AARGnews

The Newsletter of the Aerial Archaeology Research Group

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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:

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*AARG homepage.*  [http://aarg.univie.ac.at/](http://aarg.univie.ac.at/)

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* 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

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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 is 1 July.
AARGnews is the newsletter of the Aerial Archaeology Research Group

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Editorial

Travels
Feeling a bit restless early in the year, I booked a couple of cheap flights to Poznan and Riga. My Poznan visit was well-timed as it followed immediately a day’s meeting at Zakopane between aerial people and inspectors – the latter being traditionally anti-aerial survey. It was good to learn that a sufficient amount of aerial photography has been done, and a fair number of LBK long houses recorded, that belief in this method of prospection was increasing. Włodek told me that one of the long-term disbelievers stood up at the end of the meeting and announced that he was now convinced. Excellent news – and during the week I was there inspectors sent in two requests for aerial photography. They still have to learn that there are right and wrong times of year to do this, but the same goes for many UK archaeologists too…. There have also been a couple of books published recently in Poland about archaeological aerial survey (see Books of Interest?), one by Zbigiew Kobylinski is an introduction to the hows and whys of the subject and is very-well illustrated with air photos of Polish archaeological features. The other book is a collection of papers edited by a Poznan trio (Andrzej, Jacek and Włodek) – mostly by Polish authors but with a handful by foreigners – of enormous size (c.500 pages) and scope. Many papers in this book shows the potential of aerial survey for some aspects of archaeology. For any of you with poor Polish, papers have summaries in English.

But the bad news is that since my visit the ex-anti aerial bloke has been replaced, so poor Włodek is back in the situation that he was 8 years ago when Zbigiew Kobylinski, the very AS-favourable Chief Inspector, was deposed.

My excuse for the Riga trip was to chat to Alma Ziemele about coming over to work with me and to do nothing much for a few days. I’d also told Juris Urtans that I’d be over and he arranged for me to talk to the Latvian Society of Archaeologists in the somewhat archaeological setting of the Latvian National Museum of History. While wandering around being a tourist I passed a series of window displays for the Latvian National Archives (or something like that) that included the cry to the people as shown in the picture below. On the Sunday Kristine Jansone borrowed a car and drove several of us to Liepaja on the west coast. The main attractions there were remains of the huge military port that the Soviets built, and a coast lined with bunkers of various types. The Soviets blew up – or attempted to – many of the coastal defences and they are now picturesquely angled on the beach or in the sea (next page). All of this is recorded in considerable detail on high-resolution satellite cover that can be seen on Google Earth and Juris told me that Jan Norrman had taken some obliques of some of the features there that (I think) he has copies of in Riga. The whole area should be thoroughly recorded and photographed as an example of Cold War defences – but that’s maybe a Britocentric view. We also visited a prison – originally Latvian military, then Soviet military, then Latvian military and now somewhere that takes paying guests for a night of ‘see what it was like’. The guide told us that guests could chose between ‘normal’ and ‘harsh’ regime. No, we didn’t stay the night.
Some of the Cold War Soviet structures at Liepaja, Latvia. From the ground (above) on Google Earth (left and with N to the top).

Cover picture
Those of you who get – or used to as I haven’t seen one this year – Derek Edwards’ emailed flight (etc) reports may recall my observations about the visibility of a ring ditch that I check on my too-frequent trips to Swindon. Finally I mapped it and it was reassuring to note that my suspected inner ditch and the ‘square thing’ around it were visible on some aerial photos. I don’t think I’ve seen most of the other ring ditches in the area (although the two in the triangular field were visible in grass quite early this summer) because in the few seconds I have to look I tend to zoom in to the larger feature. For those of you not used to my mapping, the shaded areas are deeper soil (the main ring ditch is near the top of a slope) and the darker squiggles and splodges (or macula for any of you who speak EHese) are geological features of kinds that are common on the chalk in this part of S Cambridgeshire-N Hertfordshire. The two cross-hatched blobs near the top of the map are probable mounds while the rest are ditches.

Dr Toby Driver
Congratulations to Toby for obtaining his PhD sometime earlier this year. Although it was on a non-aerial topic the fact that he managed to complete it while having a full-time job, undertaking external teaching and publicity, and growing an increasing family makes it a huge achievement.

David Wilson
One of the more difficult editorial tasks is reporting the death of members and we now have to add David Wilson, who died 6 August 2006, to that short list. It was David who called the first meeting of what later became AARG (see AARGnews 28, 10-18) but then was happy to remain in the background although he did audit the accounts for many years. The ‘background’ for David was being a voice in discussions at AARG meetings and contributing a number of pieces to AARGnews. He was elected an Honorary Member of AARG at some distant time in the past.

Information about David’s background at CUCAP can be found in our Conversation in AARGnews 17(now in pdf format on the AARG website) from which a certain amount of censored material remains unpublished in the AARGnews archive. That conversation was easier than I anticipated because I had never found it easy to talk with David, but he was happy with the result and it serves as his view of aerial survey on the eve of his retirement from CUCAP.
I can’t now recall whether we met when we were both working on causewayed enclosures (Wilson 1975; Palmer 1976) but soon after that David was appointed supervisor for my postgraduate research. I think this was the choice of neither of us and we struggled through a few meetings over a year or so after which I changed to someone in Archaeology Department. At that time (1976-7ish) David was immersed in writing what became *Air Photo Interpretation for Archaeologists* (Wilson 1982; 2000) and was particularly interested (and interesting) in the various forms of periglacial features that can be seen from the air. From this interest grew some of the most informative pages of his book, parts of which were expanded in a later paper (Wilson 1987). Within the aerial world and at CUCAP, David seemed most interested in what he called ‘problems of interpretation’ – of which he added many examples to that series of cards in the CUCAP index. He always seemed happy to talk through any photograph that I would show him, and would provide a constant flow of information about what he was seeing on the photo, why it was visible that day and, importantly, what was underneath the crop that was signalling a buried ‘something’. Listening to these, despite the lengthy time that some of those expositions took, was always a valuable learning experience.

Away from aerial photographs – which were not his first archaeological choice as he was classically trained – David’s passion was medieval dance and much of his retirement was spent (if I remember correctly) on consolidating various forms of coding dance steps into one uniform standard version. He was, or had been, also an active member of at least one dance company, Cambridge-based *Capriol Dance*, which I photographed a couple of times in 1986. It may seem frivolous to include this in a tribute to an aerial specialist, but David liked some of those photographs and seemed pleased that I’d managed to catch some of them when they were off the ground [see, there is an aerial connection…].

David’s archaeological input included contributions to Roman studies including the compilation (?with Gordon Maxwell) of a number of Recent discoveries collections for either JRS and/or Britannia as well as working on excavation reports. (But I’m sure this side will be enlarged by Romanists or in more formal obituaries.) To me, at Cambridge as a then prehistorian, David epitomised the classical scholar: dressed in a gown (and often, in the early days, a bow tie) to give lectures, very precise, and paying considerable attention to every detail. The latter, of course, being an ideal qualification for anyone working with aerial photos as is obvious in the pages of his ‘bible’ (Wilson 1982; 2000). It is that book, with its illustrations of just about everything to be seen from the air of archaeological, natural and devious origin in temperate Europe, that will keep alive the memory of David in the archaeological community.


This issue…
…was looking very thin at the beginning of August but has fattened out a bit too much (too many aerial photos!). People have been getting excited about the 2006 crop marks in what looked likely to be another dismal year until nearly the end of June. From trains and my occasional airborne views it seemed that the barley around Cambridgeshire didn’t respond to anything at all and that it was the later-ripening wheat and parching grass that were informative. This flourish of crop marks was just in time for the training course at Cirencester, UK, and this issue includes a report on that and another about the school at Barth, Germany.

Technology ranges from satellites to uses of GPS with digital cameras and transformation software. Martin Fowler writes about a means by which the time of a CORONA photograph can be calculated which may be useful to those of us who use that data or are thinking of buying some. Closer to the ground, Michael Doneus and Irwin Scollar have been making some practical experiments linking GPS to DSLRs and from there into AirPhoto to provide camera positions at the moment of exposure. This looks set to make another major advance in the image transformation process which will also help work with pre-2006 photographs.

Kirsty Millican, a post-graduate student at Glasgow, writes about the beginning of her research on Neolithic timber monuments in Scotland for which the major source of information comes from aerial photos. In the first draft of her contribution was the comment that she had searched ‘.. the whole of the NMRS ..’ which, in answer to my query, meant that she has examined all the oblique photos in search of timber structures. That alone is surely worth half a PhD – but I look forward to hearing about the ongoing research that leads to the other half.

Keeping in touch
Because our dear members can be a right pain at times it was agreed to concoct some rules for them that mainly concern joining AARG and renewals of subscriptions. You’ll find these elsewhere within this issue and once again we encourage all of you with failing memories (or otherwise) to take out a Standing Order.
Chairman’s Piece

Dave Cowley

This summer has seen weather records tumble in Scotland, which for much of July sweltered in (for us) rocketing temperatures with long periods free of rain. These conditions have given us a good cropmark season in comparison with the damp and dull seasons of the last few years. However, there have been marked regional and local variations in the areas that were productive which defy easy explanation and underline how contrary prospective aerial survey can be. The two photographs at the end of this piece illustrate two of the major themes to emerge from this year. Firstly, illustrated by Newstead Roman Fort in southern Scotland, has been the quality of definition seen in many previously recorded sites that has not been matched for many years. The second thread has been the exploration of gaps in our distributions of sites. Individually monuments such as the simple enclosure in Fife are hardly exciting, but it is amongst a significant return from areas that have not been especially productive in the past and presumably reflect the relatively extreme conditions experienced this year. It is also gratifying to hear of good returns across other parts of Europe.

