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AARG: general information, membership, addresses, student scholarships
AARGnews is the newsletter of the Aerial Archaeology Research Group

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[Cover photo: Somewhere south of Dresden on the way to Pilsen: 20 March 2016]
Air Photographs Unit, 50th anniversary (see editorial)

Marking the 50th Anniversary of RCHME’s Air Photos Unit, 1 November 2015. John Hampton (seated) with (L-R) Rog Palmer, Jonathan Edis, Roger Featherstone, Grahame Soffe, Cathy Stoertz, Pete Horne, Elaine Mucci, Cory King, Mark Watson. (Photo by Pete Horne’s camera).

John Hampton plus cake (photo, Pete Horne).
Editorial

50th anniversary celebration

Sometime around the middle of 2015 I had a phone call from John Hampton telling me that November 1 was the 50th anniversary of the founding of what became the APU (Air Photographs Unit) of the Royal Commission on the Historical Monuments of England. John ran the unit for 20 years until his retirement in 1985 during which time he built up the staff from about 1½ people to something in the region of a dozen. In 1999(?), RCHME was absorbed by English Heritage (now Historic England) and, after several changes of name, the APU may now be called Aerial Investigation and Mapping – although I found this difficult to confirm on the EH/HE web site which always confuses me.

The origin and development of the early APU is noted in John’s contribution to Derrick Riley’s Festschrift (Hampton 1989) and a more personal view was in part 2 of the Conversation published in AARGnews 13 (1996, 23-29). The brief for the job seems wonderfully elastic: ‘to use aerial photography to build up rapidly a record of field monuments throughout England and of selected areas of English towns…’ (Hampton 1989, 17). Later steps are noted in the same publication and moved from collecting aerial photographs to taking them and to a first attempt at mapping from them in 1968 (ibid, 20). I joined the APU later that year and worked there for 5 years during which period mapping seemed to be a luxury that was done when there was time to spare from cataloguing aerial photographs. More was done after I left and staff numbers increased, as for example in the photogrammetric mapping of upstanding features on Bodmin Moor (Johnson and Rose 1994) and the computer transformed crop-marked landscape of the Yorkshire Wolds published by Cathy Storetz (1997). In later years the collection of aerial photographs was separated from the Commission’s internal users of APs which enabled the development of more mapping which became known as the National Mapping Programme (which now may be called something else).

My personal view is that without John and the APU, ‘aerial archaeology’ would be dominated by aerial photographers whose publications would be limited to picture books and descriptions. APs would be used by digging archaeologists to select another site for excavation and geophysical survey results in a single modern field would be seen as a ‘landscape’. Training schools in mainland Europe would have shown people the joys of flying, airsickness and taking aerial photographs but no one would know what uses to make of them other than to illustrate examples of recognisable site types and perhaps use time sequences of photographs to show destruction.

Of the people who worked with and learned from John, three of us – Cathy Stoertz, Pete Horne and myself – kept our feet in the aerial world and so were in a good position when the first ‘flying school’ was planned in Hungary in 1996 to stamp loudly and insist that students were shown what to do with aerial photographs after they’d been taken. Results from that school were summarised in AARGnews 13 (see also Bewley et al 1996) and ‘ground schools’ became an integral part of training courses – sometimes the only part – from that date onwards. I could suggest this to be John’s influence moving into mainland Europe but this

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note is to mark the 50th anniversary, not to write a history of uses of aerial photographs for archaeology.

During John’s phone call we decided that, as HE had expressed no interest in marking the anniversary formally, it would be good to have an informal get together over a meal and drink of people who had worked at the APU while John was boss. The rest was done by personal contact which enabled ten of us (plus two spouses – is spice the plural?) to meet for lunch at a pub in Epsom, John’s hometown. So… a few drinks, an absolutely appalling meal (perhaps expected in a pub that caters for 100+), a cake that John had designed, and the chance for a short chat with people rarely seen, a couple of toasts, and away we went. John (one of our Hon members who, at a very fit 93 or 96, no longer comes to AARG meetings) was happy that we’d managed to get a few people together to celebrate the anniversary. It was a short celebration which perhaps would have been more fun if we’d met in the evening and stayed overnight to give us the chance to tell more funny stories and ‘say the things we’d really wanted to say’ (anon, pers com). But some things may best be left unsaid..?

**Experimental archaeology and Google Earth**

Among the useful things that archaeologists have made are the many reconstructions of past structures. Some, such as the experimental earthwork on Overton Down, UK, and parts of Lejre, Denmark, help us measure and visualise the post-depositional processes that banks and ditches may undergo and so strengthen our interpretations of earlier earthworks, be these still upstanding or now levelled. So it was interesting to identify some examples from Russia that I found while nosing around in Google Earth near one of the sites mentioned in the contribution by Martin Fowler in this issue. First was a ‘cursus’, some 720 x 100m as in the left image below, and to its north-east was a small ‘long barrow’ (below, right).

The experimental ‘cursus’ on the left with, at larger scale, the ‘long barrow’ above. South is to the top in both pictures. Source: Google Earth/DigitalGlobe, 17 April 2013 and 21 October 2006 respectively.
That, of course, is nonsense as both are of recent military origin rather than experimental archaeology (although they may be useful for continuing observation to keep track of their decay). The tell-tale tank hide in the top right of the ‘cursus’ picture shows this to be an area for military exercises and, seen in broader context, the whole area shows recent military connections. A closer look, shows the ‘cursus’ to have a series of internal cross banks at 50m intervals – presumably targets butts for shooting – and the most recent pictures of the ‘long barrow’ mound show that it was a nice hump for vehicles to drive over or, more likely, to raise missile engagement radar a few metres to avoid ground clutter (email discussion with Martin Fowler).

Doubtless, there will be similar examples elsewhere which, in dereliction, may provide useful information about post-depositional processes and so provide another archaeological use for Google Earth.

If you want to find it for yourself, search for Makukhin, Astrakhan Oblast, Russia (which, itself, seems to be an unpopular place) and go 6km north-east.

![Image](image_url)

Seen in context with the ‘barrow’ at B and adjacent derelict military compound and barracks. South is still to the top. Source: Google Earth/DigitalGlobe, 17 April 2013.

**Geoportals and Britain**

In the past, I’ve been somewhat scathing about the lack of a geoportal for Britain, especially when my work/play has taken me to countries which have put no end of useful stuff on their own for free access. This has changed (I’m not sure when) and we are beginning, in Britain, to get some useful stuff on the internet. It’s not yet in one cohesive whole, but sites I know of include Magic which has a range of maps, a very slow AP layer on which some have been taken on useful dates, plus a variety of polygons showing a range of habitats, landuse, etc – some of which are useful for archaeologists. There are at least two sites with old maps at reasonable quality and, following quickly on the Environment Agency’s release of its ALS tiles, a really useful joined-together version which has already (apparently) been used to locate some Roman roads. If these useful sites have been created as a result of the EU Inspire initiative, I suppose they may all be taken down if Britain decides to leave the EU…
AARG 2016, Pilsen
A late-March committee meeting in Pilsen included seeing venues chosen for the next AARG meeting and other organisation that is being done by the local Meeting Secretaries (Martin Gojda, Lucie Čulíková and Lenka Starková). The first call for papers is elsewhere in this issue and will be on the AARG website and circulated individually to members. Ideas for themes, etc are promising and the field trip is planned to end with a brewery visit. We also learned a few travel tips that will be passed on to those of you who register, and your Committee sampled rigorously to verify that the local beer was suitable for members.

This issue
Along with others who attended AARG in Santiago, I was impressed by the amount of aerial work that was presented in the ‘local session’ especially as Spain had long been a relatively black hole to those of us involved in European workshops. I’m pleased to be able to include a Spanish Section in this issue and am grateful to César Parcero-Oubiña for acting as Local Editor and persuading people to write for us, including some who did not present at AARG. There is a mixture of work among the papers, and it is good to see aerial photography being done as part of localised research projects rather than being used just to collect information that may one day be used. Meeting Daniel Langhammer at AARG 2015 led to his paper on remote sensing in Sweden while, also from AARG 2015, Mikolaj Kostyrko (et al.) has expanded his AARG scholarship-winning presentation on ‘animal tracks’. The results of 24 years of aerial surveying are being linked to a database that accompanies the Archaeological Map of the Czech Republic in a paper by Martin Godja and Lucie Čulíková. Finally, I am pleased that Martin Fowler has come out of ‘retirement’ and is again writing about information from satellites.

References


Many of us in the aerial archaeology community wear multiple hats. Happily, in my opinion, I don’t think we can divide up the community into ‘techie people’ and ‘interpretive people’ or into ‘methods people’ and ‘landscape people’. We work from various angles and perspectives, bringing these different ways of thinking and doing to each task. As I engage in an interpretive exercise, reading a landscape, I lean on a collection of technologies as my tools of the trade, from the photograph to the spectral signature. One well-known outcome of the impossibility of separating the task from the tool is that as technologies develop, practice evolves. Some technological development is fast, but much of it is relatively slow; a progression full of dead ends and mis-steps. So which exciting new toys should we be picking up? Big technical developments generally come from outside archaeology and we have to hope we are paying enough attention to spot the things that will be relevant. A few weeks ago I found myself chatting with some of the guys at the office about deep convolutional neural networks. Not that I really understand how they work or the maths behind them. But the chat goes something like this…

Office guys: ‘Yes, when we were students in the 80s there were lots of phds trying to make this flexible pattern matching using multilayer perceptron models work, and it never really did. Eventually we gave it up as unproductive and moved on to other things. Well, thirty years later a few people were stubborn enough to keep pursuing the technique, the limits on computing power are gone, and now it works. We needed more GPUs, bigger imagery sets for training. But now we have all that.’
Me: ‘So how robust is the pattern matching and feature recognition?’
Office guys: ‘Well it depends on getting a big enough training dataset. But it’s really impressive. We’ve been looking at the libraries and scripting languages. Google and facebook are using this to do image based search.’
Me: ‘We’ve got all these desert kites, out in the Middle East and North Africa. They don’t follow strict patterns, but they’re similar.’
Office guys: ‘I bet we could spot those in all that Corona imagery we have hanging around. We need a project to learn the tools…’

This was the same week I received a suggestion for an AARG session on Automation from Dave Cowley and Dimitrij Mlekluz. So I find myself thinking that the automation conversation might be different if we drag in the guys working on the neural networks. Granted they’re meant to be spending their time doing cross-platform rapid image mapping and detecting nematodes in images of growing plants… but surely archaeology is more fun. Here’s my concern: The aerial archaeology community has been discussing the role of automated or semi-automated approaches intermittently for many years. Some of the discussion is philosophical (broad brush vs. detail, scale, pattern vs. serendipity) as well as technical, but we’re having it based on a slightly dated idea of what automation brings to the table. Archaeology is always interdisciplinary, in particular when it comes to adopting and adapting methods. As we revisit the idea of automation, a topic that will no doubt be on the
table at the next AARG meeting in Pilsen, it seems an opportune moment to look outward again. We may well find ourselves seeking new collaborators and learning to use new tools and think in new ways.

Thoughts of automation go hand in hand with that buzz-phrase “big data” (how big is big data?). Image data, if you are trying to do pixel level comparisons, gets big fairly fast. And past and present landscapes, the archaeological record as we try to study it, are -if anything- even bigger. Aerial archaeology, as we practice it, has long been oriented toward spotting interesting sites and features, understanding them in their context. In short, we try to look at the archaeology. In recent years, the conversation in AARG has turned toward aerial archaeology as landscape archaeology. Within this conversation are discussions of the implications for the practice of our craft of this philosophical shift. And certainly our practice must change if we are to scale up to work with landscapes in detail. If we are to take advantage of these emerging technologies to orient ourselves strongly toward taking a holistic look at changing landscapes, taking into account all the pixels, and bring to bear the whole archive of aerial imagery and satellite imagery - across platforms and across now a half century of change in many places, what would we see? And what kind of aerial and landscape archaeology would we produce?

Rachel

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STUDENT/YOUNG RESEARCHERS’ SCHOLARSHIPS FOR AARG 2016.
These scholarships are intended to support bona fide students and young researchers who are interested in aerial archaeology and wish to attend the conference. There is no application form. Please provide the following information in an emailed headed with “Student/Young Researcher Scholarship”: Your interests in archaeology and aerial archaeology; place of study; the name and contact details of a supervisor or employer (email) who can provide a reference; why you would benefit from attending the conference; and an estimate of travel costs to attend. Furthermore, you should also be willing to provide a poster, or for exceptional work provide an abstract for a paper (20 mins) under one of the conference session themes listed above.

Applications should be addressed to Rachel Opitz at aargchair@gmail.com. In addition, there will be a competition for the best Student/Young researcher poster or paper, judged by the Chairman and Vice-Chairman. The prize will be a free 2017 conference package (registration fee, dinner and field trip). All entries for the competition must apply for the Student/Young Researchers Scholarships to be eligible. The closing date for applications is the 1st June 2016.

More information may be found at the Aerial Archaeology Research Group website: http://www.univie.ac.at/aarg/ or the conference website: http://sites.google.com/site/aargpilsen2016/
* FIRST CALL FOR PAPERS *

International Aerial Archaeology Conference

AARG 2016
Pilsen
Wednesday 7th to Friday 9th September 2016

Organised by: The Aerial Archaeology Research Group

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Papers (20 minutes) and posters (A0) are invited on the themes of:

★ teaching aerial archaeology / teaching landscapes
★ aerial archaeology of the recent past
★ experiments
★ aerial archaeology and art
★ changing landscapes

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All conference paper and poster offers to: Rachel Opitz,
CAST, 304 JBHT, University of Arkansas, Fayetteville, AR 72701, USA
Email: aarg.chair@gmail.com

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Wednesday 7th September and Thursday 8th September - Paper and Poster Sessions
Debate Session; Local Session; (Invited Papers)
Themed Sessions (Open Call for Papers)
Poster Session (Open Call for Posters)

Friday 9th September - Field Trip
Full-Day Field trip to archaeological landscapes near Pilsen, ending at Pilsen Brewery

Closing date for all proposals (with title and abstract) is the 1st June 2016.

