONLY

Applying multiscale Retinex only to luminance and leaving the colours to be restored after processing, the result is better, but it is not as good as the MAS method.
FIGURE 13 RIZZI ADAPTIVE COLOR EQUALIZATION (ACE)

Rizzi's method gives a result which has better correction of the blue component and a fairly uniform overall colour balance. However, computation time was far greater than that required for the previous methods, and for very large images may be excessive.

FIGURE 14 MANUAL WHITE POINT CORRECTION USING BRIDGE IN UPPER LEFT AS TARGET

Automatic white point correction does not work well on badly underexposed colour image as an example from Switzerland furnished by Jürg Leckebusch showed. Manual white point correction by choosing a known white target produced more natural-looking colours, but overall contrast is rather low.
FIGURE 15  ADAPTIVE LUMINANCE CORRECTION AFTER MANUAL WHITE POINT CORRECTION

MAS adaptive luminance correction applied after the manual white point correction produces an almost perfect result.

FIGURE 16  ADAPTIVE LUMINANCE CORRECTION ON AN EARLY MORNING SATELLITE IMAGE

On this satellite image of Armenia received from Rog Palmer, Luminorc, correction on the right image after loading the same satellite image twice for larger area comparison, shows how field boundaries and other features almost invisible in the original are made visible without other brighter parts of the image becoming saturated.
Bibliography

A good general survey of the tone mapping problem is:
http://library.epfl.ch/theses/?nr=3588

The algorithm (MAS) used in Lumincor is a modified form of that described in:
http://ivrgwww.epfl.ch/supplementary_material/LM_JOSA06 HTTP://JOSAA.OSA.ORG/ABSTRACT.CFM?ID=140647

The adaptation to wide-ranging luminance in Lumincor is based on a modification of the model from:

Further references available from the EPFL web site: http://ivrgwww.epfl.ch/publications/index.html including:

The MAS implementation in Lumincor, CastCor and AirPhoto uses:
http://staff.science.uva.nl/~mark/downloads.html

which in turn follows:

with improved constants taken from:

and an end of line correction from:

Classical Retinex, see:
Multiscale Retinex methods are described in:


http://dragon.larc.nasa.gov/retinex/background/retpubs.html

The ACE (Automatic Colour Equalization) is described in:


http://www.dti.unimi.it/~rizzi/papers/prl03.pdf


The Wallis algorithm is described in:


summarized in the more accessible:


Film, Grain and Lenses and their effects are discussed on many Web sites:

Tim Vitale's web page offers a modern discussion of these items:


For an excellent general discussion of digital vs. film photography see Roger N. Clark's web site:

http://www.clarkvision.com

A good non-mathematical discussion of digital sensors is:

http://learn.hamamatsu.com/articles/

Programs:

The methods reported here are available in the following programs:

http://uni-koeln.de/~al001/castcor.html
http://uni-koeln.de/~al001/lumincor.html
http://uni-koeln.de/~al001/airphoto.html

Acknowledgements:

Fabrizio Di Vittorio of HiComponents, Ladispoli, Italy is hereby thanked for implementing and adding a fast version of the ACE algorithm of Rizzi et al. and the MRSCR version of the Retinex algorithm to the HiComponents package at the author’s request.

Laurence Meylan, formerly of the EPFL, now of General Electric Research Laboratories, Lausanne, Switzerland kindly placed her Matlab code at the author’s disposal for porting to Delphi in Lumincor.

Rog Palmer of Air Photo Services, Cambridge, UK, is thanked for testing the programmes and making suggestions for many improvements.

Joost van de Weijer formerly of LEAR, Grenoble, now at the University of Barcelona called the author's attention to the Geusebroek implementation of fast Gaussian filtering and offered helpful advice on its application to the luminance problem.
Planning for your next computer disaster

Irwin Scollar with an introduction by Rog Palmer

One evening towards the end of last year I was copying photos from an external drive to my internal data disc when I heard a clicking noise from the computer body. I stopped copying, shut down the machine and had some beer. Next day Windows started up but a search in My Computer showed that I had no E: drive – my data disc. A phone call to Dell quickly ascertained that the E: drive was dead and they offered to send me a new one. Well thanks, but ... oh dear (polite version) ... when did I last make a thorough backup?

Somewhat red-faced (as apparently I’d been telling several people that they should always keep proper backups) I had to send the dead drive to a data recovery company. I chose Kroll Ontrack which was, to my pocket, hideously-expensive but they recovered all files on that drive other than the few that were active when it died. While that disc was being recovered the new one arrived and was installed. At that point Windows, on the other drive, gave up the ghost and, after a day or two of trying ideas suggested by Irwin Scollar, there seemed to be no option other than Format C: and reinstall all the programs. One result of that loss of about two weeks plus a heap of pennies is that I now have, and use, what seems to be an efficient and effective backup (using Acronis Trueimage) and Irwin offered the following note for AARGnews that may help others of you avoid going through similar anguish.