David Wilson

It is with sadness that I report the death of David Wilson, who really needs no introduction to readers of AARGnews. As a stalwart of AARG, he served the Research Group very well from the beginning – as a founder member, as a voice of experience and as a steadying hand on the Group’s finances, also serving as auditor. He will be missed.

Outreach and Integration

AARG has an excellent track record in outreach across Europe with involvement in training schools and other initiatives that have seen large numbers of practitioners and potential practitioners gaining experience in aerial survey and photo interpretation. This has found a particular expression in the C2000 projects that will pay dividends for many years to come. This year our conference includes a session under the title ‘Culture 2000: European Landscapes - Past, Present and Future’ that will give AARG an opportunity to reflect on what has been done and what happens next.

In looking forward the role of education is a clearly a vital one as new generations of fieldworkers are exposed to the importance of engaging with aerial survey, other remote sensing, and its products. This grass-roots level approach is working well and I hope to see it continue. Another track that should serve to expand the influence of AARG is the emerging relationship with the EAC and in particular the proposals for an AARG/EAC working party on Aerial Archaeology.

In March I attended a meeting of the EAC in Strasbourg to explore proposals for a working party, beginning by looking at the common ground between AARG and EAC. Any working party needs a relatively tight focus and a clear scope, set of aims, products and timetable, otherwise running the risk of ending up as a glorified talking shop. The shared ground between AARG and EAC seems to lie in two general areas. Firstly, standards and best practice especially with reference to heritage management, and secondly the development of broad-based strategies. Other issues could include
developing integrated approaches to the accessibility and preservation of existing collections of aerial photography. Research and survey agendas, involvement in education and establishing the value of aerial photography in heritage management could be other useful areas of focus. Dr Kristín Huld Sigurðardóttir, the General Director of The Archaeological Heritage Agency of Iceland, has agreed to be our link into EAC.

The extended AGM in September will provide an opportunity to discuss the direction in which we wish to go, but I hope this initiative will provide a means to further influence the decision-makers and holders of purse-strings that could provide the basis for integrated datasets and common standards across boundaries. This can only be of overall benefit to the preservation and understanding of European heritage and the uncertain future of TARA (below) is an example of the pressing need to engage with these issues, as this is a collection that should be readily accessible and widely used across Europe. It is now, with the ongoing expansion in the use of aerial survey and other remote sensing across Europe, that issues such as shared standards for aerial survey and photography, the curation and long-term preservation of imagery, and the creation of ready access to such data, should be addressed. This working party is a great opportunity to establish a broad consensus on standards and roles for aerial survey/remote sensing and the use of aerial photography across Europe as a ‘top-down’ approach.

The engagement with the EAC should also give us cause for thought about other initiatives, which might, for example, include shared conferences. AARG 1999 made some attempt to go in this direction and while I did not attend, it seemed to have been of limited success in fostering dialogue between EAA and AARG. That, however, should not put us off exploring other models for future, in which the aerial archaeological component is as integrated as possible (perhaps even to the point of not being noteworthy?).

Keele
In the last AARGnews I expressed the hope that by September 2006 there might be more information on the future of The Aerial Reconnaissance Archive (TARA) housed at Keele University in England. This has proved to be optimistic and the most recent communication from The National Archives has stressed that these issues are not easily or quickly resolved if we want permanent solutions. The National Archives are keen to emphasize that they are actively engaged in progressing towards completion of the current review, the results of which are eagerly awaited.

There is however encouraging news from Włodek Rączkowski in Poland. Anyone who has read his contribution to From the Air and papers in AARGnews will sympathise with his struggle to get the value of aerial photography recognised widely in Polish archaeology. Włodek reports that on June 1st he had the opportunity to present the value of TARA and his concerns for the future of the collection to the General Director of State Archives. The General Director and staff of the State Archive were impressed by the potential and agreed to take up the issue of TARA with the Ministry of Culture and National Heritage and raise the issue in Britain. At the time of writing Włodek is not aware of any official response from Britain to the Polish concerns, but it cannot do the future of TARA any harm at all if its importance is recognised more widely.
Newstead Roman fort has been recorded from the air many times since 1945, but the good definition of features across large areas seen during 2006 has rarely been matched (24 July 2006, Crown Copyright: RCAHMS).

‘Are you interested in this one?’ This previously unrecorded enclosure was spotted by Ronnie Cowan, one of our pilots, at Letham while we were exploring the edges of known distributions of cropmarked sites in southern and central in Fife (24 July 2006, Crown Copyright: RCAHMS).
Bringing Air and Water Together
Training School in Aerial Archaeology
Barth, Germany
1st–5th May 2006

Dr Susanne Gerhard

The Department for Archaeology and Heritage Protection of the Landesamt fuer Kultur und Denkmalpflege in the Federal State of Mecklenburg-West Pomerania is a co-organiser in the three-year EU Culture 2000 project European Landscapes: Past, Present and Future. As a part of the project, the department organises one Training School in Aerial Archaeology in each of the three years, focussing on the special situation of coastal and underwater archaeological sites. Two Schools lie behind us now, the first one having taken place in June 2005, the second one from May 1st–5th, 2006. The base for the schools is in Barth in West Pomerania. Situated on the coast of the Barther Bodden, the charming little town provides a small airfield and the most hospitable Pommernhotel, located ideally only some minutes away from the airfield.

The organising tasks lie in the hands of Hauke Joens (head of the department) and Susanne Gerhard. AARG and English Heritage (through the Culture 2000 project) made possible the attendance of Dave MacLeod, Antje Faustmann (in 2005), Lidka Żuk and Enrico Donati (junior tutors in 2005, tutors in 2006) as Ground School tutors. But nothing would have happened at all without Otto Braasch. Pursuing aerial reconnaissance in Mecklenburg-West Pomerania for nearly 15 years, he is the motor behind the Schools and, of course, the Aerial School tutor. Chris Musson was a “working guest” in 2006.

In 2005, we gained the impression that students from Eastern European countries faced massive financial problems that prevented them from coming. Even though there are no fees for the School itself and for flying, travel and accommodation have to be paid for. Luckily, in 2006, we were able to gain financial support from the GWZO (Geisteswissenschaftliches Zentrum für die Geschichte und Kultur Ostmitteleuropas an der Universität Leipzig) that generously provided bursaries for four students from Eastern and East Middle Europe to cover their expenses for travel and accommodation. Hauke Joens made this possible thanks to his good contacts to Matthias Hardt from GWZO. One more student was supported by a sum provided by AARG.

Thanks to these bursaries, 32 applications reached us from Belgium, Croatia, Slovenia, the Czech Republic, Germany, Poland, Latvia, Lithuania, Sweden, Finland and the Netherlands during the four-week application period, one more arriving afterwards from Romania. In the end, eight female and four male young colleagues were invited to come to Barth: Maja Miše (Split), Anna Lipiec (Warschau), Łukasz Pospieszny (Poznan), Laura Lēģere (Riga), Klaïdas Perminas (Klaïpeda), Diana Saluniene (Kaunas), Pawel Garsztka (Lund), Tarja Knuutinen (Helsinki), Stefan Klatt (Greifswald), Stephanie Nöllgen (Bochum), Karin Reichenbach (Leipzig) and Suzanne Theil (Rostock).

Above left: Dave MacLeod (photo: S. Gerhard)
Above right: Enrico Donati (photo: S. Gerhard)
Left: Tutors in discussion (photo: S. Gerhard)
**Ground School – Introductory lectures**

One part of Ground School is taken over by lecturers from the Department for Archaeology and Heritage Protection of the *Landesamt fuer Kultur und Denkmalpflege*. Besides the intensive introduction to Aerial Archaeology – see below – the students should take home some ideas of heritage protection, heritage management and the archaeological features of the region they have visited. Heritage management in a country with a coastline more than 1200 km long has naturally always to deal with archaeological finds at the coast and underwater. So, Mike Belasus, Hauke Joens, Sebastian Messal and Frank Nikulka from the *Landesamt* covered various topics of their work, from ‘Managing the maritime heritage’ and ‘DenkmalGIS’ to an ‘Introduction to ship archaeology and aerial photography on the shores of Mecklenburg-West Pomerania’ and ‘Early medieval settlements and harbours in Mecklenburg-West Pomerania as seen in aerial photography’.

Goerres Grenzdoerffer from Rostock University (‘Digital airborne photogrammetry for archaeology’) and Reinhard Lampe from Greifswald University (‘The geology and history of the Mecklenburg-West Pomerania coast’) completed this part of the Training School.

As in 2005, an evening lecture was part of the Training School. Dr Matthias Hardt from GWZO was talking about ‘Christianisation, Rebellion, Colonisation. The northern parts of Germania slavica in the Early Middle Ages’ and so rounded off the lectures.