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AARG notices

The Derrick Riley Bursary

The Derrick Riley Bursary still exists. It is £500 a year, usually a single award, but sometimes is split and given to two people.

There should be an application form on the Sheffield Archaeology Department website and a Riley Bursary page on the Sheffield website where potential applicants will be able to find information and download the application form.

Finding the relevant page represents the first challenge, but if you can’t please contact Bob Johnston (r.johnston@sheffield.ac.uk) who administers the bursary.

*Please apply for this even though it is not used only for conference attendance. AARG has limited funding and access to the Riley Bursary extends this amount to something more useful. No whinging about lack of money if you don’t apply.*

ISAP Fund

In August 2015, ISAP announced establishment of a fund to provide support of up to £1000 to assist with members’ projects [membership costs less per year than AARG does] that ‘further the objectives of the Society’.

Info and application form from the ISAP web site: [http://www.archprospection.org/isap-fund](http://www.archprospection.org/isap-fund)

Information for *AARGnews* contributors

*AARGnews* is published at six-monthly intervals. Copy for *AARGnews* 53 (which will be completed after AARG, Pilsen but will not necessarily draw content from it) needs to be with me by **September 14, 2016**. Editorial policy (for want of a better word) tends to be that if I am sent interesting contributions they go in unless there’s a danger of an issue overflowing. Instructions for contributors are no longer on the AARG website, but this issue and a page that can be sent on request may guide.

Please do not use any ‘clever’ formatting and avoid footnotes.

Good-quality jpegs are suitable for illustrations. Tiffs are for archives.

And please send us your nominations for future AARG conversations.

Address for contributions: rog.palmer@ntlworld.com
Aerial archaeological in Spain: out of the closet?

César Parcero-Oubiña

Aerial archaeology in Spain (and Portugal) has been largely unknown beyond the limits of the Iberian Peninsula for a long time. Different reasons might be argued for that, but among them a primary one is that aerial archaeology has been actually little developed in the Iberian Peninsula until fairly recent times. A recent paper (Sánchez Pardo and Fumadó Ortega, 2006) gives a good synthetic overview for Spain, and highlights one key reason for that late development: a site-based archaeological tradition, not too concerned with the landscapes, and firmly rooted in the excavation, that basically wasn’t interested in any larger-scale data (as already stated in Orejas 1995). While this is basically true, I feel that there is another distinctive fact in the Iberian tradition that should also be considered: the virtually complete absence of fliers (either archaeologists or amateurs) that could demonstrate in practice the possibilities offered by “seeing the land from above”. A remarkable exception here is Julio del Olmo, an amateur who has been photographing large parts of the Northern Plateau for more than two decades now, and whose images have allowed the discovery of a significant number of new sites (as shown in the contribution by Marcos García to this issue).

As a result of that, aerial archives are extremely exceptional in the Iberian Peninsula. In Spain, the catalogue of aerial images prior to the 1980s is almost limited to the otherwise well-know “American flights” of the 40s (A Series) and 50s (B Series). These are the results of two extensive flights made by the US Army at the request of the Spanish dictator Franco for cartographic use. In Portugal the situation is similar, being especially remarkable here the archives of the 1947 RAF flight and the flights made by SPLAL between the 30s and 50s (Redweik et al. 2009). All those archives are nowadays extremely popular and have become a very useful tool for archaeological research, since they give us a view of a largely rural country, prior to the massive changes (and destruction in many cases) of the last decades, as the contribution by José Manuel Costa et al. proves.

It was just in the last years that the use of aerial resources has really spread among a generation of younger archaeologists, and also amateurs, who are aware of the possibilities of exploring the landscape at a large scale. The AARG meeting of last September in Santiago de Compostela gave us, on the one hand, the chance to put some of these younger archaeologists in contact with AARG (and hopefully to encourage them to have a more active involvement). On the other hand, it also gave us the opportunity to show to an international audience some examples of those new approaches. Thanks now to Rog’s initiative, this “special section” of AARGnews collects some of those papers and opens them to a larger audience.

Here you will find what I believe is a rather illustrative assortment of contributions coming from different parts of (mostly) Spain, covering a broad range of archaeological landscapes and sites, from the Later Prehistory (Neolithic, Copper and Bronze Age, paper by Marcos García), to the Roman period (Victorino Mayoral Herrera, Jesús García Sánchez, José Manuel Costa et al.) or the Middle Ages (Didierjean and Quirós García). As is common today, all those examples include the use of a range of aerial resources, not just images (either archive or recent, and both vertical and oblique), but also multispectral data, LIDAR or GIS. Most of the contributions have stressed here their use of aerial photos, but the integration with other
techniques is also explicitly illustrated in some cases (as in the contributions by José Manuel Costa or Victorino Mayoral).

I just wish that you enjoy this section. Hopefully, it will make you a little more curious of what has been going on in the Iberian context in the last years. And, hopefully too, it will help Spanish aerial archaeology a little to come out of the closet.

(With many thanks to Rog for proposing this section).

References


Interpreting social change from above: causewayed enclosures of Northern Spanish Plateau

Marcos García García

1. Can Aerial Archaeology explain social change?
During the last 25 years, synthesis and meetings about Neolithic ditched enclosures have prospered in United Kingdom, France, Germany and Denmark. They reflect a long tradition of research that includes the first aerial surveys as early as 1928 in Southern England. Meanwhile, the first identification of enclosures in Iberia took place in the 1970s, delaying the aerial recognition to the 1990s. As it has been stated (Jiménez Jáimez 2015), these differences caused the exclusion of Iberian enclosures of the main seminars and publications. As an illustration of this omission, it should be noted that a distribution map of the European enclosures appeared in a cross-cultural paper about fortifications in the continent (Parkinson and Duffy 2007: 99). That image showed significant empty areas in Iberia, despite the well-known enclosures in Andalusia, Valencia, Madrid, Extremadura or Portugal, at least for Spanish readers (Bernabeu 1993; Díaz-del-Río 2003; Márquez 2003). The blanks were not only over the maps, but also on the interpretation of the enclosures. These gaps have resulted in two groups of difficulties: first, the lack of synchrony in their discovery has deprived researchers of a coherent and global explanation of a European phenomenon; second, due to the lag in its discovery, description of historical processes in Iberia has not included the significance of these monuments into the social changes that arose in the Neolithic. The inclusion of Iberia to the debate about enclosures may be described as belated, but it has spurred Spanish and Portuguese archaeologists to update their enclosure database through aerial surveys as well as to include them in their interpretations of Neolithic and Copper Age.

The purpose of this paper is to summarize an experience in Central Iberia that attempts to include enclosures into the equation of transformation that took place at the end of Neolithic. In this study, Aerial Archaeology was the main source for the interpretation of enclosures and their contribution into the understanding of social change.

2. The discovery of causewayed enclosures of Northern Spanish Plateau
The research covers the sedimentary lands of the Northern Spanish Plateau, usually known as the Douro valley since this river and its tributaries run over the region. Its center is a sunken sector of the Spanish Plateau: a flat area of 700 to 800 MASL, surrounded by mesas of about 850-900 MASL. This area, named middle Douro valley, is under Castile and Leon autonomous administration, specifically in its subdivisions or provinces of Palencia, Salamanca, Segovia, Valladolid and Zamora (Figure 1).

For decades, Archaeology of middle Douro valley has stated that there were no stable structures prior to Iron Age, so the region was either a ‘vacuum’ or a ‘transit’ zone for transhumant pastoralism. In the mid-nineties several monuments were identified from air in the plains of Douro valley (Olmo 1999). It was a shock: they were the causewayed enclosures that in Europe had been dated between Late Neolithic and Copper Age. From that moment on, other enclosures were detected in the region (Ariño y Rodríguez 1997; STRATO 2009; García García 2013). All of them showed similar characteristics: circular or oval designs with

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one to three discontinuous ditches and a material culture related to the Chalcolithic and the Bronze Age. The unexpected number of enclosures and their dating, somehow contradicted the statement that there were no permanent structures in the region before the Iron Age. The potential of the discoveries encouraged a research project in the area to collect information about the new sites.

The work was planned around aerial recognition and archaeological survey. In the sedimentary lands of Douro valley, where traditionally cereals grow in the fields, the crop marks are easily visible from a plane. In the case of the enclosures, the nutrient-rich deposits
that fill the buried ditches make the plants grow earlier and taller. The resulting differences in
colour and height are clearly visible at the end of May and the first weeks of June. Because of
its reliance on climatic change, there were several image sources that allowed us to identify
the enclosures.

The main source was the aerial photographs taken by Julio del Olmo from 1994 to 2001, since
they provided the evidence for 15 of the total 18 enclosures. At the very beginning, enclosures
were found by chance, i.e. during flights aimed to record roman villae. The images were taken
from an ultralight aircraft (Safari GT model), and some years later from a Piper Cherokee
light airplane. The height during these flights was about 300 to 500 meters and the camera
models were hand-carried Nikon and Olympus with 35 mm colour and infrared films. Since
the pilot himself photographed most of the enclosures, the images were obviously oblique
(Delibes et al. 2014: 16). There were other oblique photographs taken by Enrique Ariño at
Las Canteras enclosure (1997). The main problem with this kind of images is that they do not
represent the exact size or form of the enclosures. Therefore we needed either to correct them,
either to find substitutes for them.

The latter option was possible thanks to our secondary source, the PNOA project (Aerial
Orthophotography National Plan) that offers orthophotographs of the region
(http://pnoa.ign.es). The advantage of an orthographic image is the uniform scale of the
pictured objects as they were in a map. In addition, PNOA-images have a great spatial and
time resolution: each pixel equates to 25 or 50 cm in the ‘real’ world, and there are new
photos of the same place every two years. Also, the PNOA project georeferences every image,
so it can be handled on GIS and Remote Sensing software to measure and locate the
archaeological structures. And there is more, in the PNOA database both colour and ‘false
colour’ pictures can be found. The ‘false colour’ pictures are especially useful to detect
negative structures, since they contain an infrared band, which represents the chlorophyll
levels in the plants, i.e. the vigour of the crops that grow over buried ditches and pits. With
the exception of Santa Cruz enclosure, we found PNOA images for all the enclosures, so we
had a geographically correct interpretation of the prehistoric sites. The georeferenced images
were also used as a background to ‘orthorectificate’ the oblique photographs where there were
no PNOA orthophotographs or to combine several sources to improve the interpretation of the
less visible areas of an enclosure.

Orthorectification consists in transforming an oblique photograph into an orthophotograph,
i.e. a picture taken from a 90 degree inclination to the ground (Figure 2). This process
followed the next stages: first, it was selected a PNOA orthophotograph of the place where
the enclosure laid; then, we identified common features in the oblique picture and in the
background orthophotograph; after that, we selected 10-12 control points and ‘tied’ them in
the GIS software; finally, the links were interpolated using the ‘spline transformation’
algorithm.
Once we collected orthographic images of every enclosure, we applied several zooms and enhancements to the image in order to get a much clearer view of ditches and pits (Figure 3). Best results appeared by adjusting the histogram of the image to the applied zoom using 2 standard deviations. Since the values of each image varied from zone to zone, we had to use several zooms and re-enhancements in every picture of an enclosure. As we were obtaining a clearer delimitation of the ditches, we ‘drew’ them in a vector map. After following these steps on the whole picture, we got a complete and clean interpretation of the subterranean structures, i.e. of ditches, pits and huts.

As for the archaeological ground surveys, Delibes and Pardo directed the works in the 15 enclosures discovered by Olmo. On his own, E. Ariño led another one at Las Canteras and shared the information with us. There were also archaeological excavations at El Casetón, Las
Figure 4. Plans of the 18 causewayed enclosures of Douro valley.

1. Cuesta del Pájaro (Villaguillo, SG); 2. El Campillo (Aldea de San Miguel, VA); 3. Las Canteras (San Cristobal de la Cuesta, SA); 4. El Casetón de la Era II (Villalba de los Alcores, VA); 5. El Cesto III (Nueva Villa de las Torres, VA); 6. La Corona (Alba de Cerrato, PA); 7. La Cuesta-Los Villares (Medina de Rioseco, VA); 8. Las Ligeras de Abajo (Vertavillo, PA); 9. Los Melonares-Zofraga (Rueda, VA); 10. El Mesón (Villarmentero de Esgueva, VA); 11. El Moscatel (Torrellobatón, VA); 12. El Parral (Esguevillas de Esgueva, VA); 13. Las Pozas (Casaseca de las Chanas, ZA); 14. San Martín El Rasillo I (Castronuevo de Esgueva, VA); 15. San Miguel (Cubillas de Cerrato, PA); 16. Santa Cruz (Casasola de Arión, VA); 17. Santa Cruz III (Cabezón de Pisuerga, VA); 18. Somante al Cuadro (Esguevillas de Esgueva, VA).
Pozas and Santa Cruz III enclosures, which confirmed the chronological correlation of the sites to the prehistoric horizons of the region.

3. The causewayed enclosures of Douro valley
After 15 years of research, the data gathered allowed us to offer a complete description of 18 enclosures; to discuss their chronology, morphology and hypothetical use based on a spatial analysis (Delibes et al. 2014). We shall sum up its main characteristics here.

The 18 enclosures display causewayed ditches that follow a circular or oval pattern, except El Parral that is polygonal (Figure 4). The majority (13) show multiple rings –mostly a double ring (8)—, while 10 enclosures are made up of a single ring. Their size varies from 0.46 ha (Las Ligeras de Abajo) to 3.39 ha (Las Canteras and La Cuesta-Los Villares). Using the categories of English causewayed enclosures (Oswald et al. 2001: 73), 12 of the Duero enclosures can be considered ‘small’ (0.4-1.2 ha) and 11 would be classified as ‘medium’ (1.4-5.5 ha). These minor areas are even more remarkable when compared to the enclosures of southern Spain (Márquez y Jiménez 2010: 482): Papa Uvas (9.5 ha), Perdigões (16 ha), La Pijotilla (70 ha), Marroquíes Bajos (130 ha). These differences may express that in the northern half of Iberia the degree of social complexity was lower than in the southern half (Díaz-del-Río 2006): the enclosures of Madrid show a similar size to those of Douro valley, all of them under 1 ha (Díaz-del-Río 2003: 68-69).