I thought of some of the most common things, but the main idea is to get people thinking that such things happen, and not as infrequently as they would like to believe even if they have given any thought to it all. There is no absolutely way to prevent some loss of data in extreme situations, but a sensible plan and frequent automatic or manual backups greatly reduces the agony in case everything has to be restored, and certainly protects the piggy bank. If everyone did this regularly, then the data recovery services wouldn’t prosper, but then they are rather like undertakers or pathologists who one doesn’t want to see prospering too much either, how every necessary they may be otherwise.

Make a disaster plan, write it out and stick to it. Use the “what would happen if?” method to guide in making the plan. Regard all measures taken as merely reducing the effects of disasters, not eliminating them. Plan for the Tsunami even if it’s not likely to happen in your generation.

Start with the things in the inverse order of effort required to implement them. The little backups made at hourly or more frequent intervals to another machine or to a second disk can be automated as can daily backups. The weekly backups of all vital data and the operating system can be done manually or automatically. Monthly backups to external media which is stored elsewhere requires more work, but lightning does strike and buildings do burn.

Some typical “what would happen if?” questions are in order of decreasing probability and increasing consequences and effort required to reduce the damage:

1) A mistake is made when saving data to a file and something else is overwritten.
2) A program crashes when saving data.
Hourly or more frequent automatic backups with xcopy in a tiny batch file of an important data directory to another directory, preferably on another disk or a networked machine can be easily scheduled. Use Accessories, System Tools, Schedule Tasks. Use Accessories, System Tools, Schedule Tasks for simple scheduling. For more complex scheduling, open the Windows Help and study the many possibilities of the command line schtasks command. Recommended for the hearty who are not afraid of the command line window. Combined with a batch file edited with Notepad, you can do almost anything at any time if you know how to programme batch files.

3) The power fails or the operating system crashes or stops working during a save to disk operation.

An un-interruptible power supply with acoustic warning is a cheap safety belt. Use separate ones for each machine in the same room.

4) A non-fatal disk error occurs (disk partition full etc.)

Monitor the state of all disk partitions at least once a week. Never allow a disk partition to fill up to more than 50% of maximum capacity. This is also helpful if automatic scheduled disk defragmenting is available like it is under Vista or with commercial products under XP.

5) The operating system, data and programs are on the same physical disk, and it crashes.

Use a disk imaging program (e.g. Acronis) and make frequent scheduled mirror images of the whole disk to a second disk. Never use RAID 1 disk options if you have two disks, since a failure of one will render both unreadable. Use RAID 0 or better still RAID 5 (requires at least 3 hard disks).

If a laptop is involved, use Windows Backup to make full backups of the system and all partitions on the disk to files and transfer these to a network machine or write to external media like DVDs. Be sure to select the Backup System State option.

6) The backup medium (Network, second disk) fails.

Make backups to external media frequently.

7) Lightning strikes or a severe electrical disturbance damages all the hardware at a location, or the building burns down.

Put external backups on DVD in the safe deposit box of a nearby bank and mail copies to a trusted address in a different city.

This list should be augmented at each location and set of circumstances.

The solutions to each of the above will differ depending upon the number of people working on a system or systems and the place where the work is being done. There are no patent recipes, but common sense tells us that if anything can fail, it will fail with a distinct probability at the most inconvenient time.

Anti-virus and Ad-Spyware software are usually rather ineffective in these days of rapidly-spreading worms and trojans but if configured with hourly updates from the Internet, they are better than nothing. Self-discipline with regard to e-mail attachments and web links and configuration of Internet browsers to avoid trap pages are probably better.
Military trenches or Ancient Fortification Constructions?

D. Kaimaris1, O. Georgoula, G. Karadedos, P. Patias

Summary: In a wider area of Eastern Macedonia, Northern Greece, from ancient Amphipolis to Philippi, an area of 500 Km², an extensive research was conducted in order to locate buried and upstanding antiquities, using aerial photographs and satellite images as primary tools for archaeological prospection. In this paper we discuss low-relief features, detected on historical aerial photographs. They are attributed to either military trenches from the Balkan wars or WWI, or to ancient fortification constructions. Total length of these constructions is about 23 Km and future surface research may finally allow their dating.

Key words: diachronic aerial photographs, historical maps, photogrammetric processing, marks, low-relief constructions, photo interpretation, military trenches.

1. Introduction

The use of aerial photographs in the localization of buried antiquities goes back to the early 20th century (Web 1; Donoghue 1999; Bewley 2003; Driver and Musson 1999). For the first time in Greece, extensive research was conducted using aerial photographs and satellite images as primary tools to locate antiquities. Our research area was 500 sq Km in Eastern Macedonia (figures 1, 2) from ancient Amphipolis to Philippi (Kaimaris 2006).

This is an area of major archaeological importance, with sites, dating back to the Palaeolithic period, and its prime use during Hellenistic and Roman times. Besides that, this area was of high military importance during the Balkan war (1912-1913) and WWI (1914-1918).