**Ground School – Aerial Archaeology**

After a general introduction on safety at airfields and in aircraft, on navigation, communication, GPS, protocol sheets as well as on the important points of air sickness and fear of flying plus some basic explanations of handling the digital SLR, there followed modules on more specialised topics.

Dave MacLeod first gave an introduction to aerial archaeology. The characteristics and differences of vertical and oblique photographs were then explained, discussed and specific problems illustrated by numerous examples. Criteria to distinguish archaeological and non-archaeological features were demonstrated. Practical exercises in finding and describing archaeological features and working with stereo pairs formed then part of the teaching programme. Last but not least, a session followed on the theory and practice of the plotting of archaeological structures from aerial photos onto maps by means of the Network Method of plotting. Dave contributed a wealth of photos and his own rich experience of aerial archaeological work to illustrate his expositions.

The standard software *AirPhoto* – Irwin Scollar kindly put a Demo version of the program at our disposal – was demonstrated by Lidka Żuk. Afterwards, there was time enough for practical exercises. The students worked in groups of two with maps and photographs prepared and provided by Lidka. Concentration, slow and meticulous work proved to be necessary, like the day before when practising the Network Method. Lidka’s intensive support and routine with *AirPhoto* gave the students the possibility to explore the program’s complexities and possibilities.

Enrico Donati not only archived all the photos during the course, but also gave an overview of image formats, photo archiving and digital image databases. His lecture was illustrated by examples from last year’s photos on the one hand and from the digital photoarchive of the Area di Archaeologia Medievale at the University of Siena on the
other. Digital photography is becoming more and more important and some basic
information for the students was thought necessary and taken in eagerly.

Above: Networking (photo: S. Gerhard)
Left: Working with Stereoscopes (photo: D. MacLeod)

Air School – Training and Practice
Hardly any of the students had had previous experience of flying in light aircraft, so they
went to Barth airfield with suspense and some mixed feelings on Monday to enter Otto
Braasch’s Cessna for a first flight.

Mecklenburg-West Pomerania’s weather goddesses remained well tempered – admittedly
soothed by some libation ceremonies in the evenings – and so flying was calm like the
weather during the whole week.

Otto Braasch took the students to sites where visibility was good. They got the
opportunity to see and photograph many ship wrecks, the youngest ones being
fishermens’ boats deliberately sunk in Dranske harbour around 1968 as breakwaters. But
there were also the ruins of a medieval chapel-cum-lighthouse, undefined underwater
structures, megalithic graves situated directly at the coast and military areas. Equally
fascinating were features of landscape history: sunken trees in the Baltic, possibly
remnants of a little wood of times long past when the sea level was several meters lower
than today, or the traces of growing and diminishing shorelines along the small islands.
Inevitably, shoals of fish trying to disguise themselves as shipwrecks had to be assessed,
luckily betraying themselves by moving around! A special treat was, of course, viewing
the slavic stronghold at Kap Arkona during the final flight and observing the clearly-
defined rampart as well as the traces of last years’ excavations.

Fascination of the sites and joy of the beautiful landscape apart, lots of basic principles of
aerial photography have been taught during the flights, beginning with accurate keeping
of protocol sheets and camera handling. Rules of photographing had to be learned and followed: centering an object, finding suitable control points. Special challenges were posed by sunlight reflection by the sea. Light wind and oblique sunlight – ideal weather for a holiday at the coast of the Baltic – caused some problems!

Photos
As in 2005, a digital SLR camera was used by students in the air. This was a Canon EOS 350D, generously put at the participants’ disposal by Otto Braasch.

During his archiving work after the flights, Enrico sifted through the ‘crop’ and commented on the photos only a short time after they had been taken. This was very valuable help for the participants, especially for those who before had not used SLR and/or digital cameras.

All in all, each participant flew an average of around 4.5 hours, exactly as in 2005. The students produced nearly 2,500 photos (4.3 GB of data). Altogether, 64 sites, mostly under water off the coast or directly at the coast, were documented.

Résumé
On Friday a résumé of the week was drawn together under the chairmainship of Dr Hauke Joens. Enrico presented an overview of common problems, faults and omissions on the photos, illustrated by some of the pictures. Also Otto, Susanne, Lidka and Chris – who had taken over after Dave MacLeod was called away for family reasons – gave their assessment of the week’s work. The participants’ feedback included the wish of a thorough introduction to working with digital SLRs, an introduction to GPS use and one or two days more without flying but dedicated only to introductory work and theory.
Assessing the aims of the Culture 2000 project, some quite essential points have been conveyed by means of the Training Schools: young colleagues and students got the opportunity to gain first experience with Aerial Archaeology or to add to previous experience. The network of Europe’s aerial archaeologists was strengthened and widened, new contacts have been made and will be used in the future, especially in regions where aerial archaeology is not yet an everyday means of archaeological work (but not only professional contacts have been made, but also new friends). Last, the participants gained awareness of the special situation of the cultural heritage at the coast of the Baltic.

The megalithic grave of Nobbin on the island of Ruegen (photo: K. Perminas)

**Prospects**

The absolute necessity for financial support of participants from Eastern Europe has already been stressed above. Luckily, prospects for our last Barth Training School in 2007 are good, because Matthias Hardt from GWZO stressed his intention to support our cause on GWZO official bodies and AARG has already promised to help again with 500 €.

Participants, tutors and organisers left Barth with the certainty that all had enjoyed a great week. A small tradition has been founded with this second Training School in Aerial Archaeology and we are optimistic to continue and round it off with a third successful Barth Training School in spring 2007.
Aerial Archaeology Training Course
1 – 9 July 2006, Cirencester, England

Alma Ziemele

I was asked to write a report about this course from a student’s point of view – to show its good and not very successful points. But it is a rather difficult task to write about these “not very successful points” because to me everything seemed to be very thrilling and splendid. And even if something gave me any trouble or dislike – it was only my fault.

The course was attended by 16 participants (tutors are not included in this number) from different countries: Great Britain, Ireland, Italy, USA, Romania, Hungary, Poland and Latvia. The reasons for attending the course were almost the same for everyone – to understand the theory of aerial archaeology, to have a practical experience in the air, to learn aerial photo interpretation and creation of maps from specialists, etc. But each student’s preliminary knowledge in this sphere was different. Only a couple of us had previous flying experience and had taken aerial photographs before. But at least everyone was somehow connected to conventional archaeology, except me (who is actually a folklorist with an interest in aerial archaeology).

The first two days were spent on introductions to basic principles of aerial archaeology, instructions about using digital cameras and health and safety regulations in aircraft and airfield. A very useful exercise was when the participants had to get used to in-flight conditions with a help of a video simulation – to learn how to behave in the aircraft, how to take pictures. It looked maybe funny, but only afterwards in the real flight I understood how important this exercise was.

In those first days after listening to all the safety rules and other instructions it seemed impossible to be able to do something correctly or to do it at all. Besides that I had a feeling that all the prohibitions were related only to me (no smoking at the airfield, no mobile phone, no earrings etc.). I hope that everyone felt the same!

The whole training course had two sections: “Air School” and “Ground School”. In the “Air School” we spent time flying, taking photographs from the aircraft and learning the organisation of the flight. While in the “Ground School” we studied aerial photographs to learn the different kinds of information they showed and we were taught how to relate these photos to the maps, how to rectify them, etc. It is difficult to say which one from the Schools was more interesting or useful – they both were the same. It should be that “Air School” would be much more thrilling – because you don’t do flying so often – but the “Ground School” was very important with all the knowledge about basics of aerial archaeology.

It was hoped that we would have to fly every day but, of course, thanks to the British Summer (in few days it started to rain very heavily) we couldn’t do that. But because of that we had a lot of time to learn other things a bit more – cataloguing and archiving of photographs, some navigation exercises. (As I heard, some students had to wash the airplane as well !!)

A very important part of all the activities at the airfield was, together with one of the tutors, to have a look at the photos from the flight soon after the landing – so you
understand your mistakes and success and in the next flight you would think more about these things.

To carry on about flying, it should be mentioned that only one participant (out of 16) was sick only once (we all had 3-4 flights). I think even this one point shows how successful this training course was! Everyone had their own good characteristics and their own problems in the air. I had a feeling that during the flights I made everyone angry: pilots, tutors and my partner – because of being uncertain and shy and because of my incapability to explain what I was seeing and what I wanted the pilot to do… (I hope this was forgiven to me because of language barrier and because I was the youngest of all the participants!)

Of course we didn’t spend all our time only studying aerial archaeology. There was always time for some informal parts in the evenings – so I can’t complain about too much learning and lack of entertainment. On Monday we celebrated our first day of flying and two birthdays. One of the tutors said that such parties are not a common thing on those courses on Mondays – it usually happens on Fridays. So, as we started like this, the rest of the week was the same! (But it didn’t cause any problems on the following days during studies or flights.) Every evening we were sitting in the local bar or somewhere in the yard of the Agricultural College where we lived. But anyway almost all the conversations were about aerial archaeology. It was very interesting to learn not only about classical aerial archaeology in Britain, but also about the situation in other countries and to get to know what have all the participants done in this sphere etc.