Although ditches are discontinuous, we do not consider every interruption as an access since there could be earth banks that closed some of the breaks. As in England (Oswald et al. 2001: 43; Fig. 3.9), those banks are mostly invisible in an excavation, but in some aerial images there are traces of the banks in the gaps between ditches and groups of pits, as we have detected in 9 enclosures (Figure 5). Furthermore, the entrances were marked by the pattern of the segments like the English enclosures (Oswald et al. 2001: 49-53): commonly the ditches of an access are curved or overlapped, and if there are multiple rings, entrances may be face to face. Probably the ditches were not dug at the same time nor by the same people: the irregularity of the segments and the differences between them may be a result of a factionalism in the mobilisation of a collective workforce (Díaz-del-Río 2004). In addition, the radiocarbon dates from El Casetón (Figure 6) show an aggregation of successive rings from inside to outside, and there are several examples of enclosures that overlap.
Cuesta del Pájaro-3), that suffered modifications (Las Caneras, Cuesta del Pájaro-1 and 2) or that were relocated (La Cuesta del Pájaro-4, Somante al Cuadro).

Figure 6. Relation between calibrated dating and climatic events: the orange area represents the sunspot cycle, marking its maximums in red and minimums in blue (Eddy, 1977, 182); the blue gradient corresponds to a cold phase amongst 5400-4700 cal. BP (Geel et al., 1998, 545); the red gradient indicates the ‘4,0 ka BP’ event with a darkest tone over 2350 cal. BCE, when there is an speed up of the climatic change to warmer and drier conditions (Harvey, 1980; Peiser, 1998; Franco Múgica et al., 2001, 354-355; Cacho et al., 2010, 14).

As common as ditches, dotted areas are visible both inside and outside of the enclosures. The circles of 1,5-2 m in diameter are interpreted as pits, since those were the dimensions of the pits excavated at El Casetón, Las Pozas or Santa Cruz III. As there, they probably contained grains but after they lost their primary use they served as containers of ashes, brick-muds, food and object refuse or even burials. The biggest circles (3-4 m in diameter) could be the huts made up of mud bricks – those burnt, refused and thrown in pits or ditches— like the unearthed huts in El Casetón (Delibes et al. 2015: 433-434).

The material culture found in surface surveys and excavations is clearly related to ‘Las Pozas’ horizon (Early Chalcolithic) in 17 of the total 18 enclosures. Only the archaeological remains of El Parral cannot be dated in the Copper Age, since they belong to Middle Bronze Age, which can explain the oddity of its shape and its location on a flood plain. Four of the enclosures were ‘revisited’ during the Bronze Age, probably when the ditches were filled as it has been proved at El Casetón excavation. The available radiocarbon dates confirm the occupation in the Early Chalcolithic (ca. 3300-2350 cal. BCE), as well as they show a
correlation between the end of the causewayed enclosure phenomenon and the climatic event ‘4,0 ka BP’ (Harvey 1980; Peiser 1998; Cacho et al. 2010), which was a fast shift to drier and warmer weather (Figure 6) also detected in the palynological record of Douro Valley.

4. The enclosures as an expression of social change
The climate proxies and the paleoecological record of Douro valley reveal that severe deforestation started ca. 2500 cal. BCE. Considering the information provided by two spatial analyses carried out in the study area (Delibes et al. 2014; García García 2015), we interpret the changes to the environment as a consequence of a landscape monumentalization that took place between 2500 and 2350 cal. BCE. This process included a high scale logging for pasture and the building of causewayed enclosures. From it, we understand the enclosures as a result of an anthropic domestication of nature, a way to mark the territory exploited by groups that inhabited more than a village.

Northern Spanish Plateau enclosures were first thought to have been villages and later were interpreted to be ritual places. Nowadays we have come to an agreement that they were both. They were inhabited, as it is demonstrated by the existence of huts and their location by the best potential soils for agriculture. Their subsistence options may be diverse (extensive or intensive agriculture, sometimes combined with livestock in diverse degrees of importance), but all enclosures share a common exceptional meaning: they have a special symbolic character as a ritual place, a group emblem, and a way to bring to terms the old commonage (Neolithic) and the new venues of social organization linked to lineages.

The introduction of animal drawn equipment detected in the Copper Age of Douro valley, changed production organization of the small semi-nomadic groups from Neolithic to the much stable and bigger from Copper Age. Property of the agrological tools fell to those who worked in the fields, setting the scenario for the rise of masculinity hegemony that took shape of leadership into the families. The clustering of villages around enclosures suggests a society organized around kinship relations where domestic groups gathered around some respected man, i.e. patrilineal lineages.

The atmosphere of equality from Neolithic was substituted by competition into the group. Competing for public respect, the heads of each lineage mobilized the available workforce to excavate different segments of the ditch. This would explain the differences amongst ditches, while the coherence of the whole design supports the existence of a shared goal towards the visibility of group strength and the veiling of unequal relations.

Ceremonies held at the enclosures were celebrations of daily life, particularly of those aspects associated to the new labor techniques (deposits of bovines) and to the new modes of social organization of property based on lineages (deposits of building material from dismantled huts that belonged to the head of the lineage).

After the apogee of the climatic event ‘4,0 ka BP’ (ca. 2350 cal. BCE), Bell Beaker pottery spread all over the region while enclosures were deserted. This situation was accompanied by a drastic change in settlement patterns that we understand as an expression of new social organization (Table 1).
<table>
<thead>
<tr>
<th>EARLY CHALCOLITHIC</th>
<th>BELL BEAKER</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Small</strong> close sites (connected through <strong>natural</strong> paths)</td>
<td><strong>Less but bigger</strong> sites (isolated from natural paths)</td>
</tr>
<tr>
<td>Close to sandy river soils, pastures and woods (<strong>variety</strong>)</td>
<td>Close to <strong>sandy river soils</strong> (variety diminishes)</td>
</tr>
<tr>
<td><strong>Comfortable</strong> conditions, easy access</td>
<td><strong>Non comfortable, difficult access</strong></td>
</tr>
<tr>
<td><strong>Lowlands</strong>, enclosures as landscape reference</td>
<td><strong>Prominent</strong> locations, visual control</td>
</tr>
<tr>
<td><strong>Lineage's heads</strong> mobilize workforce, group gathering in enclosures.</td>
<td><strong>Beaker ceremonies by non-hereditary leaders (opportunists) to maintain contact between groups.</strong></td>
</tr>
<tr>
<td><strong>Daily life ceremonies</strong>: deposits of bovines and remains of huts.</td>
<td><strong>Elite ceremonies</strong>: commensality, funerary rituals, hunting.</td>
</tr>
<tr>
<td>‣ Agricultural colonization</td>
<td>‣ <strong>Intensification of agriculture</strong></td>
</tr>
<tr>
<td>‣ <strong>Friendly environment</strong></td>
<td>‣ <strong>Atmosphere of distrust</strong></td>
</tr>
</tbody>
</table>

Table 1. Summary of settlement patterns from Early Chalcolithic and Bell Beaker horizons.

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A view from the far west of Europe:
Aerial Archaeology at the Merida Institute of Archaeology

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1. Introduction

In this contribution we will show very briefly the experience of a research programme focused on the potential of aerial survey developed within the Institute of Archaeology. It is still a very young line of work compared with the evolution of this discipline in research institutions of other European countries like Italy, France, Germany, Poland or UK. Actually, generally speaking the practice of Aerial Archaeology in Spain has been characterized by a lack of sustained efforts in time and space (see a review in Sánchez and Fumadó, 2006). Obviously the consequence of this situation is, in general terms, a poverty of results. This is something striking, if we take into account the extraordinary abundance and quality of traces identified from the air where constant work has been developed.

Figure 1. Location of the study area and sites mentioned in the text within the Iberian Peninsula. 1.-Contributa Iulia. 2.-Castildavid. 3.-las Torremochas. 4.-Doña Angustias.

The particular experience to be described was developed in the framework of a research initiative focused on the potential of non-destructive methods for the study and valorization of archaeological heritage. It included the combined application of several

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2 http://riteca.gobex.es/es/subproyectos-ii/patrimonio-y-materiales-de-construccion
geophysical methods, surface survey and aerial photography. The latter had a very important role, and the results have by far exceeded our expectations, largely due to the novelty of this work in the geographic area in which it has done.

Beyond the obvious general objective to record archaeological targets, more specific goals determined the need to combine different techniques for image capture. On one hand, most of the campaigns have been oriented towards the detection of previously unknown traces at different scales, from the detail of a single archaeological site, to the extensive exploration at a landscape scale. These images were all captured from a paramotor. Although they have a significantly lower autonomy than that of an ultralight or a plane, our experience is that it allows us to cover large areas, and thus recognize broad series of points of interest. On the other hand, we have used low altitude aerial devices like helium blimps and UAVs for the geometric characterization of excavated and/or previously known sites through photogrammetric techniques (see Verhoeven 2009 for a complete review of advantages and drawbacks of different systems).

Figure 2: Methods used for the capture of aerial images.
2. What are we looking for?

Our main interest analyzing aerial images has been their potential to reveal the presence of elements of interest not directly visible on the surface. In this regard the corpus of the different types of traces has been well established for a long time (see for example Musson 2005). Therefore, we will directly focus on those that have been detected in the course of our work.

Crop-marks have been by far the kind of trace that yielded the best results in our study cases. One particularly successful experience was at the archaeological site of Los Cercos (Medina de las Torres, province of Badajoz), identified as the Roman town of Contributa Iulia (Mateos, Pizzo and Mayoral, 2014). Here we found a combination of extremely favorable factors (Ortiz et al. 2014). The site is entirely covered by ploughed terrain devoted to dry crop cereals. Soils were very shallow and archaeological features were quite near to the surface. Therefore, the contrast of differential growth of plants was very pronounced, producing very sharp marks. To maximize the chance of detecting marks, the campaign was conducted in early May (when the crops begin to ripen), and the photos were taken with the first light of day.

![Figure 3: Crop-marks in the Roman site of Contributa Iulia. A.-Oblique view of the site from the south. B.-Detail of a small temple.](image)

As a result, the images offer a lot of crop-marks covering the entire area of the old town, so it is possible to perceive roughly the limits and urban structure of the site. We also have identified almost all the outline of the town walls. It is possible to distinguish very clearly the distribution of streets and blocks (insulae), and even to recognize some individual buildings. Examination of the aerial photographs suggested there was a small cult complex comprising a temple and a well, located in the south end of the town. This interpretation was corroborated point by point by subsequent excavation. Numerous marks were also detected beyond the urban enclosure, revealing a significant density of buildings in the suburban area. It has been possible to define in great detail the shape of a large oval structure whose geophysical survey and later excavations have identified as an amphitheater. Finally, these images have revealed the existence of numerous linear structures that converge on the site. Some may be water supply lines, while others seem to correspond to roads or paths connecting the Roman town with its hinterland.
Our search has also been successful in the identification of crop-marks of small rural settlements. A representative example may be that of the Roman site of "Las Cañadas", located about three kilometers east of Contributa. It is possible to distinguish at least two apse-shaped rooms face to face and separated by a quadrangular space. Their interpretation as the remains of the residential compound of a Roman villa was confirmed through earlier surface survey. Far from the Contributa hinterland, aerial survey in the Serena region also provided nice examples of small rural sites revealed through the detection of crop-marks. One example is at the "Doña Angustias" site, which has very sharp traces, especially of a rectangular isolated building on the top of a small hill (probably a warehouse). Again direct exploration revealed the existence of a quite obtrusive surface concentration of Roman finds.

Although in smaller quantities, our flights provided other kinds of traces, like the shadow marks of the Torremochas site, drawing very clearly a big circular enclosure in the top of a hill near Quintana de La Serena. In the same area, some rural buildings made with earth roofs to shelter pigs are recognizable from the air thanks to the micro-relief enhanced by shadow contrasts. Texture anomalies generated by cairns and "islands" of non ploughed terrain are also good indicators of archaeological sites. These are good examples of how the
correct interpretation of the aerial images requires specific knowledge of the type of artificial structures that can be recognized in a given landscape.

![Image](image_url)

**Figure 6.** Fortified settlement of Castildavid (Don Benito, Badajoz).

Finally, aerial images were very useful for the study of non-excavated but very prominent archaeological structures. There is, for example, a group of fortified settlements in the Serena region dated to early Roman times that we are systematically recording. The aerial photographs were used for the production of 3D surface models and orthoimages that were very useful for the knowledge of their spatial structure.

### 3. Beyond the human eye

Some flights were done with different types of sensors to capture aerial images beyond the visible spectrum. Two different systems were used to work in the thermal infrared band. The first one was a ThermaCAM S65 operated from a paramotor. It can record data in a wavelength from 7.5 to 13 µm, able to measure a temperature range from -40 °C to 1500 °C. The second one was a FLIR SC655 with a spectral resolution from 8 to 12 µm. The potential of these devices to capture archaeological features has been tested both in Contributa and La Serena.

The results were particularly good in bare soils of fallow lands, where the shallowness of buried wall foundations increased contrast in the heat emissivity. In some cases the information provided by thermal images was wonderfully complementary to the one registered in the visible spectrum. In the case of the temple already mentioned, if the crop marks made it possible to identify the outline of the wall foundations, emissivity contrasts clearly showed the compact filling corresponding to the podium platform. Other prominent
features of the townscape of Contributa, like the town walls or the amphitheatre could be better described through high emisitivity values of thermal IR images. On the contrary "cool" anomalies clearly indicate negative traces, like ditches for the robbery of building materials, and especially some long linear features that excavation identified as drainage channels in the east side of the town.

![Figure 7. Thermal infrared images of Contributa. A-Temple identified in figure 3-B, B.-limits of the town walls; C.-Amphitheatre.](image)

Finally, the remote sensing research developed in the project included the capture of hyperspectral images in the Contributa site. Data analysis is still in progress but already it has been possible to elaborate different vegetation indexes that are maximizing the identification of traces for the reconstruction of the urban landscape.
4. **What for?**

Beyond the mere identification of archaeological features, an essential part of the work with aerial images has been its geometric correction and geo-referencing, in order to integrate this information with other layers of survey and excavation results. This process has been based on the application of photogrammetric techniques. The line of research developed in this regard from the Institute of Archaeology has focused on finding automated methods to obtain quality models, taking advantage of all kinds of images. Trials have been conducted with various commercial applications (123D Catch, Visual SFM, Photomodeller, PhotoScan, ShaperCapture, etc).