Our research resulted in the identification, on historical remote sensing data, of hundreds of buried and upstanding monuments. In this paper we present the low-relief constructions (figure 2, 3), of which a total length of 23 Km was traced.

2. Research Data

Three hundred and twenty vertical black and white aerial photographs of the study area were collected. These were taken between 1945 and 1996, and were of scales between 1:42,000 and 1:6,000. In addition we examined a number of historical maps from 1901 to 1945 of scales from 1:20,000 to 1:200,000, 60 modern maps and 6 geological maps scaled 1:5,000 and 1:50,000. A further 80 land distribution diagrams from 1925 to 1987,

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scaled 1:5,000 complemented the research data. After their digital archiving, all data was georeferenced to the modern coordinate system (GGRS ’87, 1987 Greek Geodesic Referencing System).

Figure 3. Wider area of the constructions’ localization.
Blue colour: Water streams, black: low relief features.

3. Photogrammetric processing and photo interpreting historical aerial photographs

For the digitization of the analogue images at 1200 dpi (greyscale, 8bit) we used an ordinary scanner, EPSON GT-1200, whose calibration proved to be of high geometric and radiometric precision.

After the digital archiving of the images, the mediocre quality of the analogue images (poor lighting and low contrast) was improved by digital processing (Histogram Equalization, Brightness/contrast, Sharpen, Unsharp Mask, Convolution, Wallis Filter). Then followed their photogrammetric processing, using common 3D points recognised on the modern maps scaled 1:5,000 and on the aerial photographs and the Digital Terrain Model. Finally, after matching the histograms of all the images of each flight, mosaic images of the flight strips were created. The software used was Erdas Imagine 8.7.

Photo interpreting was done in two stages. In the first stage the analogue images were viewed monoscopically and stereoscopically. In the second stage the enhanced digital images were viewed in the computer monoscopically and stereoscopically. Finally, the features we had identified were defined and attributed to their precise positions in the new Geographical Trace Management System.

4. Marks of Military trenches or ancient fortification constructions

This paper deals only with the low-relief constructions we have identified on historical aerial photographs (figures 4 to 9). These are mostly of curved form rather than straight or square constructions and their total length is about 23 Km (Figure 3). In the northern part of Figure 3, we can observe the almost “horizontal”
deployment, beginning at the east of Mount Paggaio foot and ending at Angitis river, for the control, possibly, and the protection of the passages to the north. The constructions in their entirety were created at the highest spots of their regions and follow the contour lines.

The remains of upstanding monuments have different reflective behaviour than the surrounding materials (ground or flora) (Qingju and Jianqi 2004) which produces the tonal differences on images of remote sensing data. Apart from this, during stereoscopic observation of the aerial photographs, it was seen that these upstanding monuments have small depth. This is the reason for the shadows in their inside (shadow marks) (Betti 1963; Scollar 1963; Brooks and Johannes 1990, 135-136; Wilson 1982, 27-30; American Society for Photogrammetry and Remote Sensing 1997, 557). In the collection of aerial photographs available to us there is missing information about the time and in many cases the date (not the year) of image acquisition. It is definite, though, that the time of image acquisition of most of the aerial photographs, except for the ones taken in 1945, has helped in the localization of the low relief constructions through the means of shadows. Thus, the improvement of observation in newer aerial photographs (figures 4(2), 5(2), 6(2), 7(2), 9(2,3)), can probably be attributed to their larger scale (1/7,000) and to the improvement of film quality over the years.

Specifically, the upstanding monuments captured on the aerial photograph of 1945 (Figure 4(1)) cannot be identified, though their presence is felt through the intense tonal differences of their residue. The opposite happens in Figure 4(2). This is attributed to the shadow observed within the low-relief construction and the clarity offered by the improvement of film quality and in the large scale of the aerial photograph. Similar observations can be made on Figures 5(1,2) and 6(1,2). A minimum of shadows and tonal differences caused by the different reflective behaviour of the upstanding monuments and the surrounding material are observed in the aerial photograph of 1945 in Figure 7(1). Contrary to that, the low relief constructions, in the newer aerial photographs are more visible (figure 7(2)). Lastly, the shadows (exclusively) helped in the observation of monuments in the aerial photographs of 1945 (figure 9(1)) and of 1983 (figure 9(3)). This does not happen though in the aerial photographs of 1977 (figure 9(2)), where the upstanding monuments are almost localized via minor tonal differences of their residuals.
Figure 4 (2). Detail of a 1983 aerial photograph, Hellenic Mapping and Cadastral Organization (HMCO), scaled 1:7,000. The same feature visible in relief and as tonal differences that include shadows.

Figure 5 (1). Detail of a 1945 aerial photograph showing constructions in relief (HMGS), scaled 1:42,000.