The culminating point was the BBQ party on the last evening for which the students had made a cake which had archaeological features on it (made from sugar icing). Eating was followed by playing some funny but slightly brutal games (after these games, as I later heard, one of the pilots was injured…)

I was afraid to write about this course on behalf of all 16 participants, but at least I know that almost everyone of us said that this has been the best course ever attended !!! Although it is difficult to explain what exactly was so excellent… – just the large amount of wisdom we heard (and hopefully learnt) and the fantastic time we spent. I think this was an extremely friendly course (not only among students, but also with tutors). Moreover, all students still keep on writing e-mails to each other about adventures on their way back home from the course, about their occupation at the moment and about their future plans connected with aerial archaeology. Everyone when they left this course had learnt something new. Maybe they became more convinced of themselves and their knowledge, maybe got some inspiration for working more with aerial archaeology.

But the most important thing is to think about what can you do with all this acquired knowledge. In my case I had (and still have) to think about using aerial archaeology in the different circumstances of Latvia (where aerial archaeology is only in the beginning of development), about adapting these methods to our situation. After seeing Britain’s classical and good visible crop marks I tried to find something similar during my next flight in Latvia. But why it is almost impossible to find such features in our conditions and how to deal with that should be already a different story to tell.
It is time to have some Membership Rules!

Cinzia Bacilieri (AARG Hon Sec)

I have now been AARG Membership Sec, and then Hon Sec, for a total of four years during which time I have witnessed with great pleasure the growth of membership from a small group of 80-90 (ish) to the international assemblage which currently makes up AARG.

Over the years I have kept track of the coming and going of new and old members, promoted AARG among students and professionals, sent annual (but often bi- or tri-annual) reminders of payment to existing members, and at times, openly begged (hum…MacLeod?) for membership money. At the time of writing (August 2006) there are 168 fully paid membership subscriptions and 64 still outstanding. Some of the latter are ex-members who, possibly due to a change of interest, are no longer keen to be being part of the group. Others will be delegates at the coming AARG conference who, because of practical reasons and the laughably expensive bank-transaction fee, prefer to pay their membership fee in person at the conference. Others are the usual suspects, those who have always been and always will be part of AARG, unquestionably interested in maintaining their status as members but, alas, too lazy to present their money in time (even when blessed by the ideal situation of having the AARG Hon Sec literally a few steps away from their desks… MacLeod, I still want your money!).

In February 2006, the AARG Committee agreed that the time had come to put down in black and white some guidelines for membership, as follows:

- Membership runs from January until December, each year.
- Renewed memberships need to be paid in full before the end of February.
- Members from the UK are invited to make a standing order payment (forms on request) with payment on 1st of January.
- Any late renewals or new subscribers between 1st March and the end of September (AARG Conference) will subscribe for the year, but will only get a paper copy of the September AARGnews issue (it is not cost effective for us to print additional copies of AARGnews speculatively).
- Any new member or late renewal after September will subscribe automatically for the following year and will get no copies of AARGnews until the following March.
- If attending the conference, members who still use money will be encouraged to pay their subscriptions for the following year. This will help our administration enormously.
- New members are requested to submit forms via email or send a print-out (ideally) in the post. Handwritten forms will be accepted only when legible (it is hard work trying to decipher horrible handwriting and in some cases misinterpretations may cause incorrect details to be stored in the database). The country of provenance must always be stated when filling in forms (unfortunately new members often forget to add the country at the bottom of their postal address!).
- It is the responsibility of members to notify the AARG Hon Sec of changes of postal address. AARG will not replace copies of AARGnews lost due to failure to provide a new postal address far enough in advance of delivery (i.e. before February and August each year). Most importantly, members should notify the AARG Hon Sec of changes of email address. Old or incorrect email addresses will be deleted from the membership list when sent messages bounce back as *permanent error, the message could not be delivered to the recipient*.
Contextualising the cropmark record: the timber monuments of the Neolithic of Scotland

Kirsty Millican

Introduction
The Neolithic period is well known for its stone and earth monuments. However, the cropmark record and a small number of excavations demonstrate that monuments, in a variety of different forms, were also built of timber. Although timber monuments have been photographed from the air since aerial survey began in Scotland and, as a result, the National Monuments Record of Scotland (NMRS) holds a very rich record of these sites, there has not yet been any analysis or synthesis of this record as a whole. I hope to begin to remedy this through my PhD research which aims to identify and examine the Neolithic timber monuments of Scotland as a whole for the first time. This paper is a preliminary note following almost a year of research. My research, which is based at Glasgow University, is funded by the AHRC and is in collaboration with RCAHMS.

Methodology
The main aims of my research are to identify and gather together all the sites in the cropmark record of potentially Neolithic timber monuments, to provide a framework for the classification of Neolithic timber monuments, to investigate how these sites can inform our understanding of Neolithic Scotland and to assess the significance and purpose of the sites to Neolithic society. The first step towards achieving this has involved a complete search of the data and oblique aerial photographs held by the NMRS in order to identify all the sites recorded which may be Neolithic timber monuments and the creation of a database of these sites. The next stage, which is as yet only partially completed, involves the transcription of all the sites identified which will allow the detailed examination, analysis and comparison of sites. This will allow the beginning of a re-assessment of the current typologies. The next phase will begin to consider the context of the sites and will involve the identification of case study areas, field visits and fieldwalking of the sites within these areas and the examination of timber sites within their Neolithic context. It is hoped that this will aid the interpretation and understanding of the sites, but also begin to shed light upon the significance and purpose of these sites and their place within our understandings of the Neolithic.

Why?
So why look at Scotland’s Neolithic timber monuments? There are several reasons. As mentioned above, there has been no analysis or synthesis of this record as a whole. Although there have been a few studies focused upon particular forms of site, such as cursus monuments (Brophy 1999) or pit-circles (Tolan 1988, Millican 2003), the Neolithic timber monuments recorded in Scotland have never been identified or examined as a whole. As a result, it is not known how many are recorded, where they are located or the character of these sites. This is despite the fact that Neolithic timber sites have been recorded since the very beginning of aerial survey in Scotland. Examples include the late Neolithic palisaded enclosure at Meldon Bridge, Borders (Figure 1) originally recorded by St Joseph (RCAHMS 1967), the cursus monument at Inchbare also a St Joseph (1976) discovery and Balbridie recorded during the first season of flying by RCAHMS in 1976 (Maxwell 1978). Although none of these sites were interpreted as Neolithic when first recorded, there is now a much greater understanding of the existence of timber monuments during the Neolithic period.
through a limited amount of research and a small number of important excavations. As a result we are in a much better position to interpret the cropmarks than when they first began to be recorded. However, any interpretation that has taken place has tended to focus upon typology and even here there are problems and inconsistencies with the typologies used resulting in ambiguity in the way in which many sites are classified. In addition, although a small amount of work has been carried out on some Neolithic timber monuments, there is a lack of coherence to this work and often a lack of follow-up. There have been only limited attempts to consider the archaeological significance of some of these timber sites or place them within wider Neolithic studies. Therefore an assessment and re-examination of the cropmark evidence of timber monuments and the manner in which they are interpreted is long overdue.

What are Neolithic timber monuments?

Although a small proportion has been discovered through the course of excavation, the majority of these sites are revealed by cropmarks. Only a small number have so far been excavated, therefore interpretation relies primarily upon morphology. As a result, there remains the possibility that some of these sites do not in fact date to the Neolithic period at all. Nevertheless, their superficial similarity to those sites we can quite securely assign to the Neolithic mean that until other evidence is forthcoming, it is reasonable to assume that they belong to the Neolithic period.

Neolithic timber post-holes are revealed on aerial photographs as sites defined by the cropmarks of pits. At present, it is possible to divide these sites up into several superficial categories: pit-circles, pit-defined cursus monuments, large later Neolithic palisaded enclosures, rectilinear structures and enclosures which are variously called timber halls, rectilinear pit-defined enclosures or mortuary enclosures, curvilinear pit-defined
enclosures, avenues and pit-settings and timber structures found below later barrows, usually termed mortuary structures. These structures span the whole breadth of the Neolithic period and will have had a variety of different functions. It is important to point out that the divisions suggested below are not intended to indicate function, but are simply a way of handling the material at present. Divisions between the different forms of site are not always as clear-cut as the individual terms would suggest and these are only superficial categories. These categories will be refined in the future.

*Pit-circles*
Turning to pit-circles first there are immediately problems of interpretation as, from the air, isolated circles of pits of modest size could represent either the remains of later prehistoric round houses or ceremonial timber circles dating to the Neolithic. A typical example is that of Torr Wood (Figure 2a). It is often only the context in which the sites lie that provide the clue as to how to interpret them. For example, some sites lie in apparent association with other monuments (Figure 2b) or are components of a larger site (Figure 2c). Some pit-circles can be interpreted as earlier structures below later barrows, for example the site at Eckford Mill (Figure 2d). The specific morphology of sites may also help interpretation. A few sites, though, still elude interpretation. This is a problem that I will have to tackle and it is hoped that my research will be able to construct a method of interpreting difficult sites such as these.