![Photogrammetric restitution from aerial images.](image)

The result of this process is a point cloud with photo-realistic color. They were directly analyzed with several 3D software applications like Cloud Compare or Meshlab. These tools allowed point edition, creation of orthoimages and 3D meshes, and even some basic geometrical analysis. Nevertheless, the need to correlate the results of aerial survey with other data sources made imperative the migration of these products to a GIS environment. This has allowed the creation of detailed plans both of indirect traces like the crop-marks as of visible surface structures. In the case of Contributa it was the basis for a global cartography of its urbanism, and a key tool for decision making in the future management of the site. Digital surface models were also valuable resources for a micro-topographical analysis of sites and a better understanding of its internal structure.
GIS applications have also improved the possibilities for analyzing aerial images through digital treatment. Filter for edge detection and image enhancement offered a much sharper view of complex patterns of traces across the cultivated fields. We have also started a line of research on the third dimension of crop-marks. The high resolution of the surface models makes possible to perceive subtle variations in the differential growth of plants. Therefore, in a GIS environment we can replicate multiple lighting conditions through analytical shading. More interestingly, other types of geometrical analysis can be done (like the ones implemented in the Relief Visualization Toolkit developed by the Archaeolandscapes project) that could improve even more the recognition of surface marks.

5. **The power of aerial images as a tool for communication.**

As we developed our research, we began to realize that our aerial photos were a valuable resource for catching the attention of the general public. Therefore, with the aim of bringing the results of our work to the rural communities within which we are working, we produced a travelling exhibition called "memories from the air" (http://www.memoriasdesdeelaire.com/). Supported by the regional administration, it was conceived to visit small populations of rural areas. The design and structure was light and flexible, easy to mount and deploy in any kind of available space. Far from presenting pictures as framed "pieces of art", we printed them in a big format, combined with maps, texts and graphics.
The narrative of the exhibition was organized in four thematic blocks with a common concept: aerial photography is a powerful tool to discover and reconstruct human action over the landscape across History. We can acquire this knowledge through observation and decode of a series of visual signs, that tell us about physical phenomena produced by the presence of archaeological remains. The common thread of these signs is the way different properties of light interact with targets on the ground, revealing shapes, volumes, textures, colors etc. We tried to transmit that by guiding the visitor, educating their way of looking, and stimulating the capacity to observe, so that everyone could be able to interpret this "secret code". Guided tours and workshops were organized to offer the contents of the exhibition in a more interactive and accessible way. The dynamic created with visitors was very rewarding when a discussion emerged on what we see and how we perceive it.

Figure 10. The aerial archaeology travelling exhibition "Memories from the air".

6. Some final thoughts

To sum up, our experience of these last years around aerial photography has been extraordinarily fruitful. It emphasizes the high potential of its application in an environment with a still poorly developed tradition of research. We have much to learn. The casuistry of the archaeological evidence is extremely varied, and only if we persevere on the same areas in the longer term we will really get coherent and consistent results. Aerial images can give us very valuable information, but we must keep in mind that it is one more piece within a joint strategy of recording methods. This complementary nature demands, on one hand, ground truthing of image interpretation through surface survey and excavation. On the other hand, it is essential a rigorous work of correction and geo-referencing if we want to integrate
successfully these data with the information provided by many other sources. A challenge in this direction is a good integration of procedures and software tools for digital image treatment, photogrammetry, 3D modeling and GIS spatial analysis.

Last but not least, for its aesthetic dimension, the view of archaeological sites from the air can become a powerful tool for communication and awareness about the importance of Cultural Heritage. Contemplation of the material traces of the past in the general framework of the landscape can be an excellent chance to think about the role of humans in the transformation of our environment.

Bibliography


Aerial survey of the Ager Segisamonensis: 
a Roman landscape revisited (Sasamón, Spain)

Jesús García Sánchez¹ (University of Leiden)

The Ager Segisamonensis project was planned to study the Roman city of Segisama, modern-day Sasamón, in Burgos province. The roots of the project are a spatial analysis of the transition from Late Iron Age to Roman times in an area in between the River Duero basin (Odra-Pisuerga region) and the foothills of the Cantabric Mountains (Lora). This study of the settlement pattern showed the traditional isolation of the Late Iron Age hillforts in contrast to the new focus on agricultural production of the Roman foundations and the Late Roman villa-landscape.

The landscape approach also arose from the established existence of an organized Roman landscape in the north of the Duero basin during the period from the end of the 1st c. BC and the 1st c. AD. The IV Legion established its main camp in Pisoraca (Herrera de Pisuerga) and from that location controlled its prata, territory that belonged to the army probably as ager publicus snatched from indigenous populations and delimited with termini pratorum (Cortés Barcena 2009). One of these (CIL II 2916ε) marked the border between the legion’s prata and the ager belonging to the inhabitants of Segisamo. The existence of evidence of an organized landscape was suggestive enough to start an off-site survey aided by periodical oblique flights.

The aim of this paper is to present the sources employed by the project, which include evidence or aerial photographs taken by researchers who studied the area previously, the evidence present in historical imagery and finally the results of my own flights, accompanied by field-survey datasets².

Description of the study area
The research area is located in the northwest of Burgos province, in Castilla y Leon. Like most of the River Duero basin, the north is delimited by the foothills of the Cantabric Mountains, historically inhabited by the Cantabrii in large hillforts controlling the wide open landscape of the basin. One of those hillforts, La Ulaña (Humada) has been excavated recently (Cisneros Cunchillos 2005), serves as northern limit for the study area.

Taking the mountains as the northern limit, we encounter two different scenarios while looking south towards the Duero Basin. In the western zone the landscape turns into an alluvial basin with gentle slopes and altitudinal loss towards the central part of the basin. Meanwhile, the east is a non-eroded calcareous barren upland. The low areas crossed by river basins supported settlement and agriculture, nevertheless we cannot exclude communities dwelling in the liminal areas of the barren upland from Neolithic times. An interesting example of dwelling on the borders of the opposite side of the calcareous barren upland is the mound of Arroyal I (Carmona, Arnaiz Alonso, and Alameda 2014).

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² For further information about the off-site survey methodology and other intra-site research in the area, the reader can access previously published reports (García-Sánchez y Cisneros 2013; García Sánchez 2013; Garcia-Sanchez y Cisneros 2014).
Previous aerial research

Our aerial survey project was not the first to focus on Segisamo. In fact, the remarkable position of Segisamo in the via De Italia in Hispania has attracted attention from scholars interested in reconstructing the Roman road, but also aiming to document any possible remains of the Roman city. In the following paragraphs, I review the previous aerial research on the Odra-Pisuerga region.

Del Olmo, one of the main producers of aerial oblique surveys in Castilla y León, is interested in the urban landscape from the Late Iron Age (3rd c. BC) to Late Roman times (4th c. AD). His photographs range from Chalcolithic to Late Roman sites, and fortunately for archaeological research, he very often includes interpretative maps and colour level modifications. In one work (del Olmo 2006, 335) he presents a photograph of an insulae plan at the North of the current inhabited nucleus of Sasamón, confirming that the Roman city was larger than the current town (Figure 2: 1). This is indeed one of the best preserved archaeological areas of the city centre; I recognised exactly the same urban plan in 2011, and rectification of the picture enables a model of insulae of 1x2 actus (35x70m) to be proposed, similar to other Augustean foundations.

Didijerjean and Abasolo (2007) were more interested in the Via Aquitana (in Asturica Burdigalam), and reconstructed the road before it crossed the Brullés river, immediately to the west of the Roman city. They also made conclusions about other anomalies that we have

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3 Granted by Obra Social of Caja Burgos and its “Youth Excellence” programme, with 400 euros on 2011 and 800 euros in 2014. Regrettably only half of the 2011 grant was paid without further explanation.
identified as signs of the field division before the 1950s after inspection of the so-called American flight (Series B, 1956).

Immediately after that publication, Didierjean (2008) published traces of two Roman camps, the second one (Carrecastr) with its card-shape offers no doubt to its interpretation: the other two could have been other kinds of ditches and trenches possibly related to the camp (Figure 2: 2 and 2: 3).

Moreno Gallo (2001, 32-34), also interested in the Roman network, has paid attention to aerial photography, and to the detailed inspection of regional orthophotography, historical maps and archaeological evidence. His publication reconstructs brilliantly the Roman communication system (especially the via Asturica Burdigalam) in Hispania in the regional context of Burgos.

**Ager Segisamonensis Aerial Survey (ASAS)**

Our aerial flights were first organized in 2011 in the context of the off-site survey of the territory of ancient Segisamo. Nevertheless, the scope of the flights was not limited to the “Roman” phase of the landscape but to the long-term development, focusing especially on the Iron Age (5th c. BC–1st c. BC) and Roman era (1st c. BC–5th c. AD).

As previously mentioned, our goal was to gain new evidence of the entire Odra-Pisuerga region, so oblique photographs were taken across the area with especial emphasis in those...
places where important sites had been already detected by other means, mostly archaeological gazetteers, survey and local informers.

Following a chronological line for presenting our results we can start with the interesting Late Iron Age site of El Espinillo (Villadiego). This site has often been interpreted as a dump area due to the presence of greyish strata, burnt bones and ceramics. The flights over the research area, east of river Grande yielded the location of both the dump areas and other features that help to contextualize the site. Among those we found a series of holes (related to surface pottery scatters) that could have been used for storage. Also oval-shaped features were detected both in the oblique pictures and in the orthophotos; we interpret those as domestic contexts or cattle enclosures.

Several kilometres to the south we encounter the hillfort of Castarreño (Olmillos de Sasamón), interpreted as pre-Roman Segisama. The flight allowed us to achieve a new perspective of the entire hill over the surrounding landscape of the river Brullès. The stone walls are completely gone, but the aerial imagery allows us to identify where collapsed remains occur, and to propose an ideal layout of the wall. Also in the upper platform some features can be easily identified. A ditch encloses the northern extreme of the hill, maybe creating a closed space. Nonetheless the hillfort of La Ulaña (Cisneros Cunchillos 2005, 86), controlling the area from the north, also has this closing wall in its narrowest extreme.

In the upper platform, a flat area of about 20 ha, we located a large number of holes, post-holes or the holes left by the tree roots (Figure 3, left). This data has not yet undergone interpretation, due to the lack of good pictures for the rest of the platform.

With the conquest of the north of the Peninsula, Augustus forced the indigenous population to settle in ex novo cities founded on the alluvial plain, abandoning most of the prominent locations in the hills that were only reoccupied in moments of instability in Late Roman times. The area of Segisamo become important from very early times, including in a war context, as it is known that Augustus established his camp in the surroundings. Efforts to identify a camp within the city have not been completely successful (Abásolo 1975); and Didierjean’s photographs of the camp in the surroundings have not attracted too much attention. Our flights over Sasamón and its surroundings aimed to detect new sites or

4 I am grateful to Heliodoro Pablo Salazar (Lolo) and Nicolas Gallego for their constant help in our campaigns, and their interest in fostering archaeological research in the region.
dwellings areas that could contribute to better understanding of the agricultural exploitation of the lowlands, and also the formation of the later villa landscape, so typical of the Duero basin in the 3rd to 5th c AD.

We (re)discovered the insula plan north of the city, the road, leaving the city to the west just before crossing the so-called Puente de Trisla, attributed to Roman times but in an illogical position considering the path of the Roman road. I propose a medieval chronology for the bridge which is part of a new (medieval) road to cross the river Brullés, which immediately after the bridge alters its path to use the former Roman paved road.

Another feature discovered by our flight is the path of the wall north of the current city, cut by the modern road towards Villadiego. It is visible on both sides of the road when the vegetation is not too intrusive and in the aerial photo thanks to its massive construction (Figure 4). This wall is also visible to the northeast of the city, but we quickly lost its path. Large-scale remains are only visible on one of the NE edges of the city.

Another big achievement of the urban and sub-urban exploration of Segisamo from the air is the location of the site of Tisosa (Figure 5). This site was first discovered during the off-site survey in 2010, and since then became the central point of our research of the area. After locating the site, we explored the historical photographs from the regional services (García-Sánchez, 2013) in order to understand what was going on in Tisosa.

The American flight revealed a black coloured spot that fits perfectly with the pottery density recorded during the GPS-aided survey of the site. The Near Infra-Red imaging helped to produce the first interpretation of the site, and later, one of our oblique flights in May 2012
defined with greater accuracy new features within the site, and an access way from the main road.

Figure 5. Tisosa as recorded on historic orthophotos (1956, 2009), NIR (2007, 2009) and our interpretation over a transformed oblique photo.
The aerial interpretation, combined with the results of a very detailed intra-site survey, has resulted in an original product to draw conclusions about the formation of the archaeological record process in Tisosa and to achieve a first insight into the functional use of the site. Our recent publication on Tisosa (García-Sanchez and Cisneros 2014) reveals the importance of the site in Late Republican-Early Empire times, in the context of the Roman army in the area.

The Late Empire is also important for the long-term understanding of the Duero basin. The agricultural importance of the basin in Late Roman times is widely accepted, thanks to the connections of elite families with the Imperial family. The exploitation of the large estates was organized not only from the urban centres but from isolated villas. In the nearest context of our study area we encounter some of the best examples of this process (Chavarria 2005), starting from La Olmeda (Pedrosa de la Vega, Palencia), Quintanilla de la Cueva and Santa Cruz (Baños de Valdearados). In 2012 we started a project based on aerial and ground surveying of the valley, focusing on 4 sites. La Tejera (Villavedón), Granjería (Sandoval de la Reina), Villamayor de Treviño and Villahizán de Treviño. Eventually we directed our efforts to the first two sites. The intra-site survey was successful in locating large collections of material, illustrating the richness level of these sites. The aerial survey failed in outlining structures (some features can be observed though), but conclusions can be drawn for an explanation of the human decisions to locate their residence on the terraces over the river.