Figure 5 (2). Left: Detail of a 1977 aerial photograph, HMCO, scaled 1:7,000. Shadows indicate upstanding constructions in sharper detail than on 1945 photographs. Right: rendition of the constructions in blue.
Figure 6 (1). Detail of a 1945 aerial photograph on which tonal differences indicate constructions, HMGS, scaled 1:42,000.

Figure 6 (2). Left: Detail of a 1977 aerial photograph, HMCO, scaled 1:7,000. Shadows and relief indicate upstanding constructions. Right: Rendition of the constructions in yellow.

Figure 7 (1). Detail of a 1945 aerial photograph, HMGS, scaled 1:42,000. Minimum shadows and tonal differences.
Figure 7 (2). Detail of a 1977 aerial photograph, HMCO, scaled 1:7,000. Shadows and relief indicate upstanding constructions.

Figure 7 (3). Rendition of the constructions in yellow.

Figure 8. Detail of a 1985 aerial photograph, HMCO, scaled 1:7,000. Curved and square constructions indicated by shadows, highlights and in relief. Right: Their average dimensions.
As well as the remote sensing data, we also examined historical maps, scaled 1:20,000 to 1:200,000 that were made between 1901 and 1945. In places we observed the coincidence of a small number of the features located on aerial photographs, with constructions on the 1:20,000 scale 1918 map (figure 10) which are mentioned in the map’s appendix as “Fire Trenches”. Thus, initially the constructions were attributed to military defensive trenches of the Balkan war (1912-1913) or WWI (1914-1918). However, not all of the constructions identified during photo interpreting have been surveyed on the historical maps (for example, those in figure 9). Could these features therefore be a combination of military and ancient constructions? Could it be that the constructions were interpreted as military by the 1918 map’s editors, while they were actually created during antiquity?

It is hoped that future surface research may lead to the determination of the nature and dates of these constructions.
Figure 10. Above: Detail of the 1918 map, scaled 1:20,000. Below: We can observe the coincidence of a small number of the marks (in blue) with the military trenches of the 1918 map, as well as the tracing of constructions others than the ones mapped.
5. Conclusions

The localization of the upstanding constructions on 1945 historical aerial photographs, despite their small scale (1:42,000), demonstrates the capacity of this analogue data to locate monuments. The use of diachronic data has confirmed their presence and, thanks to the larger scale and improved definition of the more-recent photographs, has improved our perception of the constructions. Georeferencing all the data has allowed precise spatial determination of the construction’s position. Finally, the surface research that will shortly take place may allow the determination of the nature of the constructions, namely if they’re military trenches, ancient fortification constructions or a combination of both.

6. References


Web reference

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Department of Architecture, Aristotle University of Thessaloniki, Greece
Short report: Fli-map 400 LiDAR system

Anthony Corns, Robert Shaw

The remit of the Discovery Programme, an Irish archaeological research company, includes researching archaeological methods and technologies and from an early stage has applied 3D modelling as a primary survey technique. Height data was initially gathered through ground survey (e.g. total station and differential GPS) but this was very time consuming (good surveyors may achieve 1000 – 2000 points per day), and became prohibitively expensive as the size of the survey areas increased.

Subsequently, in dealing with larger landscape areas PCI Geomatica 10 software was applied to process true vertical photography. Through complex pixel-matching processes a Digital Elevation Model (DEM) is extracted from overlapping stereo images and orthophotographs derived. While the orthophotos were an invaluable landscape analysis resource, the 3D models were more variable. From very large-scale photographs (1:1500) highly-detailed models, which matched the quality associated with ground survey techniques, were created, but only when the areas were broken down into smaller tiles and re-processed with fine settings. In general, particularly at the popular medium scale (1:7500), the models derived were too coarse to reflect the subtleties required for the 3D modelling of archaeological sites, although they did provide a useful 3D landscape model. The alternative of fixed-wing airborne LiDAR (Light Detection and Ranging) sensors as a potential option for archaeological modelling (e.g. Colin Shell, Dept. of Archaeology, Cambridge University; see http://www.ucl.ac.uk/prehistoric/past/past51.html#Loughcrew), did not in our opinion have sufficient resolution or accuracy to model the subtle features which comprise an archaeological site, see Table 1.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>25 – 100kHz</th>
</tr>
</thead>
<tbody>
<tr>
<td>Absolute accuracy</td>
<td>15cm</td>
</tr>
<tr>
<td>Laser point density</td>
<td>0.5 – 1m spacing</td>
</tr>
</tbody>
</table>

Table 1. Fixed-wing LiDAR specification

It was our aerial photography supplier, BKS Ltd who alerted us to a new method of LiDAR survey that offered the potential for high precision, high accuracy data for 3D modelling. The Fli-Map 400 system - an aerial LiDAR survey system - was initially designed to survey infrastructural assets such as roads, railways and electricity supply networks. The sensor system mounted beneath the main helicopter fuselage consists of:

- three 150kHz LiDAR sensors (forward, nadir and aft).
- two RTK GPS receivers – provide accurate location in used in conjunction with RTK base stations.
- Inertial Navigation System (INS).
- Digital image (11 megapixel) and digital video capture.