![Figure 2 Pit-circles](© Crown Copyright RCAHMS)
**Pit-defined cursus monuments**

A second type of timber monument is the pit-defined cursus monument. Examples include the sites recorded at Balneaves Cottage and Reedieleys (Figure 3). A number of these sites have been recorded in Scotland. On aerial photographs they appear as parallel alignments of pits, up to several hundred metres in length and enclosed at one or both ends, often with internal divisions. There are also a small number of sites recorded which are superficially similar to pit-defined cursus monuments but are not always classified as such. These include sites such as the Neolithic timber enclosures excavated at Douglasmuir in Angus (Kendrick 1995) and Castle Menzies in Perthshire (Halliday 2002). A certain amount of work has already been undertaken on cursus monuments in general and I hope to be able to build on this work.

![Figure 3 Cursus monuments (a) Balneaves Cottage (b) Reedieleys (© Crown Copyright RCAHMS)](image)

**Timber halls/Rectilinear pit-defined enclosures/mortuary enclosures**

There is a group of sites recorded which are broadly similar but are variously called timber halls, pit-defined enclosures or mortuary enclosures. All are rectilinear in form and defined by pits. It is here that the terminology used begins to get quite confused. Similar sites are often given very different classifications and equally very different sites are
classified under the same terms. Examples include the cropmarks recorded at Balrae, Fortingall, Gilchrist and Millhill (Figure 4) and excavated sites such as the early Neolithic timber halls excavated at Balbridie and Claish Farm and the later Neolithic unroofed timber structures at Littleour, Carsie Mains (Figure 2b) and Balfarg Riding School. A variety of different sites are encompassed by these terms, which tend not to be applied with any consistency. My research aims to disentangle some of this confusion.

Later Neolithic palisaded enclosures

A small number of distinctive sites can be identified as later Neolithic palisaded enclosures. Four have so far been identified in Scotland; Dunragit (Figure 5), Forteviot, Leadketty and Meldon Bridge (Figure 1). These are large enclosures defined by massive individual posts with out-turned entrances defined by avenues of posts. From the air these sites appear as large enclosures defined by individual pits.
Curvilinear pit-defined enclosures
A relatively small group of sites can be identified as curvilinear pit-defined enclosures. Examples include the sites recorded at Hall of Aberuthven and Dunragit (Figure 6). Some bear a superficial resemblance to some of the rectilinear pit-enclosures or mortuary enclosures, others look like smaller versions of the larger palisaded enclosures, others look like very large pit-circles and there are some which cannot yet be explained. In many ways some of these sites are an unknown quantity, but their superficial similarity to some of the timber monuments which can be dated to the Neolithic means that they are forming part of my inquiry.

![Figure 6 Curvilinear pit-defined enclosures (a) Hall of Aberuthven (b) Dunragit](© Crown Copyright RCAHMS)

Avenues/pit-settings (Figure 7)
A small number of sites are classified simply as avenues or pit-settings. Avenues consist of an open-ended parallel pair of lines of pits, sometimes curving slightly. Pit-settings appear to come in a variety of forms, but generally appear to be shorter than avenues, consisting of two parallel lines of perhaps around three or four pits. These too are open-ended. Some look superficially similar to some of the sites also classified as pit-defined enclosures. A number of Neolithic sites are approached by avenues therefore it is possible that the avenues identified on aerial photographs originally defined an approach to a monument of some form.

![Figure 7 Avenues/pit-settings (a) Kirklands (b) Black Wood (c) Sprouston](© Crown Copyright RCAHMS)
**Mortuary structures**

The final type of timber monument being considered are structures over which later barrows or cairns were constructed, usually termed mortuary structures. These include sites such as the timber structures excavated below Pitmacre round barrow (Coles and Simpson 1965), Lochhill long cairn (Masters 1973) and Dalladies long barrow (Piggott 1973). These structures are generally not discovered through aerial photography, but usually through excavation and tend to be roughly rectilinear in plan.

**Where are the Neolithic timber monuments?**

A search through the NMRS has revealed that just under two hundred potentially Neolithic timber sites have so far been recorded as cropmarks. When sites recorded during excavation are added, this takes the number of sites to just over two hundred. When all these sites are plotted on a map (Figure 8), it is possible to see for the first time the distribution of sites across the whole of Scotland. As would perhaps be expected, the distribution of sites does generally follow the pattern of flying by RCAHMS, that is with a largely eastern bias with a small concentration to the south-west. However, it is possible at this stage to pick out a few patterns within this distribution of sites. Firstly and perhaps most obviously there is a substantial concentration of sites in Perth and Kinross, far more than in any other region of Scotland. Although the expectation would be that a large number of sites would be recognised in this area as it has been well flown, the concentration of sites appears to be in excess of coverage certainly if compared with other parts of Scotland. Therefore, this does appear to be a genuine pattern and timber monuments do appear to occur more frequently in the east of Scotland.
In contrast, despite intense aerial coverage of East Lothian and the fact that we know that this area is densely populated by cropmarks, the number of sites recorded in this area is relatively low (Figure 9). It is certainly much lower than would be expected considering the dense aerial coverage of this region and in comparison with the number of sites found in Perth and Kinross. Indeed East Lothian is the most intensely flown area of Scotland because of its proximity to RCAHMS’s base in Edinburgh and arable cultivation, which makes this relative absence seem even more obvious. This then may be another regional variation.

![Figure 9 Patterns in the distribution (a) Perth and Kinross (b) East Lothian](image)

Obviously, the distribution of cropmarks is a complex issue and there are many factors affecting where cropmarks are seen. Certainly the fact that several sites recently recorded in East Lothian (MacGregor and Shearer 2003) were not discovered as cropmarks but by excavation demonstrates that despite the dense aerial coverage of this area, we do not have a complete picture from the aerial record alone. However, the examples given above demonstrate that there are definite patterns in the distribution of timber sites in Scotland which will require to be explained and suggests that further analysis may reveal additional patterns.

**Conclusions**

My research so far has identified a wide range of timber sites which potentially date to the Neolithic period and some patterning in the distribution of sites can be identified. Although there are difficulties involved in working with this material, such as the problems with classification, timber monuments have the potential to add much to what we already know about the Neolithic period in Scotland. Ultimately, I want to move beyond simply collecting and classifying a group of sites to thinking about what they actually represent, that is significant Neolithic structures, and begin to think about issues such as what they were, what they looked like and functioned, how they fitted into Neolithic life and what they can tell us about the Neolithic way of life in Scotland and the people who used them. It is hoped that this research will open up and increase the understanding of a previously poorly-studied area of the Neolithic and help to begin to integrate it within our current understanding of the Neolithic period.
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Soilmarks
(defn: not crop marks, not crop-marks, not cropmarks)

RoboGEO
This may be a software solution for Canon users and others who cannot link a GPS directly with their DSLR. Their web site (http://www.robogeo.com/home/) notes that RoboGEO can write latitude, longitude and time to a file’s EXIF file and can create ArcView shape files or DXF files of a track.

More flying GPS?
Sony announced their GPS-CS1 device that allows users to link time and location to their photographs. The link is not physical but via software and any potential purchasers should check carefully before buying because the small-print suggests that the software may only talk to Sony cameras. http://www.sonystyle.com/is-bin and search from there.

Culture 2000
There is a new address for the Culture 2000 Project European Landscapes; past, present and future website: www.e-landscapes.com.

(more on p 47)
Using GPS with Digital Cameras

Michael Doneus and Irwin Scollar

Introduction
Digital cameras are being increasingly used in aerial archaeology. Taking and managing digital photographs pose new problems and there are many unsolved challenges coming with it. Issues of hardware, long term storage, standard formats, handling and post-processing of digital images, digital archives, or the question of authenticity have to be discussed (Doneus, 2005). On the other hand, digital cameras offer new features and possibilities that can be helpful in the daily workflow.

This paper will show some aspects of the meta-information that comes with a digital image: using GPS with digital cameras and how current mapping software is already making use of the EXIF header.

EXIF and IPTC
EXIF stands for “Exchangeable image file format” and is a specification for metadata used by digital cameras. It was created by a consortium of camera manufacturers in Japan (Japan Electronic Industry Development Association - JEIDA). With the specification a large set of camera data was standardized and is now incorporated into the headers of JPEG compressed image files and in high-end cameras in TIFF and some RAW files as well. Even low end consumer zoom lens cameras with JPEG output include the actual focal length at the moment of exposure.

Although the content of the metadata is standardised, each camera model will record a different set of tags. Usually, a broad spectrum is covered, including:
- Date and time information (date and time of exposure)
- Camera settings (camera model, orientation, aperture, shutter speed, focal length, metering mode, and film speed information)
- Location information (information from a GPS receiver connected to the camera; at the time of writing, only a very few cameras, e.g. the highest-end Nikons can incorporate GPS data from a standard GPS receiver in the aircraft)

Image descriptions and copyright information can be also included in the file header following the IPTC-NAA-standard (International Press Telecommunications Council and Newspaper Association of America). The standard defines a set of metadata attributes for copyright information, image description, keywords that can be applied individually to images.

Most recent image manipulation programs recognize EXIF and IPTC data. When applying changes to images, one has to take care, because not all programs will keep the metadata when saving the image after modification.

Using GPS with digital cameras
When archiving aerial photographs, we are often faced with the problem that in certain areas it is difficult to locate the image because of missing distinct features. Similar
problems occur when mapping images in areas where field boundaries are either non-existent or too far from the area of an image for use in mapping.

With the Nikon D2X and D200 DSLR cameras, direct GPS recording is available. NMEA 0183 compliant GPS units can be connected via a GPS cable to record latitude, longitude, altitude, and UTC (Coordinated Universal Time) information for each shot. The information is stored in the EXIF header of the digital image.