The local geomorphology of the Odra River is easy to understand. The river flows from its spring in Fuente Odra in a calcareous formation between Peña Ulaña and Peña Amaya. Its follows a straight N-S course towards the river Brullés. The eastern side of the river presents a slope that ends in a terrace over the river valley, forming a plateau protected from the bottom of the valley. To the west is the bottom of the valley, where the river can flow unconstrained. That dichotomy between the flood plain and the terrace is the key concept to understanding the risk management and the settlement pattern for the inhabitants of the Late Roman villas.

Figure 6. 1. Flood plain; 2. Current course of Odra river; 3. Terrace slope. Palaeochannels are marked in blue.
Major river embankment works were undertaken to protect crops and the massive landscape change from the 1960s onwards provided a snapshot of the river structure in the area. The aerial survey along the river course demonstrates the changing “river-scape” (Figure 6-7). This tool, which can be also compared in quantitatively measuring the sinuosity (length of segment/length of straight line of segment), is helpful for studying the formation process of the landscape and eventually relating the palaeo-river with other evidence like off-site surface scatters, archaeological features, catchment analysis and settlement pattern.

Figure 7. Another example of changing “river-scape”. Interpretation (left) and original oblique (right).

Conclusions
The aerial survey project has contributed to gaining new evidence to explore the urban landscape of Sasamón in a moment when other kinds of archaeological research is restricted due to lack of funds or by the disruption of the current town. Even though not many new sites were discovered, the information obtained from those already known, like Castarreño or El Espinillo, will contribute in the near future to an overall understanding of Iron Age-Roman dynamics in a forgotten area. In addition, the exploration of the photographs has revealed other unexpected proxies to study the Late Roman settlement pattern and economic strategy, and the crop marks that reveal the river movement previous to the embankment work of the last century. There are no new aerial survey projects, but a regional approach to river movement and the river-shore archaeology (villas) can endorse the planning of the landscape for extensive agriculture in Late Roman times.

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Roman military settlements in the Northwest of the Iberian Peninsula. The contribution of historical and modern aerial photography, satellite imagery and airborne LiDAR

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The origins of a discipline

The relationship between Roman military archaeology and aerial photography is not new in the Iberian Peninsula. In the early 20th century J. R. Mélida commissioned to the incipient Spanish military aviation a photographic flight over Numantia (González Reguero 2007: 239). Some of the camps of the famous scipionic siege could have been then identified. The military get involved in the aerial surveying of several archaeological sites in the following years, including the republican camp of Cáceres el Viejo (Almagro Basch 1943). After World War II the Spanish government commissioned to the USAF two stereoscopic flights covering the whole country (1945-6 and 1956-7). The second one, named “Vuelo General de España Serie B” (USAF AST6 54-AM-78), was repeatedly used by archaeologists. The discovering of new camps as those of Castrocalbón (Loewinsohn 1965) and Valdemeda (Sánchez-Palencia 1986) was possible thanks to the reviewing of those old photographs.

During the decades of 1990 and 2000 aerial photography also played an important role in the awakening of the Roman military archaeology as a discipline in Spain. The planning of flights sensitive to the archaeological methodology allowed the discovery of new camps as well as the detailed study of other previously known (del Olmo 1995; García Merino 1996; Peralta 2011). At this very moment, the popularization of aerial and satellite photography, GIS and airborne LiDAR opens a new phase in which low-cost specific methodologies are blooming (Menéndez Blanco \textit{et al.} 2013a).

\textsuperscript{1} This contribution results from a poster presented in AARG 2015 in Santiago de Compostela, which can be downloaded through this URL: \url{http://hdl.handle.net/10347/13563}

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Camps of Cáceres el Viejo (1) (mid 1940s), Valdemeda (2) (1957) and Villalazán (3) (early 1990s)

The use of modern aerial photography
Since 2004, the *Plan Nacional de Ortofotografía Aérea* (PNOA) aims to obtain digital aerial orthophotos of the entire Spanish territory with a resolution of 25 or 50 cm and with an annual temporal resolution adapted to each autonomous region (http://pnoa.ign.es/). While these data are open access in Spain, in Portugal a comprehensive coverage of digital orthophotos with 50 cm resolution is only accessible through web-mapping services supported by the National Geographic Institute (www.igeo.pt).

In the recent past, the open access to PNOA data has allowed us to develop a systematic survey method, especially effective in mountainous areas without dense vegetation canopy (i.e. Asturias or León). Sometimes the ancient earth ramparts were still visible and could be
remotely detected, other times the ditches were tracked due to the differential accumulation of moisture. After locating those potential sites, we planned their archaeological field survey. In this way, we discovered many castra aestiuas such as Moyapán, Huerga de Frailes, El Mouru, Valbona, A Granda das Xarras, A Rechacha, A Pedra Dereta, Chao Carrubeiro, Picu el Outeiro or Serra da Casiña (Costa et al. 2015; Gago & Fernández 2015; González Álvez et al. 2008, 2011-2012; Menéndez Blanco et al. 2011a, 2011b, 2013b, 2015).

**The contribution of historical aerial photography**

The PNOA also offers a Digital Photo Library service in which several photogrammetric flights from the 1930s onwards can be located (http://fototeca.cnig.es/), including the two already mentioned USAF flights. Although this information is open access, sometimes the photos have not been accurately orthorectified. In Portugal, similar data can be obtained by request from the *Secção de Fotografia Cartográfica* of the Geographic Institute of the Portuguese Army (https://www.igeoe.pt/).

The use of historical aerial photos introduces a significant diachronic factor in the study of Roman military sites: many of these camps have been hidden or destroyed in recent times mainly because of the impact of anthropogenic activity. That is the case of Campos, razed during the construction of an industrial park (Costa García *et al.* 2015a). Reforestation plans or the mechanization of farming have also damaged the camps of Cornado, El Pico el Outeiro, Huerga de Frailes, Monte dos Trollos, Monte da Modorra, Cabianca and Monte da Chá in a different degree (Costa García *et al.* 2015b; Gago & Fernández 2015; Menéndez Blanco *et al.* 2011b, 2013b).

Some camps detected after reviewing USAF 1956-7 historical aerial photos: Cornado (1), Monte da Modorra (2) and Monte da Chá (3)
Structure from Motion (SfM) photogrammetry has been also employed to orthorectify and georeference historical aerial photos from the 1940s and the 1950s. The production of photogrammetric cartographic data, namely Digital Surface Models (DSM) and orthophotos, has been vital to the study of some of those sites.

**Airborne laser scanning**

In areas densely forested, the identification of archaeological features is still very problematic (Doneus *et al.* 2008). The introduction of airborne LiDAR has helped to overcome this problem because of its unique capability to penetrate vegetation canopies, making it possible to document the underlying topographic surface and to identify any cultural remains on it (Opitz & Cowley 2013).

However, the identification of archaeological features on LiDAR-derived DEMs is very dependent on visualization techniques that can enhance our perception of anthropogenic features. Different methods have been proposed, from simple hillshading to more complex calculations like Sky View Factor (Kokalj *et al.* 2011) or Local Relief Models (Hesse 2010). These visualization techniques have been compared (Bennett *et al.* 2012; Chalis *et al.* 2012; Štular *et al.* 2012) and the results confirm that no single method outperforms the rest in all types of terrain. Therefore, a combination of these techniques is the only way to obtain the maximum volume of information on potential archaeological features. Among the more
effective are the trend removal procedures (Hesse 2010; Štular et al. 2012) based in the theoretical assumption that when a smoothed surface is compared to its original, local small-scale topographic features are contrasted from large-scale landscape forms.

In Spain there is an almost complete LiDAR coverage (http://pnoa.ign.es/coberturalidar), with all the data freely available. The LiDAR data are already classified, so we only have to isolate the ground points from which we have obtained a Digital Terrain Model (DTM). Although in most of the cases we have used hillshade as a visual technique, the Resampling Filter available in SAGA GIS software (Conrad et al. 2015) has proved to be a very effective solution for the detection of Roman military sites. This is a trend removal technique that allows us to represent local small-scale elevation differences, similarly to Local Relief Models (Hesse 2010).

Towards a new low-cost methodology
In order to understand the landscape in detail, we have combined airborne LiDAR data with historic and modern aerial photos and satellite imagery. This is a valuable method since each technique reveals different features, making it possible to maximise the results (Crutchley 2009). The combination of these tools with field surveying and GIS allowed us to develop new low-cost methodologies especially effective when dealing with these kinds of structures in almost every type of terrain (Costa García et al. 2015b). Moreover, we were able not only to detect new archaeological features but also to develop new morphological and landscape analysis for the study of Roman military sites by using GIS tools (Costa García 2015).

Bringing Archaeology to the people
Our main aim now is to consolidate this research line but we are also aware of the important role people should play in archaeological and heritage research.

The research group united around romanarmy.eu (http://romanarmy.eu/en/) appears as a result of two natural dynamics. On one hand, it tries to exploit the potential of this research line, to explore its possibilities and to reinforce it where it shows its weaknesses. In summary, to better understand the Roman military presence in these regions by adopting multidimensional perspectives. On the other hand, it is the way in which the paths of a set of young researchers and their worries about the divulgation of our archaeological and cultural heritage converge. Through a narrative and visual language, we try to disseminate our research to the public and to make them participants. Our web page (http://romanarmy.eu/en/) and social media profiles (https://www.facebook.com/romanarmynw/) are the windows we have opened to the world.
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Invisible medieval villages: Aerial Research in Alava (Basque Country, Spain)
François Didierjean¹, Juan Antonio Quirós Castillo²

Introduction
The firsts systematic programs of aerial archaeological detection in the Iberian Peninsula were made by the Casa de Velázquez (1977-1985), and later by the Ausonius Institute (2001-2014) in the framework of the study of ancient landscapes (Roman roads, Roman conquest and warfare, Roman settlements) in collaboration with some Spanish universities (Bost, Didierjean forthcoming).

Recently, a new aerial archaeological project focused on the analysis of historical landscapes in Alava is being carried out by the Ausonius Institute and the University of the Basque Country in the context of a wider Landscape Archaeological project. This brief paper intends to present the objectives and the implementation of the aerial surveys carried out in Alava in the last three years, providing an overview of the results and some preliminary interpretations.

The project
Since 2002 the Research Group of Heritage and Cultural Landscape of the University of the Basque Country is conducting an aerial research project with the aim of studying historical landscapes in Alava through the analysis of settlement patterns, palaeoenvironmental records and agrarian archaeology. The project has prioritized a regressive approach, and as a consequence, ‘traditional landscapes’ and ‘traditional settlements’ have been studied in the first place. Deserted villages have been considered the best laboratories for the analysis of landscape transformations in the past. Indeed, more than 300 medieval and post-medieval deserted villages have been detected in Alava according to the relevant documentary evidence and the intensive collection of place names and oral traditions made by local historians (López de Guereñu 1989).

The research strategy has been articulated at various levels of increasing intensity. Intensive archaeological surveys were conducted in 2002-2003 and 2010-2011 in the Alava plain with the aim of identifying some of the deserted villages known in the documentary evidence (Quirós Castillo 2012). However, the results have been very disappointing because the sites were not visible in the field, even when the place names of medieval villages were well preserved. Modern agricultural works, including the reshaping of agrarian plots during the Franco period aimed to introduce the use of heavy agrarian machinery, had changed forever ‘traditional landscapes’. In fact, agriculture can be seen as a major destruction force of villages and non-monumental sites in Alava, and as a consequence, archaeological sites are almost invisible in areas such as the Alava Plain or the Rioja Alavesa.

During the subsequent years some archaeological excavations conducted in medieval deserted villages such as Zornoztegi, Aistra, Zaballa, Bagota or Torrentejo, showed that these sites are formed by empty spaces (probably old agrarian plots) and areas covered by negative structures (silos, sunken features buildings, pits, ditches and sometimes walls). The amount of

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pottery, rubbish and household waste is not very high, making complex the identification of sites in field walking surveys (e.g. Quirós Castillo 2013).

Despite the fact that place names are very useful to locate the deserted villages mentioned in the written evidence, it is very difficult to define the limits of these villages or even to locate their core area. For all these reasons, we decided to begin an aerial survey in collaboration with F. Didierjean, member of the Ausonius Institute, in order to define new strategies aimed at the analysis of historical settlement patterns, the study of well-known medieval and post-medieval deserted villages and the localization of new medieval sites. Indeed, Alava had been overflown by F. Didierjean in the framework of research programs of the Ausonius Institute, especially ‘De Hispania in Aquitaniam’, centred on the analysis of ancient roads leading from Asturica Augusta (Astorga) to Burdigala (Bordeaux), which crosses the province of Alava from west to east (Didierjean 2010). This background has allowed analysis of the changes to historical landscapes between Roman times and the Medieval period, and to integrate the new project in other aerial surveys in progress.

**Technical aspects**

For economic and practical reasons, Cessna 172 light airplanes were used because they are able to fly fast enough from Bordeaux to Alava, and to fly slowly for taking pictures. Moreover, they offer a good habitability, carrying three people and equipment, a good stability and affordable prices. Our pilots were members of the Bordeaux Yvrac Aéro Club and F. Didierjean, a pilot himself, who performed detection and photography. Since 2015, navigation has been assisted by using a tablet equipped with a GPS module and AirNav Pro. Photographic equipment in 2013 comprised a Nikon D70 with Nikkor 18-70mm. This was replaced in 2014 by a Canon Eos 50D and EF-S 18-135 mm, and a Nikon D7200 with Nikkor 18-140 mm in 2015. All digital SLR equipment provided good quality and resolution.

Flights were prepared establishing a list of sites based on the place name analysis and field work. To ensure accurate tracking, in addition to UTM coordinates, each site was shown on a map extract of IGN ([http://www.ign.es/ign/main/index.do](http://www.ign.es/ign/main/index.do)) and orthophotos of SIGPAC ([http://sigpac.mapa.es/fega/visor/](http://sigpac.mapa.es/fega/visor/)).

Photographs were taken in different formats: JPG (fine option) was complemented with RAW format (NEF for Nikon, CR2 for Canon), which includes metadata. The double shooting allows their modification preserving the original format. In this configuration each image pair is more than 40 Mb, or 1 Gb 25 photos.

After the flight, original photos were stored with the default name of the device including some chronological (e.g. PA15 for 2015 survey) and geographical reference (including the province and the place name) in different folders. An Excel table included the complete reference and data of the different campaigns.