Unlike fixed wing aircraft, which have a minimum airspeed before stalling occurs, the slower speed and lower altitude operation of a helicopter allows the collection of higher resolution data. Table 2 summarises the specification of the system. All LiDAR systems receive multiple pulse returns as the laser reflects from vegetated land cover. During post-processing,
vegetation cover such as trees and bushes can be removed from models to create a DTM (digital terrain model or “Bare Earth”). In the case of the FLI-MAP 400 system, the addition of forward and aft looking sensors increases the potential to acquire this data.

<table>
<thead>
<tr>
<th>Position</th>
<th>2 x RTK GPS sensors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude</td>
<td>Inertial Navigation System</td>
</tr>
<tr>
<td>Range</td>
<td>&lt; 300m</td>
</tr>
<tr>
<td>Altitude</td>
<td>40 – 400m</td>
</tr>
<tr>
<td>Laser scanning accuracy</td>
<td>&lt; 1cm</td>
</tr>
<tr>
<td>Laser spot size</td>
<td>5.7cm</td>
</tr>
<tr>
<td>Absolute accuracy</td>
<td>Horizontal 8cm, vertical 5cm</td>
</tr>
<tr>
<td>Swath angle</td>
<td>60° (width approximates to flying height)</td>
</tr>
<tr>
<td>Laser point density</td>
<td>Typically 50 – 100 points per m²</td>
</tr>
<tr>
<td>Multiple returns</td>
<td>Maximum 4 per pulse</td>
</tr>
<tr>
<td>Digital still imagery</td>
<td>11.0 megapixel</td>
</tr>
<tr>
<td>Digital video imagery</td>
<td>MPEG 4 format AVI 720 x 576 pixel</td>
</tr>
</tbody>
</table>

Table 2. Fli-map 400 LiDAR specification

This application has been tested on two sites, a deserted medieval settlement at Newtown Jerpoint (Co. Kilkenny), and a prehistoric hillfort, Dún Ailinne (Co. Kildare), with funding from The Heritage Council (Ireland). The specification created in conjunction with BKS / Fugro allowed us to balance the area we wished surveyed against the point density we considered appropriate to record the complexity of the archaeology (see Table 3). The initial data-processing was carried out by BKS / Fugro using FLIP7 software; the geodesy of the project is computed and checked and the data is reviewed, filtered and classified to provide two ASCII data sets – the first return and the last return. The first return provides data from which we can build Digital Surface Models (DSM), whereas the last return is the data with the vegetation removed, and this is used to generate the DTM.

<table>
<thead>
<tr>
<th>Site</th>
<th>Area</th>
<th>Resolution</th>
<th>Number of points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Newtown Jerpoint</td>
<td>0.8km²</td>
<td>50pt / m²</td>
<td>30 million</td>
</tr>
<tr>
<td>Dún Ailinne</td>
<td>2.4km²</td>
<td>14 – 30pt / m²</td>
<td>40 million</td>
</tr>
</tbody>
</table>

Table 3. Specification for the Discovery Programme LiDAR surveys

The output ASCII files created are simple x,y,z Irish Grid coordinate files supplied as tiled data to ease the data management and the GIS processing stage. The data created for Dún Ailinne was split into eight tiles and Newtown Jerpoint into four. The ASCII data was imported into Access databases for spatial display within ArcMap 9.2, our GIS system. The Triangulated Irregular Network (TIN) models were created using the 3D Analyst extension and subsequently converted into raster grids to enable faster display times and processing. The grid tiles were merged to create a single DTM and DSM grid for each project. Some minor editing of the ASCII files was needed to remove ‘spikes’ from the data where the laser returned from striking passing birds.

The most effective way of presenting the data was the Surface Analyst function in 3D Analyst to create hill-shaded models of the surfaces and examine these in detail. The following figures hopefully show the exception detail revealed by our models. Figure 1 shows the first return, (DSM) for the whole survey area at Newtown Jerpoint, with an enlargement showing how even recent tractor wheel ruts are reflected in the model. In figure 2 the DTM, with the vegetation removed, an archaeological interpretation is presented through colour
coding. Figure 3 shows a comparison between the DSM and DTM for the core area of the hillfort at Dún Ailinne. Immediately the power of the FliMap system in penetrating vegetation is apparent. The quality of definition of the banks and ditches, which are largely covered in trees and bushes, is exceptional and has been achieved without physically removing a single branch. The subtlety of the model is reflected on the top of the mound, where the edge of a back-filled excavation trench can be seen, a feature not obvious on the ground. The DTM of the full Dún Ailinne survey area (Figure 4) reveals extensive evidence of relict landscape features. Figure 5 shows a snapshot of Newtown Jerpoint with a 3D view effect taken from ArcScene.