With a simple script for ArcView 3.x, which is included in the Aerloc database at the aerial archive in Vienna (Doneus and Mayer, 2001), the position of these digital images can be mapped as a point theme (Figure 1). The plotted image positions are used during the archiving procedure and facilitate the identification of the photographed targets on the map.

![Figure 1: Detail of a plotted flightpath (dashed line) with mapped image-positions of aerial photographs taken with a NIKON D2X and an attached Garmin eTrex GPS during a flight in the Austrian Alps.](image)

Positions of images from cameras without GPS recording can also be mapped. To get good estimates of the camera positions, a GPS-flightpath with recorded GPS time is necessary as well as the offset value between camera clock time and GPS timer. The
offset value can be specified by taking a photograph and noting the time, the GPS displays. By matching the timestamps in the images with the log from the receiver, the individual image-positions can be mapped along the flightpath and stored in a point-file.

The difference of the image-positions resulting from both procedures is minimal. So far, there has been no problem with a potential drifting of the camera time, which could cause larger differences in image-positions: the drift of the camera time of the Nikon D2X was 56 seconds over 70 days, which means less than one second per day. This may not be true in other cameras, so before using their data, the clock drift must be checked against GPS time.

Mapping image locations along a flight path is automatically done by the ArcView-script mentioned before, if no GPS-metadata is found in the EXIF header. There is of course also commercially available software, as for example Robogeo (http://www.robogeo.com/) that will perform a plot of images using the internal camera time and a recorded GPS data stream.

**AirPhoto, RadCor and the EXIF-Header**

The EXIF header has also advantages when mapping photographs. The version of AirPhoto (Scollar, 1998) at the time of writing (3.23) can read the GPS data in an EXIF header of a displayed JPEG or TIFF (and RAW files like Nikon's NEF, but not Canon's RAW format) if requested on the Grid menu or on the Info menu item on the File menu. The values are shown in a small pop-up window along with the actual GPS time at the moment of exposure.

Additionally, the software can use the EXIF focal length data referred to 35mm format if the camera records it. Then this doesn't have to be entered by hand when using Fischler-Bolles rectification. This is the case at the time of writing with the high end Nikons. Unfortunately, at the moment the EXIF standard does not include the size of the CCD or CMOS camera chip, so that this information can not be inserted automatically into AirPhoto's Fischler-Bolles rectification method. The RadCor program (Scollar, 2005) gets the focal length actually used at the moment of exposure and adds automatic radial correction for a large number of digital cameras. That too will be incorporated into AirPhoto.

The next major version of AirPhoto (4.01) will make use of the GPS and lens information of the EXIF-header to start off the Bundle Adjustment with initial values. When we have an image sequence showing multiple views of hilly terrain, special techniques are required for obtaining a rectified mosaic of the image data. Until recently, accurate maps or ground truth data plus a considerable number of ground control points (points visible in the images and the maps) and a fair number of tie points (points jointly visible in various pairs of images, but not necessarily on the map) were required in order to carry out an optimal adjustment of image and terrain parameters, a so-called Bundle Adjustment which minimises the global re-projection error for all points (Doneus, 2001). The re-projection error at a given point is the difference between the calculated and true position of a point in an image pair or a map-image pair.
In order to start the optimization method (usually non-linear Levenberg Marquardt), some initial values for the parameters inside the camera, the “interior orientation” which includes focal length, width, height and perhaps focal point offset from the image center (principal point) are needed or have to be computed from the correspondences of points between images or images and the map. It would also be helpful to know something about the position of the camera at the instant of exposure, so that optimizing iteration converges quickly and stably. In the past, these values were not normally available (Figure 2).

![Figure 2: Scheme of a Bundle Adjustment. Several photographs are adjusted using ground control points and tie points. Known image positions \((X^0, Y^0, Z^0)\) from GPS can be helpful.](image)

The next version of AirPhoto will take these values from the EXIF-header, if they are available. They will permit rapid and stable convergence to a globally optimal minimum re-projection error for all the images in a set along with a map. In fact, if there are a sufficient number of images and visible tie points between them, a map may sometimes not even be necessary, since the GPS coordinates can be assigned by the optimization method to the ground points which they represent. A method for automatic extraction of possible tie points is therefore used to obtain a large number of these without user interaction will be offered (Figure 3). Corresponding points in multiple image pairs are also selected automatically.
Figure 3: Aerial photograph of a Roman villa in Austria showing automatically extracted tie-points used for subsequent Bundle Adjustment.

Conclusion
Using digital cameras offers new possibilities that are not normally available with analogue cameras. A large set of standardized camera data is now incorporated into the headers of JPEG and TIFF files including date and time of exposure, and the actual focal length and camera settings at the moment of exposure. With some NIKON camera models, even direct GPS recording is available.

Mapping software like AirPhoto is capable of integrating EXIF information to improve the easiness of the workflow and to permit rapid and stable convergence in the new Bundle Adjustment procedure. GPS-positions in the EXIF header facilitate locating image-positions during the archiving procedure in areas where distinct features are missing. But even if no direct GPS recording is available, plotting of camera position at
the moment of exposure is still possible using the internal camera time and a recorded GPS data stream.

References


Forthcoming events

**Aerial archaeology and maritime landscapes**

Seminar and workshop in Tallinn and Saaremaa (Ósel), Estonia

26–29 October 2006

Seminar and workshop will be arranged in order to introduce the possibilities to use aerial photography in the research of maritime landscapes, and to discuss the methods together with colleagues from other research institutions from the Baltic Rim countries. The seminar will be open for other listeners, for the students of Tallinn University and Tartu University as well as for a broader audience. The workshop will be arranged for discussing the research methods and further perspectives *in situ*, visiting the sites and landscapes of interest on the island of Saaremaa.

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**II International Conference Remote Sensing Archaeology**

*From Space To Place*

CNR Headquarter (Piazzale Aldo Moro), Rome, Italy

4-7 December 2006

Official Web Site of the Conference: www.space2place.org
Modelling the acquisition times of CORONA KH-4B satellite photographs

Martin J F Fowler

Introduction
The date and time of acquisition of aerial photographs are of fundamental interest to the aerial archaeologist since the azimuth and elevation of the sun, together with the viewing angle of the camera, can have a significant impact on the appearance of archaeological features on the photographs (Wilson, 2000). Since their declassification in 1995, photographs acquired by the CORONA series of photoreconnaissance satellites, in particular those from the KH-4B missions, have been used increasingly by archaeologists in support of a range of studies (see Fowler 2004 for a recent review) but, unfortunately, the catalogue for these photographs at the US Geological Survey EarthExplorer website (http://edcsns17.cr.usgs.gov/EarthExplorer) gives only the dates of acquisition of the photographs. Whilst it is possible to estimate the time of acquisition from the direction of shadows that are cast by features on the photographs (Fowler and Fowler, 2005), this requires the photograph to be accurately georeferenced, which can be difficult to achieve in featureless terrain or when only small scale maps are available.

An alternative approach is to model the orbit of the satellite in both space and time and to use the results to determine the time of image acquisition. In this note, historical orbital element sets are used together with the Satellite Tool Kit (STK) satellite-modelling package to model the orbit of KH-4B Mission 1104 throughout its 15-day photoreconnaissance mission. The high fidelity of the modelling permits the time of acquisition of the photographs acquired by the satellite to be determined accurately together with other parameters such as the solar azimuth and elevation at specific locations of interest as well as the relationship between such locations and the observing satellite.

Satellite Tool Kit
STK is a commercial-off-the-shelf modelling package for satellite operations that runs under Windows, LINUX and UNIX. The core of the package, STK Standard, is available free of charge and permits the 2-D visualisation of various time-dependent information for satellites and other space-related objects but is limited to the representation of simple conic sensors. The analytical capabilities of the package can be extended to cover different sensor types – including a rectangular sensor required to model the coverage of the CORONA panoramic cameras – and other capabilities through the purchase of STK/PRO. STK is available on request from the Analytical Graphics Inc website (http://www.agi.com) and includes a 7-day evaluation licence for STK/PRO and other add-ons, after which time the licence reverts to the core STK Standard package.

Included in STK Standard is the ability to import orbital elements provided in the form of NORAD Two Line Element (TLE) sets that provide the parameters needed to specify an orbit uniquely (Wikipedia, 2006). Because orbits change over time, multiple TLEs are required to describe a satellite over the course of its lifetime. TLEs are available over the Internet from a number of websites including Jonathan’s Home Page (http://planet4589.org/space/). However, in order to import them into the latest version of
STK (version 7.1.1), which is less tolerant of variations in the TLE file format that previous versions, it is necessary to edit the TLEs to replace a number of the blank spaces in columns 10-17 and 45-52 of line 1 into zeros as in the example shown below.

Original TLE:

1 03336U 68233.00010454 .00000000 00000-0 0 166
2 03336 82.1434 331.8756 0096200 143.7583 217.0155 16.26936006 1977

Amended TLE:

1 03336U 00000000 68233.00010454 .00000000 00000-0 0 166
2 03336 82.1434 331.8756 0096200 143.7583 217.0155 16.26936006 1977

Modelling Mission 1104

KH-4B mission 1104 was a two-part satellite reconnaissance mission that was launched at 2137 UTC on 7 August 1968 (NRO, 1968). The first capsule of film was recovered on revolution 115 on 15 August 1968 and the second on revolution 244 on 22 August 1968 terminating the mission. The satellite was given the international designation of 1968-039A and the NORAD designation 03336 (Barhost, 2005).