Adobe Photoshop or Preview was used for the treatment of pictures, when needed. In particular, the rise of sharpness, the enhance of contrast, and sometimes the balance of lighting were the main operations conducted.
Alava territory

Alava has a great diversity of landscapes due to its compartmented structure (fig. 1). It is barely larger than three thousand square kilometres, but the landscape is greatly varied. In the centre of the province there is a vast and long plateau named Alava plain surrounded by mountain ranges in the order of one thousand meters high. The Alava Plain is very well suited for agriculture. In its centre, the high medieval town of Vitoria is located, the current capital city of the Basque Country. To the south and west, rural communities lived on the mountainous areas. The southernmost fringe of the province (the modern Rioja Alavesa) is the occidental extremity of the depression formed by the Ebro valley, on the border with the Rioja region.

This relief has two major consequences for aerial work because it determines the use of land, the climate and the upper air. Large areas of the territory available for air detection are not cultivated, specifically mountain spaces. Rioja Alavesa, dominated by vineyards and tree crops is not favourable to air detection. Crops are concentrated in the plains and valleys, and above all in the Alava plain and the Zadorra valley. Climate of the area suffers oceanic influence, with significant cloudiness accentuated by the mountainous terrain. The rainfall is generally abundant, especially in the spring, with frequent instability generating storms of diurnal evolution. Fortunately, significant inter-annual variation is frequent, and the dry spring of 2015 improved the results of our aerial surveys. Nevertheless, mountainous areas are always watered, limiting their potential for aerial detection. Another aerial complication are the strong turbulences created by the compartmentation of the reliefs, especially at the entrance of the Alava Plain, but also near the transverse valleys that cut some mountain
ranges. For this reason, the study of this area is difficult and, sometimes, a dangerous work. Finally, it should be pointed out that in Alava there are no usable airfields for light aircraft, because the beautiful airport of Foronda is only open for night flying.

Preliminary results
Since 2013 three different campaigns of 5 hours per year were made, mainly in June or late May. A total of 102 sites were explored in different areas of Alava: Alava Plain, Rioja Alavesa, Ebro valley and Occidental valleys. Most of the sites recorded are medieval and post-medieval deserted villages, although in cases such as Lantarón, Tejuela or Arganzón, aerial surveys were focused on the identification of new sites. Besides, some aerial controls were carried out in Roman sites such as Arcaya, Arce or Veleia. The identification of aerial traces was complemented by field walking.

The influence of inter-annual climate, crops and humidity variation to the visibility of sites is very high, and constitutes an important difference in geographical terms. In 2005, underground structures in some sites, such as Arce in the Ebro valley, were very visible in ortophotography, but their visibility was lower in subsequent years, even if it rained less. On the other hand, the 2015 spring was quite favourable for aerial surveys, while 2013 and 2014 did not allow the identification of underground anomalies in some well-known deserted villages such as Zornoztegi, Aistra or Paternina. It is therefore necessary to repeat aerial surveys in different periods of the year and in different years in order to survey deserted villages with different visibility situations.

In the following lines we discuss three case studies, showing the nature of the inferences that can be made from this project.

The first example is Lantarón, in the occidental valleys of Alava. The site is located in close proximity to a remarkable canyon crossed by the Ebro valley, in the old Castile. Indeed, during the 9th-12th century Lantarón was the seat of an important castle that played a crucial role in the definition of the Castile county. However, the castle and the associated village of Lantarón have never been located and field walking surveys have not been able to identify any medieval settlement. This is a very complex area in terms of archaeological visibility because it is a mountainous space mainly covered by a dense forest or bushes. In addition to this difficulty, aerial survey conducted in 2013 and 2014 faced severe turbulences generated by the rugged terrain (steep mountains crossed by the Ebro canyon). The survey did not discover any evidence related to the castle, even when some place names could suggest the existence of a fortified settlement (in particular Castrejón). On the contrary, different kinds of anomalies were detected in Valderrocín (fig. 2), located 1 km to the East of Castrejón. However, intensive survey in Valderrocín could no identity any archaeological structure or evidence.

In the other two examples, results were much more significant.

Most of the medieval deserted villages of Alava are located in the Alava Plain, crossed by the Zadorra river and its tributaries. Just in the centre of the plain, the hermitage of Saint Martin is located, the old parish of the village of Ania, documented from 1025. The church, reconstructed in post-medieval times, is the last and the unique testimony of the deserted village. The parcelling around the church was created in 1950s-1960s, reorganizing the
structure of the old agriculture plots, creating new roads and changing streams. The lack of visibility of the structures of the site determined that the protection area of the deserted village was defined around the church, covering an area of 5.9 Ha. The aerial survey and the field walking conducted in 2015 allowed us to identify, in the north-western area of the church, the traces of an old palaeochannel of the river Arkaute, tributary of the Zadorra, and some cropmarks located outside of the protection area defined by the Basque Government. In particular, some channels or elongated structures were discovered, probably of modern age. Moreover, 30-40 circular anomalies that could be identified as silos and/or negative structures, and at least one building defined by postholes, were found (fig. 3). Unlike excavated sites such as Aistra, Zornoztegi or Zaballa, no domestic structure was discovered close to the church in Ania. Field walking recovered only an insignificant amount of building materials or domestic waste, including pottery on the surface of the site. However, the small amount of pottery discovered is consistent with the chronology of the site.

The last case study is the area of Arganzón, located on the bank of the river Zadorra in the south of the Alava plain. The area is characterized by two main sites: the royal town of La Puebla de Arganzón (1191) and the castle of Arganzón, funded in the 10th century including a fortified settlement, located in the canyon that separates the Alava Plain and the Ebro basin.
3. Aerial photo of Ania (20-6-2015).

4. Aerial photo of Arganzón (16-6-2013).
The presence of a church in the Arganzón canyon is documented in 871, but there was no evidence either about its location or about the existence of a village named Arganzón. However, our aerial survey carried out in 2013 discovered some regular underground structures in a plot called Convent close to the National Road 1 (fig. 4). Post-medieval written evidence shows how a Franciscan convent was built in 1635 on top of the old medieval church of Arganzón. A recent extensive excavation has confirmed the location and the nature of the site, allowing the analysis of the transformation of microterritorial settlement patterns.

One kilometre to the south a new site was discovered. In a meander of the Zadorra river, in the area called San Miguel, a new concentration of 20-30 circular anomalies that could be identified as silos and/or negative structures suggest the existence of a new medieval village (fig. 5, 6). On the other hand, few small fragments of medieval pottery were found at the site. There is no documentary evidence about the village, maybe because the site was deserted very early, immediately after the foundation of the royal town.
With all these new data a model of microterritorial formation and transformation of medieval settlement was created. According to the excavation in Arganzón, the oldest evidence of medieval villages in these area can be dated to the 8th-9th centuries, following trends observed in the nearby Alava Plain. It could be suggested that during the Early Middle Ages all the area of Arganzón was covered by a large number of small rural sites such as Arganzón or San Miguel, formed by farmhouse that included a few amount of silos, posthole structures and other domestic buildings. The emergence of a seigneurial power around the 10th century determined the construction of the castle in the canyon and the nucleation of the rural settlement outside the castle. The imposition of royal power during the High Middle Ages changed the territorial political order and the gravitational centre shifted from the castle to the new royal town. Some of the old villages remained in use, such as Arganzón, but others, like San Miguel, were deserted.

Final remarks
To conclude this brief paper, it should be pointed out that aerial survey in Alava posed a new agenda of territorial research that affects the protection policy of invisible sites, the analysis of settlement patterns and historical changes, and the definition of new approaches to the study of historical landscapes. The tremendous impact that modern agricultural practices in Alava and, probably, the repeated surface surveys, explain the limitations of traditional approaches for the analysis of settlements. Intensive aerial surveys emerge, as a consequence, as one of the most powerful tools to analyse these invisible sites. In other cases, such as Lantarón, our hopes are deposited in high resolution Lidar, because aerial surveys have been not able to solve the visibility problem.

Acknowledgements
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Remote Sensing within Swedish Archaeology

Daniel Langhammer¹

During my discussions with several other participants at the AARG 2015 conference at Santiago de Compostela it was noted that Swedish participation has been absent at these meetings for quite a while. In connection with the event Rog Palmer suggested that an update of past and recent developments within remote sensing and aerial archaeology in Sweden could be a welcome contribution to the forthcoming AARG newsletter. The interest in remote sensing has increased significantly amongst Swedish archaeologists within the last ten years. The explanation for this is Airborne Laser Scanning (ALS) and also, in the last few years, easy accessibility to data. In 2015 the National Mapping Agency of Sweden released height data with near to national coverage, as well as applications and models based on it. In retrospect Sweden also has had a long history of aerial photography within archaeology, but the number of practitioners has been relatively few and they have not managed to engage the broader archaeological community. It is possible that the increasing popularity of UAV and the revival of photogrammetry will change this in the years to come, since all these methods find applications from each other.

Fig. 1. Map of Sweden (Sverige) and neighbouring countries (Map: © geodatasamverkan, Lantmäteriet).

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Geographical background
Sweden is a long narrow country running between the 55° and 69° latitude, from the Arctic in the north down to the county of Scania (Skåne) in the south. This creates a great variety of landscapes and poses different challenges for remote sensing. The northern inland is characterised by the Scandinavian mountains and tundra conditions above the tree line. Agricultural lands constitute a low percentage in this part of the country and are most frequently found close to the coast and along the river valleys. Continuing south, a more temperate climate is present due largely to the Gulfstream, which passes close to the west coast of Norway and makes Sweden warmer than many other countries at the same latitude. The most agricultural and populated areas are found in the southern part of the country. In this part of Sweden, the landscape is very varied with plains, low hills and ridges. Lakes are numerous in Sweden, with nearly 100,000 above one hectare in size. According to the Swedish University of Agricultural Sciences about 23,3 out of 40,8 million hectares of Sweden are covered by productive forest. In total the land is estimated to be covered by 28,1 million hectares of forest (Nilsson & Cory 2015: 53). This can be compared to the amount of cropland being estimated to 2,6 million hectares and pasture land to about 450 000 hectares.

Discovering the advantage of the birds eye view
In 1924 Birger Nerman, a Swedish archaeologist, explained the benefits of aerial photography to better understand the monuments and their wider settings in the landscape. An aerial photograph he had seen taken over a hillfort in Estonia influenced his statement (Nerman 1924: 88). It is uncertain if he was aware of the pioneering work carried out the previous year above a massive waterlogged wooden construction called Bulverket, dating to the 1120s. Etymologically, the name has similarities to the English word bulwark. The remains are located in a shallow lake on the island of Gotland and the conditions for the use of aerial photography is near to perfect, both for mapping and to get an overview of the extensive structure. The person to realise this was the former artillery major, Arvid Zetterling, who managed to get naval pilots to take aerial photographs of the site in 1923 and 1925 (fig. 2). Zetterling also experimented with hydrogen balloons mounted with a camera, although the result was not always the best (Zetterling 1927: 174f, Norrman 1984: 14, Rönnby 1995: 36, 45).

During the 1930s there seemed to have been a slight awakening for aerial archaeology. In 1930, Mårten Stenberger turned to aerial photography in his study of the prehistoric forts on the island of Öland, taking some excellent photographs at the end of August at a flying height between 100-500 metres. He also wrote a brief paper presenting the aerial work he carried out on the island and emphasized the potential of the method (Stenberger 1931: 199f). About the same time another archaeologist, Ivar Schnell, also commissioned aerial photography in a study of hillforts in the counties of Södermanland and Västmanland. In Scania similar work was carried out in the early 1930s, something that was made possible through contacts between archaeologists and pilots within the air force (Norrman 1984: 14). The enthusiasm expressed by Stenberger and others for aerial archaeology does not seem to have had any deeper or long-term impact on the broader archaeological community. Except for possibly Scania much of the work being carried out in the 1930s was restricted to target photography and not aerial reconnaissance.

In 1937 a mapping programme on a national scale, excluding only the mountainous areas in the northern inland, was commissioned. A property map was to be produced at the scale of 1:10,000. The technique behind it was photogrammetry. The decision also marked the start of the National Monuments Survey (Fornminnesinventeringen) under the commission of the Swedish National Heritage Board, a work that was to continue at the agency for nearly 70 years. The primary purpose of the survey was to find and map sites and monuments. Orthophotographs became important sources during the field surveys and the mapping process. Sometimes sites were also visible or occasionally even indicated or discovered on the photographs. From the late 1950s onwards, oblique aerial photography was also used by the Swedish National Heritage Board. The need for an aerial record was realised due to the vast landscapes altered by the hydroelectric power development in the middle and north of the country. It was also used to document landscapes under pressure from urban development in the following decade. The 1950s, saw a new revival of aerial archaeology down in the southern part of the country, in Scania. This time, it was Esse Ericsson who discovered his passion for aerial archaeology, a love affair that would continue for a couple of decades and produce an aerial archive of about 2700 images (Ericsson 1984: 39, Hansen 1992: 52). The importance of the work conducted by Ericsson lies in his awareness of the working methods of aerial photography and reconnaissance. He produced excellent photographs of everything from sites visible as crop-/frostmarks to cultural heritage sites in general. After his death the
IK foundation has had an important role in promoting the legacy of Ericsson and the work he did.

The 1960s and 1970s was an intensive period in Swedish archaeology with large-scale excavations due to economic growth. This also resulted in an increasing interest in testing alternative working methods to make excavations more efficient. Aerial photography was still mostly restricted to target photography, but a couple of examples from this period deserve attention. In 1964, Ulf Erik Hagberg discovered the advantages of aerial photography, being the head of the excavation division at the Swedish National Heritage board. He had already been influenced by the work done by Ericsson as well as Irwin Scollar abroad. In association with pilots, the work targeted excavations and sometimes discovered new sites as well. The importance of Hagberg’s work is that he on several occasions had the opportunity to excavate and confirm the cropmarks that were discovered. The work was focused on Öland between 1964-1975 (Hagberg 1984: 46ff). On Gotland, a couple of other archaeologists was making use of aerial photography. One of them was Peter Manneke, who wrote several short articles of his findings of cropmark sites in the journal Gotländskt Arkiv (Manneke 1976, 1977, 1978). It would be an overstatement to say that his work was extensive, but nevertheless it was important and he produced some excellent aerial photographs. One of the most impressive being the prehistoric “fort” at Hällhage (RAÄ-nr Barlingbo 31:1) showing ditches, entrances and internal pit marks. Some of the pitmarks, most probably being postholes, run in a double row along the inner ditch. Manneke also conducted trial excavations to investigate the features recorded (see Eriksson 2012, Elmshorn 2014).