Once a final topographic model has been created it is then passed across to the archaeologist who uses it, in conjunction with supplementary field visits, to construct an interpretative record of the features. The two professions of land surveyor and archaeologist use their respective measurement and interpretative skills in partnership to produce a highly detailed model of a landscapes evolution.

The question of ‘how much does it cost?’ is often asked and no price list as such exists. The cost of mobilisation means that the price will vary depending on how many other clients have commissioned surveys. However, considering the salary and mobilisation costs of sending a land survey team to record the topography of a large archaeological complex at the same level of detail, it soon becomes apparent that the FLI-MAP 400 system is the more economical of the two approaches.

**Summary**

The application of the FLI-MAP 400 system as a primary method of recording 3D topography is of exceptional value to archaeologists, as we hope this short report has shown. The resolution of the models, and the ability to successfully model under vegetation, offer a quality of survey way beyond that possible by ground survey or photogrammetry. These two projects restricted themselves to only working with the x,y,z component from the system, not looking at the imagery, video or intensity values also recorded. Our initial results have been received with such enthusiasm that additional funding has been made available to undertake a new survey at Hill of Tara, Co. Meath and in this case all the data will be purchased to fully assess the value of the system. This will be presented as a paper to the AARG conference in Ljubljana (September 2008).

**Acknowledgements:**

Ian Doyle, the Heritage Council, Ireland
John McNally, BKS Surveys Ltd
Figure 1. First return (DSM) hillshade model for the Newtown Jerpoint study area with enlargement to show the high resolution

Figure 2. DTM of Newton Jerpoint with the archaeological interpretation presented by colour coding the model
Figure 3. The core area of Dún Ailinne comparing the hillshade models from the DSM (left) and DTM (right)

Figure 4. The complete DTM hillshade model for the Dún Ailinne study area with the inset showing a cross-section generated in ArcMap
Figure 5. A 3D effect view of the Newtown Jerpoint DTM

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**Book of interest?**

Comisiwn Brenhinol Henebion Cymru (RCAHMW). *Adolygiad Review 2006-7.* [probably free from the Commission]

Mentioned here because of the high aerial content. This includes six or seven pages about Toby Driver’s *Pembrokeshire from the Air* volume, an additional six pages about his survey activity in 2006-7, plus a few other air photos (including one of the whole world) scattered throughout (and on the cover) of this review.

More information, and more photos can be found on RCAHMW’s web site which is noted elsewhere in this issue.

Rog Palmer
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Erasmus Student Placement Programme 2007/08
– facts and thoughts from the student’s point of view

Ania Sokołowska ¹

I am a MA student of archaeology at the University of Poznań (Poland) interested in aerial archaeology – from taking the photographs through their interpretation to their further usage. This year my university gave its students an opportunity to participate in a Student Placement, a university-to-company exchange, a new form funded by the Erasmus Programme. I have served my placement in Air Photo Services in Cambridge, being taught by Rog Palmer from December 2007 till February 2008.

There were certain knowledge, skills and competence I had to acquire before I began my work. One basic was the scope and uses of UK photo collections (including internet portals) and UK Historic Environment Records. During the exercises I was extending my previous knowledge as well as getting new information and understanding of the aims, methods and techniques of interpreting aerial photographs and learned a lot about England’s archaeology. I became skilled in the use of the specialist computer programs AirPhoto and AutoCAD Map.

After this initial training period I started to work on my own projects. This work’s aim was to compile maps of specific areas, consolidating and still improving skills learned previously. I had daily consultations of progress and problems with Rog. They were enormously useful and helped to increase my understanding of what I had mapped and of past uses of the landscape. Finally I could work on one of the projects by myself, being responsible for the process and the final product. It was a challenge but gave me great pleasure and satisfaction as well.

I think that the new Erasmus university-to-company exchange is a very good and idea and I can give my placement a very good mark. The only problem was that money from Erasmus Studentship was not enough for a three months stay abroad.

I am especially satisfied with the possibilities there were to improve my skills and scientific interests as well as trying myself as an employee while still being a student. Thanks to my placement, I have opened new and wider perspectives for my future development. What is the most important is that I feel I have learned how to solve many scientific problems single-handedly.

I am writing my MA thesis now, where aerial photographs are one of the most important sources. The chance to acquire skills in working on them by mapping parts of England (as it is relevant and familiar to mapping anywhere) is helpful now in the process of working on my MA project.

I would also like thank here to my professor Włodzimierz Rączkowski for suggesting me to serve the placement and especially to Rog Palmer for letting me work for/with him, help, understanding and being a wonderful teacher on call to answer my questions.

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The Aerial Reconnaissance Archives (TARA)

Lesley Ferguson

The Royal Commission on the Ancient and Historical Monuments of Scotland (RCAHMS) is delighted to report that The Aerial Reconnaissance Archives will be transferred to Edinburgh in coming months. RCAHMS has been working closely with The National Archives and Keele University to secure the future long-term preservation and continued development of this internationally important archive.