In order to model the mission in STK it is necessary to define both the satellite's orbit and the sensors carried on the satellite. Defining the orbit is relatively straightforward as the 22 TLEs that are available for the mission can be imported into STK and then propagated into orbital positions and heights over time using the SGP4 propagator included in the package (Figure 1).

Figure 1. A single orbit (revolution 156) of Mission 1104. The ground track of the satellite is from west to east over a period of 88.6 minutes and the position of the satellite at one-minute intervals is shown by cross-bars on the approximately 230 km wide swath of the two panoramic cameras carried by the satellite.
Figure 2. Footprints of the forward and aft panoramic cameras carried by the CORONA KH-4B satellite system (after NRO, 1970).

For Mission 1104, the orbit is sun synchronous with an inclination of 82.1° and an orbital period of approximately 88.6 minutes. The effect of this orbit is that the descending path of the satellite is in sunlight with locations at the same latitude on the orbital path being passed at the same local time of day.

The KH-4B satellite system carried two panoramic cameras looking forward and aft of the satellite and each photographing a footprint of the order of 230 by 15 km at right angles to the orbital path (Figure 2). In order to represent the footprints of the cameras in STK, a simplified model based on a rectangular sensor is used. The specific parameters used to represent the coverage of the cameras are given in Table 1.

<table>
<thead>
<tr>
<th>Sub-Category</th>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Definition</td>
<td>Sensor type</td>
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</tr>
<tr>
<td></td>
<td>Vertical half angle</td>
<td>35.5 deg</td>
</tr>
<tr>
<td></td>
<td>Horizontal half angle</td>
<td>2.6 deg</td>
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<tr>
<td>Pointing</td>
<td>Pointing type</td>
<td>Fixed</td>
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<td></td>
<td>Orientation method</td>
<td>Az-El</td>
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<td></td>
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<tr>
<td></td>
<td></td>
<td>179.2 deg (Aft)</td>
</tr>
<tr>
<td></td>
<td>Elevation</td>
<td>75 deg</td>
</tr>
<tr>
<td></td>
<td>About boresight</td>
<td>Rotate</td>
</tr>
</tbody>
</table>

Table 1. Sensor data used to represent the KH-4B cameras in STK. The values used for the Fwd and Aft looking cameras are identical with the exception of the Azimuth parameters. Based on NRO (1967) and Selander (1997)
Whilst the use of the rectangular sensor model in STK does not fully reflect the coverage of the actual cameras carried by the KH-4B satellite, in particular the panoramic distortion that is inherent in the cameras, it is considered to be sufficiently precise for the present purpose. In order to take into account a slight skew in the footprint resulting from the forward motion of the satellite whilst the camera was being exposed, the azimuth of the camera is rotated by 0.8° relative to the direction of flight of the satellite.

An indication of the accuracy of the modelling of Mission 1104 can be gauged by comparing the footprints of the forward and aft cameras as provided by the EarthExplorer website and those predicted using STK. From Figure 3 it can be seen that there is a good correlated between the predicted and actual footprints of the photographs acquired on revolution 156D, with the footprint of the Aft-looking camera being some six frames behind the footprint of the Fwd-looking camera.

Having successfully modelled the orbit and camera footprints of Mission 1104, it is possible to determine the time of acquisition of Fwd frame 14 on revolution 156D that showed crop mark evidence of a number of ring ditches, pits and an enclosure at Dean Farm near Fareham, Hampshire (Fowler and Fowler, 2005), as being 11:59:13 GMT on 17th August 1968. This compares well with the estimate of an acquisition time of approximately 12:30 GMT based on the direction of shadows cast by small clouds present on the photograph. On the basis of the modelling, the azimuth and elevation of the sun at the time of acquisition were 176° and 52° respectively and the satellite was at an altitude of 157.75 km. The azimuth and elevation of the satellite from the targets at Dean Farm were 37.3° and 67.25° respectively and the slant range to the satellite was 168 km.

Figure 3. Comparison of footprints of Fwd and Aft cameras of Mission 1104 as modelled using STK (solid lines) with Fwd camera frames 10-16 of revolution 156D as provided by EarthExplorer (dashed lines).
Figure 4. KH-4B satellite photographs of Portchester Castle acquired by Mission 1104 on revolution 156D. A. Fwd camera frame 14; B. Aft camera frame 20. C. Geometry of the Fwd and Aft photographs. Data available from US Geological Survey, EROS Data Center, Sioux Falls, SD, USA.

The different geometries between the cameras and targets on the ground at the time of image acquisition can account for the differences in the appearance of features on the satellite photographs. In the case of Portchester Castle shown in Figure 4, whilst the castle is obscured by a small cloud on the photograph acquired by the Fwd camera (Figure 4A), 11 seconds later the change in geometry once the satellite has passed overhead is such that the photograph acquired by the Aft camera (Figure 4B) has unmasked the upstanding Roman walls and bastions of the Norman keep.
Discussion

This note has demonstrated that through the use of readily available historical orbital element sets and the STK modelling package it is possible to model KH-4B Mission 1104 to a high degree of fidelity and to determine the acquisition times of photographs acquired by the mission. Whilst the modelling of the sensor coverage requires the use of the STK/PRO component of the package which is no longer available once the evaluation period is complete, it is nonetheless possible to continue to use the core STK Standard package to estimate the time of photograph acquisition to the nearest minute. For the convenience of potential users of this modelling approach, details of the 16 successful KH-4B missions from which photographs are available are given in Table 2 to enable appropriate TLE data to be identified.

<table>
<thead>
<tr>
<th>Mission</th>
<th>NORAD number</th>
<th>International number</th>
<th>Launch date</th>
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<th>Part 2 recovery</th>
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<td>1101</td>
<td>02946</td>
<td>1967-087A</td>
<td>15 Sep 67</td>
<td>21 Sep 67</td>
<td>28 Sep 67</td>
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<td>15 Dec 67</td>
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<tr>
<td>1103</td>
<td>03228</td>
<td>1968-039A</td>
<td>1 May 68</td>
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<td>15 May 68</td>
</tr>
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</tr>
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<td>1968-098A</td>
<td>3 Nov 68</td>
<td>11 Nov 68</td>
<td>21 Nov 68</td>
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<tr>
<td>1106</td>
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<td>1969-010A</td>
<td>5 Feb 69</td>
<td>10 Feb 69</td>
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<td>1117</td>
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<td>1972-039A</td>
<td>25 May 72</td>
<td>27 May 72</td>
<td>31 May 72</td>
</tr>
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</table>

Table 2. Details of CORONA KH-4B missions (1967-1972).

In addition to modelling other CORONA missions, it should be possible to extend this approach to other satellite systems that are of potential use to the aerial archaeologist but for which details of the time of acquisition of their products are not available. These include the recently declassified photographs acquired by the high resolution KH-7 surveillance satellites and the lower resolution KH-9 mapping satellites, both of which have been shown to be of potential benefit to the aerial archaeologist (Fowler, 2003; Ur, 2005), although the limited data that are available on the cameras and missions flown by these satellites may complicate the process.

Acknowledgements

Thanks to Deep Damle of AGI for providing a copy of STK and to Jens Ramrath and Justin Poley for advising how to make the non-standard TLEs work with the latest version of STK. The continuing assistance of the Information Access and Release Center of the US National Reconnaissance Office in providing copies of original records relating to the CORONA programme is gratefully appreciated.
References

Fowler M. J. F. 2003. The archaeological potential of declassified KH-7 and KH-9 intelligence satellite photographs, AARGnews 26, 11-16.


A good year for cropmarks in Wales

Toby Driver

Summer 2006 started the way most summers do in Wales, with a very wet May but warming into June and July. By late June, Soil Moisture Deficit figures were high – for Wales – being into the 70s and 80s for the Vale of Glamorgan, Welsh Borderlands and north-west Wales including the Isle of Anglesey. Into July, with the temperatures on 19th July reaching 34 degrees Celsius, the hottest on record for Wales, SMDs climbed into the 100s for much of Wales, yielding good discoveries in all parts except Pembrokeshire, Gwent and the far north-east.

A small selection of some of the most interesting discoveries is shown here, but undoubtedly the most significant have been two probable Neolithic causewayed enclosures. Prior to this summer’s flying only three were previously known from Wales, one on Anglesey found during excavation, and two in south Wales. The first of these is at Norton, Ogmore, discovered from vertical aerial photographs by the writer (Driver 1997), and the other at Corntown discovered by Chris Musson. The latter had an unusual array of two close-set concentric interrupted ditches but has been effectively dated by the prior discovery, through fieldwalking, of a massive assemblage of early Neolithic flintwork (see Burrow et. al. 2001).

The two newly-discovered causewayed enclosures are both slightly different. The first, at Womaston, near Walton in south Radnorshire, was discovered by Chris Musson on a recce of the Welsh Borderlands following work in Herefordshire. This is a characteristic oval bivallate causewayed enclosure on a rounded hill. The second was discovered during reconnaissance in south Wales at Flemingston, near St Athan. This also has interrupted ditches but shares a similar morphology, the close-set concentric ditches, with the Corntown enclosure which lies some 14km north-west.