Of notable importance in the last decades of the 20th Century is the work carried out by Jan Norrman. Originally a surveyor at the Swedish National Heritage Board, his role gradually changed to that of an aerial photographer. In 1983 and 1984, he and his colleague Kjell Edvinger had the opportunity to do aerial reconnaissance in association with the National Monuments Survey (Edvinger 1984: 27f, 34f, Norrman 1992: 37f). Although satisfying results were achieved (e.g. fig. 3), aerial reconnaissance was never to be used in a systematic way within the National Monuments Survey. In 1987, Norrman had a position where he was to be responsible for aerial photography targeting sites of National interest (Riksintressen) as well as heritage landscapes in general. During these flights he randomly had the opportunity to discover and record archaeological sites (Norrman 1992: 39f). Norrman was concerned with the future developments of aerial archaeology in Sweden. In contrast to many of his predecessors, Norrman stressed that all areas with open landscape, from the north to the south of Sweden in fact have a potential for aerial reconnaissance (Norrman 1984: 18). Looking at a soil map of Swedish cropland it is obvious that Norrman had a valid point (fig. 4). Even the distinctive clay and silt soils of the Lake Mälaren Valley should occasionally be able to produce cropmark sites. Especially in association with very warm and dry summer periods, such as have been the case in recent years.

The timeline described above does not include everyone involved in aerial photography within Swedish archaeology, but it singles out some of the more influential practitioners. As stated by Edvinger in 1984, there was (and still are) a limited understanding of the potential posed by all the different air photo collections in the country (Edvinger 1984: 35f). The recent trends in digitalisation and ongoing developments in digital infrastructure might overcome this problem in the years to come.
Fig. 3. Cropmarks in Larv Parish, Västergötland, recorded in 1983 and 1988. The picture shows a circular cropmark (centre) of a grave, pitmarks and linear marks (caused by periglacial cracking?). The lager monochrome cropmark directly to the right of the circular one, represents a refilled quarry where graves had been discovered. A damaged stone-circle is located by the single tree to the north of the quarry (See Edvinger 1984: 30f). Further graves and stone-circles are also recorded to the NE of this site. LIDAR data show that the site is located on a low ridge (Photo: Jan Norrman 1988. Published with the permission of the Swedish Armed Forces).

Fig. 4. Soil survey map showing the south part of Sweden. The survey has been done by the Swedish Board of Agriculture. In this case it exemplifies that Swedish cropland have a great variety of soil types, with different potentials for revealing cropmark sites. Although clay and silt is very dominant around the Lake Mälaren Valley (top right: brown areas) it also shows dynamic and mixed background (Data: Jordbruksverket).
A new awakening
The attitude towards remote sensing has changed quite dramatically in the last 10 years, due mostly to the use of Airborne Laser Scanning (ALS). This comes as no surprise in a country with vast woodlands. In 2006, pioneering work was carried out in Dalarna county where height data was used to map sites in areas affected by property changes. The work was a result of collaboration between the County Administrative Board, the Swedish Forest Agency and the Swedish Mapping Agency. The ALS was done with a resolution of up to 10 hits/m². In addition to being an opportunity to understand how different types of sites were expressed in the terrain models generated (Jansson, Alexander & Söderman 2009: 4, 32ff, 71), observations about the limitations of the data were equally important. From 2009 to 2015 the National Mapping Agency (Lantmäteriet) set out to collect height data with National coverage based on Airborne Laser Scanning. The original point cloud has been scanned at an average resolution of 0.5–1 pts/m² (0.25 above the tree line in the mountain areas), with a 0.4–0.8 m footprint depending on the altitude of the scanning. In the products available the data has been interpolated with bilinear interpolation into a 1 m grid. In addition to easy access to the master data, products such as a Web Map Service for hillshade (HS) and slope were released in 2014 and a Web Coverage Service in 2015. The latter is of specific interest since the service allows the user to set parameters using actual raster images based on the height data. The new accessibility of height data has also helped to increase the amount of users within Swedish archaeology, as well as creating an awareness of remote sensing data. Over the last few years terrain models are more and more commonly integrated in archaeological reports, especially concerning survey work or in chapters dealing with landscape analysis. In recent years there has also been a growing interest in 3D applications and archaeology. This is a development that could benefit the future use of aerial photography and photogrammetry, at least when working on a larger scale. In addition much could still be gained by combining aerial photographs and LiDAR data. In the case of crop- or soilmarks, LiDAR helps to understand the three dimensions of the landscape and why sites are located where they are. In some examples the data also give complementary information about the actual features identified. Here (fig. 5a and 5b), for example, the aerial photograph seems to show an entrance in the ditch on the SE side, but looking at the LiDAR there is a somewhat obscure gap in the bank on the SW side. The latter was confirmed by ground observations made by Manneke in 1978 who mentioned a gap in the SW side which is also visible on an oblique photograph taken in 1978 (Manneke 1978: 94ff, Elmshorn 2014: 4).
Fig. 5a and 5b: A cultivated prehistoric “fort”, top left corner. These images illustrate the importance of using multiple records. In the terrain model above it is possible to get an indication of the structure of the wall, but together with the aerial image below (made brighter) it is also possible to trace a ditch as well as perhaps an entrance in the southwest. Norrlanda parish, county Gotland (imagery: © geodatasamverkan, Lantmäteriet).
Recent work at the Swedish National Heritage Board

The Swedish National Heritage Board is currently running a major programme (DAP) to create a digital infrastructure supporting the workflow within the archaeological process between planners, fieldworkers and state agencies. The programme includes several projects; among them resolving quality issues in the Archaeological Sites and Monuments Record. One of the projects initiated was a remote sensing project (*Fjärranalysprojektet*), running between late 2014 and early 2015. The budget was relatively modest, which at an early stage restricted the project towards looking at the possibilities of using existing remote sensing data. The main objectives of the project have been to look at the advantages of different remote sensing techniques and how they may be used to resolve quality deficiencies among already recorded archaeological sites (fig. 6). Furthermore, it has also looked at the possibilities of creating analytical GIS resources for archaeologists and planners. A fortunate coincidence has been that the project started during the time when the National Mapping Agency began to release new products based on ALS data.

Fig. 6. Charcoal stacks and charcoal pits, Hille parish in county Gästrikland. Multiple HS combined with Negative Openness. Yellow show the objects recorded in the Swedish archaeological sites and monuments record (Sept. 2015). The image also shows what seem to be minor errors in location as indications of unrecorded stacks and pits. The linear tracks on the left are probably traces of modern forest cultivation/forestry (Data: © geodatasamverkan, Lantmäteriet).

The level of detail in the data provided by the National Mapping Agency is sufficient enough to trace archaeological sites showing a typical morphology, regular shape and height contrast. Many of the sites visible may be identified in the archaeological sites and monuments database, giving clues to how similar sites are revealed in the data. Categories of sites showing a regular pattern are also easier to identify, for example a row of pit traps rather than a single trap. In almost any case new indications will require an onsite inspection to secure a positive confirmation. Although data in general will only show features above the size of a few metres at any detail, there exist examples when smaller objects might be detectable (for
example large standing stones in a structure). The data, originally not optimized for archaeology, also inherits some of the usual drawbacks from low ground vegetation or areas showing a bad quality of laser hits. LAS density files might give a clue to the latter example.

Two preparatory studies were commissioned by the project to sort out any questions about available remote sensing methods and data. These were done by Metria, a consultancy for geographical information and technology, and resulted in two reports. The first report mainly focused on the techniques available and how they were useful to correct the geographical locations of already recorded archaeological sites. It also suggested how to go forward. In conclusion, the report mainly favored a manually operated correction of geographic positions and suggested that a useful way of moving forward would be to create analytical packages (e.g. derivates combining different remote sensing data such as ALS, AP and other records such as historical maps). These could work as an aid to heritage workers and archaeologists (Törnqvist & Lundberg 2014: 94).

The second report focused on looking at different ways to visualise terrain models and aerial imagery, by looking at various landscape settings from different geographical areas in Sweden. It described an analytical and a public-user approach to the visualization techniques studied. In conclusion, the report suggested use of known visualization techniques (i.e. described by Yokoyama et al 2002, Kokalj et al 2013). Techniques considered as specifically useful were Positive & Negative Openness, Multiple HS, Local Relief Model, Topographic Position Index (TPI) and slope. Combinations of Multiple HS with Positive Openness or TPI were also suggested within this framework. Not surprisingly, the report also stated that there are no universal parameters to use for the multitude of different landscape types and categories of sites found in Sweden. Although, it also suggested that most sites visible in the data would work well within certain fixed parameters (Törnqvist 2015: 11ff, 24).

By combining a web resource with aerial imagery and the data provided by the Swedish archaeological sites and monuments database, it would be possible to create a powerful tool for planners, archaeologists and heritage workers. This would be the case especially combined with other resources such as historic maps and historic orthophotographs. Such an application would not only provide valuable information about specific sites, but also about the landscape which they are a part of. Based on the experiences and results from the initial studies and discussions within the Remote Sensing Project, an IT consultant started technical work using the Web Coverage Service provided by the National Mapping Agency to build a map application. This would allow the user to decide the desired visualization of the data, for example choosing HS or openness, and adjust the parameters online. This work has been put on hold due to more urgent priorities within the Digital Archaeological Programme (DAP), and it has not yet been decided if this will proceed to completion. In the meantime, the current version of the public Archaeological Sites and Monuments Database (Fornsök) has support for a HS and a slope model displayed through a Web Map Service provided by the National Mapping Agency (fig. 7). These are to some extent helpful for the everyday user, but have several drawbacks for analytical purposes due to the static character (see Törnqvist & Lundberg 2014: 87).
Fig. 7. Screenshot (2016-03-08) of the archaeological sites and monuments database (Fornsök). The map shows the Viking Age settlement of Birka; the hillfort, the burial mounds and the town wall. By choosing map background it is possible to get a terrain model in HS or slope.

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An archaeological flight further than post-processualism – seeking a non-anthropocentric perspective

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Introduction – on the periphery of archaeology?

Without doubt the aerial perspective has greatly influenced archaeological studies of past landscapes (Rączkowski 2002a). A method that at the beginning seemed to be only an additional tool for documentation used during excavation, soon became an independent way of tracing the remains of past human activities (Rączkowski 2002a, Musson 2013). Sky brought new possibilities, scholars could finally focus on a holistic comprehension of landscapes, changing the face of archaeology forever. Although the keyhole perspective that was provided by archaeological excavation was not abandoned, researchers had a tool which gave them a chance to gaze through an open door, so to speak. With the change of scale of research, landscape studies could finally unfold (Rączkowski 2002b: 312-315, Campana 2009). Over time and with changes of technology, aerial archaeology has developed into a multisensory perspective. Thanks to sets of new tools, the introduction of multi-spectral satellite data and the enchantment caused by ALS-derivatives, it seems that aerial perspectives have engaged more researchers than ever before. In many cases these data are now available in an open-access way via national geoportals (i.e. geoportal.gov.pl or gis.arso.gov.si). In addition, we have recently been experiencing a vast spread of personal UAVs capable of taking aerial photographs. One might think that aerial archaeology is doing better than ever. More people than ever before have the possibility to study remote-sensing materials. Professionals as well as non-professionals can obtain them without even leaving her/his own house.

This situation might not look quite as fine as we try to answer a simple question: what is “the contribution of aerial techniques to [contemporary – authors postscript] archaeology”? (Aldred 2014). Although the importance and contribution of aerial techniques in finding new sites and structures in not questionable, we would like to change the way of thinking and ask this question with regard to our understanding of the past landscapes. Putting it another way: what is the contribution of aerial perspective into post-modern understandings of archaeology? Is post-processual archaeology and all the perspectives that emerged out of it immune to the charm of aerial perspective (Żuk 2005a)? Does “aerial archaeology [have to be – authors postscript] pushed into a periphery of archaeology and limited to problems of protection and preservation of archaeological heritage” (Rączkowski 1999: 13)?

Aerial archaeology as pornography

Before answering the question raised in the previous paragraph let’s first reflect upon the issue of post-processual thought in aerial archaeology. Almost one and a half decades have passed since the first article which stressed the fact that aerial perspective had not been yet influenced by post-processual archaeology (Rączkowski 1999). This has initiated a self-reflexive debate within a society of aerial archaeologists referring to cognitive relativism as well as to the role of textualism in context of photography (Rączkowski 2002a, 2002b,

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Brophy 2005, Žuk 2005a, Michalik 2014). Although it seems that the researchers were not interested in being further involved in developing archaeology itself, just as if the role of a “stamp collectors, generating data for the sake of it” and “playing it safe” in the “periphery of archaeology” was good enough (Brophy 2005: 7, Rączkowski 1999: 13). K. Brophy (2005: 7) notices that “If […] excavation is like striptease, then aerial archaeology is like pornography – the object of attention is viewed from distance but without the possibility of physical contact”. This analogy may seem to be even more accurate in the contemporary perspective. Just as porn in the world entrapped within the worldwide web, remote sensing data are easily accessible providing constant arousal by finds and by that fulfilling a fantasy of being a successful archaeologist. And yet we must remember that pornography is a world of fantasy, not education (more on the subject see: Zimbardo, Coloumbe 2013).

If aerial archaeologists choose not to influence other researchers with their theoretical reflections on about the past, the outcome will be predictable. Just as in the world of porn where “love” is obtained without any commitment and is ready to be “taken”, here archaeological sites are “ready to be found” through/“on” already gathered and sometimes even post-processed derivatives. Just like pornography with its constant visual stimulation, easily available remote-sensing data leads to addiction of finding new archaeological sites with no further engagement to be expected. Engagement through which narrativization of the past is created. In this scenario the aerial archaeologist will be no longer needed and will eventually become extinct just as slowly “stamp collecting” is becoming less and less popular in the times of electronic age (Collinson 2013).