The archive comprises some 10 million aerial images from across Europe, North Africa, and the Middle East dating from 1939 through to relatively recent Ministry of Defence material. In the 45 years that TARA has been in the care of Keele University it has grown steadily in size and this has added to pressures on storage and public access. For these reasons it was decided to explore other organisations that could provide a long-term home. RCAHMS with its long track record of effective archive management of large collections of aerial photography was one of the options explored. An agreement was reached between RCAHMS, The National Archives and Keele in December 2007.

TARA is a largely untapped resource with incredible potential for development to open up access for education and research. The archive predates the rapid urbanisation, mechanisation of agriculture and industrialisation that have been such a feature of the second half of the 20th century and is therefore a fundamental source for any archaeologist or landscape historian. Its potential extends to those researching family history, teachers in a range of curriculum subjects, military historians, urban planners and conservationists across Europe and indeed, many parts of the world. The potential of the TARA collection for use in all these areas is completely undeveloped.

It is an archive of international importance, and at an European level its holdings are recognised as a significant, irreplaceable and unique component of a shared European Heritage, the use and importance of which can only continue to grow, provided the collection is preserved with ready accessibility, on-line access and an active programme of interpretation and promotion.

The move to Edinburgh will take some months. The public service at Keele University stopped at the end of 2007 to enable preparations for the move, which it is anticipated will be completed by summer 2008. During the process there will be no access to the collection and RCAHMS is working with colleagues in The National Archives and Keele University to keep the period of disruption to a minimum.

As RCAHMS celebrates its centenary year it welcomes the opportunity to enhance the public service and to develop the research potential of this incredible resource over the coming years.

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The Aerofilms Collection

Katy Whitaker

In June last year English Heritage, RCHAMW and RCAHMS announced the acquisition of the Aerofilms Collection. This fragile archive was the best and most significant collection of oblique air photographs still to remain in private hands until saved for the nation with financial support from EH’s donors, the National Heritage Memorial Fund and the Friends of National Libraries.

The collection – which includes more than 1 million negatives and transparencies and 2000 print albums – has now been moved to the NMR’s specialist storage and is being unpacked for preliminary assessment. As well as the major air photograph collection there are also ground photographs and expedition photography generated by Aerofilms Ltd or collected by the firm in its eighty years of operation.

The Aerofilms Collection is unrivalled for its chronological depth – 1919 to 2006 – and geographical breadth, with UK and overseas coverage. The images are of national importance in historical, social and environmental terms and, in complementing the existing national collections, present an unparalleled picture of the changing face of Britain in the twentieth-century.

Long-term planning for conserving, cataloguing and digitising the collection has begun. Current access levels are explained at http://www.english-heritage.org.uk/server/show/nav.18493. Small selections of Aerofilms images are also available on Viewfinder, http://viewfinder.english-heritage.org.uk/ (use the Advanced Search option to look for Aerofilms Collection images) and the EH prints website http://www.englishheritageprints.com/ (enter Aerofilms into the search box). For more information about the project to conserve and catalogue the collection please contact Katy Whitaker.

1 katy.whitaker@english-heritage.org.uk 01793 414495

Information for contributors

AARGnews is published at six-monthly intervals. Copy for AARGnews 37 needs to be with me by August 15. Editorial policy (for want of a better word) tends to be that if I am sent interesting contributions they go in up to a limit of about 50 pages.

Address for contributions:
Rog Palmer, 21 Gunhild Way, Cambridge, CB1 8QX, UK. rog.palmer@ntlworld.com
New websites


This site presents the results of 12 years work on 50,000+ air photos that has allowed mapping of 30,000= sites (whatever a ‘site’ is). This is an excellent web site. It includes versions of the usual introductions followed by Explore Cornwall’s Past that takes the user through a series of themed pages (eg ceremony and ritual, defended Cornwall). All these, complete with illustrations, can be downloaded as PDF files and so could make useful teaching aids. The site also has an interactive link to the mapping that allows a user to zoom into smallish areas and examine the mapping over 1:25,000 and 1:10,000 base maps. The same maps can also be used to show access routes to sites.

The site is well worth a visit to see how to present the results of a mapping project and how to set up a web site to present parts of its past. If this can be linked to Heritage Gateway* information a user can do a considerable amount of useful research before going into the field or on holiday.

* [http://www.heritagegateway.org.uk/Gateway](http://www.heritagegateway.org.uk/Gateway) : a site on which it is planned to have all HER’s accessible to the public)

(Rog Palmer)

New website for Royal Commission in Wales: [www.rcahmw.gov.uk](http://www.rcahmw.gov.uk) ¹

The Royal Commission on the Ancient and Historical Monuments of Wales is committed to providing a dynamic website that provides easy access to authoritative information. The new bilingual site is a showcase for the work of the Royal Commission, highlighting the breadth of knowledge and information that it holds, and it is an important medium for enhanced accessibility to the material.