There were other notable discoveries; a large circular concentric enclosure at Goginan near Aberystwyth, flanked by a newly-recorded upstanding barrow and cropmarks of a large pit, is unique so far in Ceredigion. The monument showed clearly from the ground on a recent visit. Two previously unknown Roman fortlets have been discovered guarding strategic passes on the Roman road system near Llanerfyl in northern Powys and near Bala in Gwynedd. One of the most rewarding discoveries was the outline of a hitherto lost medieval church in the Vale of Conwy, once part of a medieval township. There are many documentary records of medieval townships but few in Wales have produced such important aerial discoveries. It is surrounded by other traces of wall footings and roads, but no conclusive evidence of an associated cemetery.

Currently no regional flying is being funded in Wales, although there are plans to re-start this in 2007. Covering the country with a single set of eyes would have been more difficult without additional flights later in the season by Hugh Toller, who provided useful observations on parchmark development, and by Chris Musson in the Borderlands. Chris also opted to fill the vacant back seat on a number of flights, overflying parts of Wales he never thought he’d see again from the air following his retirement in 1997 from the Royal
Commission. His view from the right-hand seat was invaluable and many sites, including the ‘lost church’ might have been missed without his help.

References


The concentric lines of a probable ‘Corntown-type’ Neolithic causewayed enclosure at Flemingston, St Athan (Crown Copyright RCAHMW).

Cropmarks of a Bronze Age circular enclosure revealed at Pen-y-wal, Dollwen, Gogninan near Aberystwyth, with a newly recorded upstanding barrow (above the enclosure) and a possible ‘ritual pit’ (to the right) completing an interesting complex (Crown Copyright RCAHMW).

The Womaston causewayed enclosure, near Walton, Radnorshire (Crown Copyright RCAHMW).

The concentric Pen-y-wal enclosure showing from the ground as grass re-growth in a field cut for silage, with a very pleased landowner providing scale in the centre (Crown Copyright RCAHMW).

[More pics from Toby on page 45]
Soilmarks
(defn: not crop marks, not crop-marks, not cropmarks)

Simmons Aerofilms
In May I received a letter from Simmons Aerofilms stating that, from the end of June 2006 they “... will no longer be offering any kind of search or photographic printing services.” Chris Mawson, their librarian, confirmed that this will include not making digital copies from existing film stock. Everything is moving to their Somerset HQ and presumably will be kept in safe storage. Copyright remains with Simmons Aerofilms.

The loss of this collection is likely to have serious implications among those of us who dabble in legal disputes for which their photographs, along with those taken by the OS, tend to be a main source of recent information. OK, it’s not a real loss as most of their recent surveys will be held at county and district offices, but we will no longer be able to buy the hideously-expensive enlargements that have been helpful in convincing the legal profession that we know what we’re doing.

Dr Beccy Jones
Congratulations to Beccy Jones of RCAHMS who has just been awarded her PhD for a thesis entitled The temporary encampments of the Roman army in Scotland which was based on information gathered mainly from aerial photographs. Receipt of an AHRC Collaborative Doctoral Award enabled Beccy to work full time on the thesis for several months over the last year to bring it to completion. She compiled a comprehensive gazetteer of all the sites known in Scotland with newly transcribed plans supplemented with data from excavations and field survey. In her synthesis she considered the functions of camps, various aspect of their structural details, their holding capacity, distribution and re-use. Finally she offered a critique of existing theories proposed for their historical context, ably demonstrating the important contribution of aerial photography to Roman archaeology. Students of Roman military archaeology will look forward with anticipation to publication of the thesis as a monograph.

[Information from Bill Hanson]

Nasca things
A PhD thesis on the photogrammetric documentation and archaeological analysis of the Nasca geoglyphs of Palpa, Ica, Peru has recently been published. You can find more information about the book, its content and how to order on the publisher’s website: http://www.lindensoft.de/Palpa/index.html

For further information on the Nasca-Palpa project please visit the following websites:
- of ETH Zurich: http://www.photogrammetry.ethz.ch/research/peru/index.html
- further papers for download: http://www.photogrammetry.ethz.ch/general/persons/karsten/publications_lambers.html

[Info: K. Lambers, Nasca-Palpa Project]

Zbigniew was one of the ‘students’ on the first training course we ran in Hungary in 1996. At the time he was Chief Inspector of Ancient Monuments and things were looking good for aerial survey in Poland. Political upheaval removed him from that post and he is currently teaching at Warsaw. The book appears (because I’m basing this entirely on the pictures) to be an introduction to archaeological aerial photography for Poles. It covers the how and why of how and why things can be seen from the air, a history of aerial photography in Poland (including the AARG relationship and the teaching which they have subsequently done), and ends with pictorial examples in chronological order. The book may provide a useful guide to beginners and others wanting to find out about the structures from which their beloved artefact scatters may have come.

Rog Palmer


This huge ‘brick’ (Żuk, pers com) presents papers discussing applications of aerial photography in Poland, plus a handful from other parts of Europe. These are mostly archaeological but include some relevant geological/geomorphological work and most are illustrated with an abundance of maps, tables and photographs. Each paper has a short summary in English plus translations of the figure captions. The one thing I would have liked was an English contents list – but that’s a minor point in a book that shows just how far uses of aerial photos have come in the last 15 years and should give other Europeans and Brits something to try to match up to.

I read most of the summaries when I was staying in Poznan, but didn’t take notes although two points may be worth comment. The book includes a paper (Tomasz Burda) that shows the massive level of looting and destruction that is taking place in present-day Iraq – presumably under US and UK administration? This needs to be better known and I’ve already suggested the author submits something similar to *Antiquity*. There is also a contribution from Germany that includes more references than text – something I’ve never seen before, not even in theoretical papers. This may be useful for German students of German aerial photography but surely is out of place in a Polish book?

Rog Palmer

Authors’ abstract:

In this study, the potential and feasibility of the use of panchromatic and multispectral QuickBird data for the identification and spatial characterization of archaeological sites was evaluated. The analysis focused on an assessment of the capability of QuickBird images to detect surface anomalies expected in the presence of archaeological buried remains. The investigations were performed for a test case in the south of Italy, where human activity has been logged from the Palaeolithic to the Middle Ages. The results show that the QuickBird panchromatic and data fusion products can be a flexible data source for archaeological prospection, and can be useful for extracting features of archaeological sites prior to any excavation work and for increasing the cultural value of historical sites.

Thanks to Martin Fowler I’ve had a quick read through a pdf copy that he sent and it seems initially disappointing. The authors have selected an upstanding site that they know and have played games with edge detection algorithms to ‘identify’ the archaeological features on the images. Shades of that paper we sat through at Leuven… but I suppose they give a foretaste of what is to come by way of ‘interpretation’ of aerial images (taken from any height) when it’s done by GISers and others who rely on machine technology rather than eyeballs and brains. I couldn’t help but imagine the results of any search using edge detection over a county-sized area.

Rog Palmer

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[Below are the remaining air photos that illustrate Toby Driver’s note (p 41-42)]

Prehistoric enclosure discovered in a playing field, Efailnewydd near Pwllheli in north-west Wales.

Detail of lost medieval church, Llwydfaen medieval township, Vale of Conwy, north Wales, a very unusual discovery for Welsh aerial archaeology (Crown Copyright RCAHMW).
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Please send your contributions in digital form via email, CD or floppy disc. Preferred form for contributions is in Rich Text Format or Word for Windows files within which illustrations can be placed in appropriate places. It makes life easier if I can do this myself, so please send text and illustrations as separate files. Camera-ready photographs or drawings are accepted.

Colour illustrations
Our printers can include colour pages (see AARGnews 32 for examples) for which we ask the author to pay. At present one colour page costs 30p per side and a print run is in the region of 180 copies.

Big files
For some reason ntl restricts me to accepting 5MB email attachments. Please forewarn me if you are sending a series of these otherwise they’ll start bouncing.

Please format Page Setup as A4-Portrait with a 3.5cm margin at the top and 2.5cm for the other three. If this is not done in your original all hell can break lose when I juggle to reformat your carefully placed pictures to the AARGnews page size.

Please adhere more or less to the style of headings, etc found in recent issues. This seems currently standardised(±) as:

- Times New Roman 12pt for single column text;
- Times New Roman 11pt for double column pages;
- Times New Roman 14pt bold for the title of your contribution;
- Arial 9 or 10pt for figure captions.

Location Maps
Now that AARG and AARGnews contents have spread from their Cambridge origins it has been suggested that contributors might include some kind of location map with their work – or at least mention the country they are working in!

AARGnews is published at six-monthly intervals so please adhere to the copy dates. Copy for AARGnews 34 needs to be with me by February 14. Editorial policy (for want of a better word) tends to be that if I am sent interesting contributions they go in. I do not wait until the copy date and wisely consider the merits of each. If an issue becomes too thick (too expensive) I will hold a contribution, with permission, until the next issue. Definitely first come, first published!

Address for contributions: Rog Palmer
21 Gunhild Way
Cambridge  CB1 8QZ
UK
Fax 01223 572063
rog.palmer@ntlworld.com
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