**About Us** provides information about the staff, structure, and operational objectives of the Royal Commission. News and press information are also included in this section. The **Search Records** section introduces the wealth of archival material held in National Monument Record of Wales (NMRW) and explains how to use the Commission’s online database, Coflein. It also provides links to other online information about the historic environment. The **Heritage of Wales** section offers introductions to a wide range of themes, locations and periods in Welsh history. It examines the geographical distinctiveness of the built environment within the regions of Wales and provides broad overviews of the historical development of social, economic and religious aspects of life, both thematically and by period. There is also a new **Gallery of aerial photographs** of Wales, and aerial photographs feature throughout the various sections of the new website. A **Learning** area has been created which promotes the use of information that the Royal Commission has collected. This section provides articles and illustrative material that are interesting and useful to students and teachers alike. We hope that you will find the site interesting, informative and attractive, as it continues to develop and new features are added.

¹ Taken from press release by Karen.andrews@rcahmw.gov.uk
Cropmarks

harvested by Rog Palmer

AirPhoto3D…

…is a new separate and free program from Irwin Scollar which offers three dimensional dynamic display of rectified images on maps using AirPhoto height data. The rectified data is ‘draped’ over the map which is shown in 3D, and you can ‘fly’ around the image interactively using the keyboard and the mouse to see it from all sides rather like in a flight simulation program.

You can show the elevation data of the map in spectral colours which you may change to suit your taste. The new program accepts thousands of irregularly spaced heights and constructs its own digital terrain model from them in a very short time.

The file airdata.exe has been updated to provide a test data example. The new program is available for use with all versions of AirPhoto, past and present, although it is recommended to use AirPhoto 3.30 which has been modified for optimal use with AirPhoto3D. The program may also be used with black and white maps alone with height data and without a rectified aerial image for DTM display. The height data may be imported into or created from contour lines in AirPhoto and saved in AirPhoto’s .hgt format.

Download from:
http://www.uni-koeln.de/~al001/airdown.html {Univ. of Cologne, Germany}
http://super5.arcl.ed.ac.uk/baspmirror/airdown.html {Univ. of Edinburgh, Scotland}
http://www.baspsoftware.org {Vancouver, Washington, USA}

CUCAP card index – home wanted

Simon Crutchley (EH, Swindon) is looking for a home for the old CUCAP card index acquired by RCHME in the 1980s (+/-). These, covering England only, are ordered thematically using terms such as ring ditch, village and also by cropmarks – Suffolk or earthworks – Warks, etc. Simon estimates there to be about 2300 cards (which makes them a selective part of the original whole index) occupying 11 drawers (which themselves may not be part of the gift).

Prospective owners contact Simon.Crutchley@english-heritage.org.uk or 01793 414704.

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1 rog.palmer@ntlworld.com
The Aerial Archaeology Research Group

The Aerial Archaeology Research Group (AARG) provides a forum for the exchange of ideas and information for all those actively involved in aerial photography, photo interpretation, field archaeology and landscape history. This also includes the use of aerial photography in defining preservation policies for archaeological sites and landscapes.

Since its foundation in 1980, AARG has actively encouraged such exchange through its annual conference, specialist meetings and, more recently, through the biannual publication of its newsletter, AARGnews.

Membership of AARG is open to those interested in aerial archaeology as well as its active participants. All applications for membership, subscriptions and changes of address should be sent to the Secretary:

Lidka Źuk, Institute of Prehistory, Adam Mickiewicz University, ul. Sw. Marcin 78, P61-809 Poznań, Poland.  lidkazuk@amu.edu.pl

AARG is a registered charity: number SC 023162.

AARG homepage. http://aarg.univie.ac.at/

Membership/subscription rates: Individual £15.00 20.00 Euro
Students * £10.00 10.00 Euro
Institutional £25.00 40.00 Euro

* and applicants from Albania, Bulgaria, Croatia, Czech Republic, Hungary, Montenegro, Poland, Romania, Serbia, Slovakia, Slovenia, and countries of the former Soviet Union.

Subscription reminders may be sent out on January 1

Methods of payment:

Standing Order mandate
Cheque in Sterling payable to AARG
Bank notes in other currencies to Sterling value

Bank details are available on request for direct payment from overseas. Please contact the Secretary.

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Student bursaries. AARG has a limited number of student bursaries for attendance at its annual meeting. These are aimed at supporting bona fide students who are interested in aerial archaeology and who wish to attend.

Anyone wishing to apply should write to Dave Cowley, RCAHMS, 16 Bernard Terrace, Edinburgh, EH8 9NX, Scotland (Dave.Cowley@rcahms.gov.uk) with information about their interests in archaeology and aerial archaeology, as well as their place of study. Annual closing date for applications to the annual AARG conference is 31 May, other meetings for which bursaries may be available will be advertised on an ad hoc basis.