Messy landscape, palimpsest of traces and archaeology of the contemporary past
We have already stated that the aerial perspective influenced archaeological thinking about past societies and that post-processual archaeology impacted aerial archaeology, now we can proceed to answering the question: what is the contribution of aerial perspective into post-modern theory of archaeology? Landscape studies from the very beginning have greatly gained with development of aerial archaeology (Rączkowski 2002a). With the influence of post-processual thought, the aerial prospection may lead to forming new propositions of interpretation of traces left in the landscape. One such expression created within the scope of remote-sensing studies is the messiness of landscape. This concept has further developed as a proposition to perceive all traces encountered in the landscape as context for human dwelling throughout the world. However, it seems obvious that humans as well as non-humans alike leave traces in the landscapes (Mlekuž 2013). Taking into account the notion of messiness, the earlier understanding, which deals with perception of the landscape as set of connected places, is abandoned. By that landscapes can be perceived as palimpsests of traces. It leads us to uncovering the “continuous processes of composition” of landscape as a whole (Mlekuž 2013: 127). Palimpsest which is understood after O.S.G. Crawford as a “manuscript […] composed of all kinds of elements from different eras”, in opposition to its later use of the term as a document of that, has undergone continuous erasing processes (Lucas 2015: 317). From this point of view landscape is created by the present societies as well as by traces left by

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2 It may seem that aerial archaeology was influenced by post-processual thought to take a closer look at its data collecting and interpretation processes. Although one must remember that the self-reflexive side had already existed within this sub-discipline of archaeology (more on the subject see: Rączkowski 2005, Žuk 2005b, Brophy 2005).

3 It is important to notice that with the easier access to remote-sensing data, the aerial approach has gained also a great data base of information allowing a further development of its earlier assumptions on study of the past.
activities of the past societies. This way of studying relies on deciphering the traces forming “surface assemblages” (Harrison 2011). In this context it is important to notice that quite surprisingly aerial perspective has not yet contributed to the archaeology of the contemporary past issues. Is it not the role of every interpreter of remote-sensing data to look at the traces of the recent past as well as the distant ones? So far only a few reflections in that matter have been published and certainly none of them have contributed to the fast development of archaeology of the contemporary past.

Aerial archaeology: from non-human perspective to perspective on non-humans

Interestingly, with the influence of phenomenological thought introduced by post-processual reflection within archaeology, the aerial perspective has been regarded as a disadvantage. It has been noticed that the aerial perspective detaches the researcher from the studied landscape, and that it provides a “dehumanized” perspective as in opposition to a ‘human’ perspective that one would have on the ground (see also: Rączkowski 2001, Brophy 2005). We do not intend to argue with these assertions. From our point of view, it can be seen as an advantage rather than a disadvantage, even within the scope of post-processual archaeology. In our opinion this perspective can influence our new research questions. Dehumanization of researchers’ perspectives may lead to acknowledging other than human forces that had an impact on creation of past landscapes (e.g. geomorphological – Palmer 2013: 180-187). Although we may not be able to incorporate them in to our narrativization of the past yet, their creative forces should already be acknowledged.

Although the term archaeology comes from two ancient Greek words meaning ancient or old (archaeios) and word or speech (logos), in modern definitions we can find statements that archaeology is a humanistic study focused on the past of only one animal – human being (Ławecka 2000: 5). History of human evolution is reconstructed through careful examinations of the traces left behind by our activities in the landscape. It is the humanistic perspective of archaeology that imposes the human being to be in the centre of attention. Along these lines, it is this anthropocentric viewpoint that has led us to the spot in which human agency is perceived as something unique in the world in which we dwell. By that, most of archaeological and historical narratives of the past tell the stories in which animals are only used, moved, hunted or tamed (Davis 2002, Sykes et. al. 2006). If the history of animals is discussed, it is only as a context or a pretext to show the history of human conquering the “natural world”. We want to propose a broader perspective of understanding the landscape: a landscape in which we are immersed in and which is constructed by human as well as non-human agents alike. Our goal is to return the agency to animals in archaeological studies. It is worth pointing out that the attempt to create the counter-history which would abolish the hegemony of human species in study of the past has been recently widely discussed, yet its main focus was on things or landscapes (i.e. Domańska 2006, Olsen 2003, 2010). Not denying that the new materialism studies play an important role to the changes of our perspective upon understanding connections ruling our everyday being in the world, we seek to add also the agency of animals to this melting pot.

Following É. Baratay’s (2014) project of the peripheral history, our study aspires to emphesise the role(s) of animals and to write another/new version of the history of landscape in the archaeological studies. We take into account that animals have their agency and that they are constituents and essential parts of the meshwork of interrelations between human – non-human beings. Thus, we want to propose writing the story of the world in which animals

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also have their own agency. Landscapes dwelled in by various animals (human and non-human) have been constructed, deconstructed and reconstructed by all of them according to their needs, and we as the researchers who want to study landscapes and their past have to be aware of the role of animals in ‘marking’ those landscapes (Fig 1).

Figure 1. Different traces left by animals in the landscape. A – ant roads (J. Mardas), B- beaver tracks (M. Kostyrko), C – eaten out patches of meadow by cows (W. Rączkowski), D – elaborate meshwork of mole hills (W. Rączkowski).

Landscape can be viewed then as a product of practices, movements, trajectories, interrelations and flows. And this sense of landscape, as a continuous weaving, relating and associating, forever in the making, is in our opinion much more productive than its static notions in terms of features, sites, places, areas. While interpreting remote-sensing data one must cope with traces left by different agents, traces which constitute a context of different activities. Landscape is something more than human and, to tell is straight, there is no
ontological difference between human or non-human traces. There is nothing in traces themselves that would imply that agency is limited only to human animals.

Accordingly, this is what we see on the LiDAR derived high-resolution topographic data (or remote sensing in general): multiplicity and richness of past things, traces of past activities and tasks, human and non-human materialized in a landscape. Lime kilns, charcoal burning platforms, fields, hollowways, tracks, lynchets, quarry pits, but also animal trails, paleo channels, tree throws, landslides: landscapes are full of these traces. These features overlap, crisscross, are destroyed, reworked or incorporated into other features (Fig. 2).

The aerial perspective offers the scope to interpret the landscape as a whole. If it is pushed beyond its usual role of detecting new archaeological sites, it has potential to create new contexts and by that to write the new stories of the past landscapes. To achieve this point we need to be aware of all the entities that refurbish the structure of this world. Process of “cleaning” or separating traces into “anthropogenic” and “natural” completely misses the richness and the interconnectedness of agencies in a landscape. The only proper way is to treat all traces in the same way and as a starting point in understanding the interconnectedness and hybrid nature of landscape.

Approaching landscapes without taking animals (also other ‘beings’ such as things and flora – for more on the subject see: Olsen 2010) into the account produces dead, lonely, artificially clean and poor landscapes. The change of perspective from landscape as purely anthropogenic construct to a richer, pluralistic, hybrid understanding of it can significantly enrich our understanding of it and the ways of dwelling in it by human and non-human animals (Fig. 3). This leads to more democratic and inclusive understanding of landscapes: as assemblages of traces produced by animals, humans, things, natural processes, technologies and their hybrids of different forms. The detailed interpretation of landscape and traces, marks and scratches
that are visible on remote sensing imagery enable us to approach and understand the web of interconnections between the living beings that construct and reconstruct the world that surrounds them. We, as archaeologists, should understand that landscape is shaped not only by human beings but also by the living and non-living forces and their hybrids that have been largely ignored by research so far.

Figure 3. Traces of past human activities are privileged only by archaeological perception. On the left rabbit tracks on snow – they will soon melt with the snow. On the right dog tracks on the pavement – who knows how long will they endure? (M. Kostyrko)

Conclusions
The aim of this short article was to pay aerial archaeologists attention towards the understanding of landscape that is not only focused on human but also on other entities (animals, plants, things) that create the “canvas” of our research. The lack of our interest has an impact on the limits of our seeing and interpreting of landscapes (Bergson 2007: 1-8): some of them seem more obscure than the ones we have studied so far. Animals possess the agency to create and recreate landscapes and by that also history of humankind. Neglecting this intertwine connection between the two is a way of marginalizing an important part of agents which influence creation of modern as well as past landscapes. Sometimes events that leave subtle evidence in everyday practice, when performed under certain conditions, leave traces that “write” the history (see: fig. 3). One may say that archaeology is full of this evidence. In other words, if it is the “low reversibility” of encountered assemblages (González-Ruibal 2013: 41) of traces of past activities that constitute archaeology as it is, we
will never have certainty that the (hi)stories that we as researchers create (in their perspective) had the same significance in the past as we put upon it.

It is through the study of recent traces or contemporary past that we can establish how much of the “picture” of the past we miss and how much of it can still be “retrieved” from the “footprints” that we encounter. One may also keep in mind that this field of our study as archaeologists may have a great impact on other disciplines (Hill 2015).

It is important to notice that the idea to observe animals, their behaviour and their impact on the environment, is a well-established subdiscipline of geomorphological studies called zoogeomorphology (Butler 1995, Butler, Sawyer 2012). Aerial perspective may be one of the ways of studying the influence of animals on geomorphological processes (aerial photography: Butler 1995, 2002, satellite imagery: i.e. Engvall 2013, low-aerial photography: i.e. Puttock et al. 2015). This should be perceived as big advantage for aerial archaeological studies. It shows a great potential for interdisciplinary research studies. This example as well as the others (see: Hill 2015) display a great ability to broaden our understanding of the complex and messy relations between the human and the non-human in making the landscape.

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Making hidden components of past landscapes interpretable: from air photos to structured records

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This contribution outlines the database and associated GIS-based mapping process that had been developed within two research projects From Find to Structure and Archaeological Map of the Czech Republic (AMCR). Financially supported between 2013 - 2015 by the Czech Grant Agency and Ministry of Culture respectively, the process was carried out by the Institute of Archaeology of the Academy of Sciences of the Czech Republic in Prague (IA) in order to assist uses of photographs resulting from a long-term archaeological remote survey in Bohemia on one hand, and to transform archaeologically interpreted data identified on them into central national archaeological sites and monuments record on the other.

Aerial archaeology emerged rather late in the Czech Republic – only after the political and social transformations of 1989. In the preceding period, free aerial photography and the use of aerial photographs had been virtually impossible because any spatial information of this kind was treated as secret by the communist regime. From the beginning of the post-communist era Czech archaeology has strived to catch up with the delay and launched the programme of aerial reconnaissance in 1992. As early as 1990s, due to several research grants, it was possible to establish at the IA a special department for the application of remote survey and other non-invasive methods and equip it with the necessary technological devices, including the Institute’s own aircraft (which was in use from 1997 until 2015), cameras, magnetometers, soft/hardware, etc. Anyway, in the course of the past 24 years of systematic aerial survey in the IA it has been possible to create an extensive archive of oblique aerial images and related data.

The Archive of Aerial Photographs

The Archive of Aerial Photographs (AAP) has been part of the IA since 1992 and now holds some 22,000 aerial photographs taken during annual intensive aerial survey campaigns. These photographs exist both in analogue (negatives, paper positive enlargements, slides) and digital form. Between 2012 and 2015 a systematic catalogue of existing photos and the corresponding sites has been created, including APs from another three archaeological institutions in Bohemia which have been involved in aerial reconnaissance. Both crop- and soil-marked sites and many hundreds of standing architectonic monuments and historic urban sites have been recorded. This data will become part of the AMCR information system and contribute to the Europe-wide ARIADNE research infrastructure. By means of a specialized module of the AMCR, aerial photographs can be described and linked to other database segments (Fig. 1). Independently of the AMCR activities, the rectification, geo-referencing and vectorisation of selected aerial photos in GIS environment is currently carried out.

The Archive of Aerial Photographs has been systematically created within a long-term research programme of the IA. It has been used for a continuous storage of visual data (photographs and video records/films) obtained by aerial prospection and remote landscape documentation.

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The AAP is divided into two sections: the analogue and the digital. The former is composed of sources that had been acquired from the beginning of the aerial archaeology programme in 1992 to the second half of the last decade when digital technology took over the principal role in archaeological photography.

The analogue section of the archive is structured as follows:

- Library of aerial photographs. This most extensive section of the analogue AAP consists of files – currently 840 binders organized by cadastres – containing selected (the best) paper prints (enlarged either from negatives or slides), a copy of 1:10,000 paper map of the cadastre area showing the position of individual sites (as polygons), and basic textual information on sites. This is primarily the part of the archive that is widely visited by professionals.
- Collection of negatives (both colour and black-and-white). Altogether 6,500 shots from 380 films, available either as film originals or 1:1 positive contact copies. This collection is now completely digitized.
- Collection of 5,700 colour slides organized in two groups ordered according to (i) the site category and (ii) the date of acquisition. Also all slides have been transformed into digital format.

The AAP digital section includes three sets of copies of the photos taken by digital cameras, in JPG and RAW formats. The photographs collection is principally structured by name of the cadastre on the territory of which sites are situated, the other two sets (collecting the same photos) are organised chronologically and categorically; this arrangement will be soon outdated when the AMCR model will take over the task of querying data. All digital data is

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Fig. 1. AMCR data model; letters mark segments of the system. F: specific extension for aerial archaeology. Information about APs are placed in the upper left part of the scheme in two boxes marked F. DOCUMENTS: metadata of all documents input into the AMCR including APs. FILES: concrete forms of each document, such as JPG and RAW format of the respective image; FLIGHTS: metadata of each flight; SHAPES: types of crop-marked features (line, enclosure, macula). After: Kuna et al. 2015.
stored on the IA servers. Photographs are administered through the Zoner Photo Studio software (Fig. 2 upper) that is also used for the description of images in a template defined by the IA archivists (Fig. 2 lower).

Another part of the AAP digital section contains a 15-hour footage made by a digital video camera/camcorder. In addition to the original scanning medium (magnetic videotapes), this data is saved on a hard disk, VHS and DVD media. Altogether 468 video records/shots taken over Bohemia/Moravia and 40 records taken over foreign countries (England, Italy, Poland) can be easily visited by interactive link connecting the digital list (placed in each of the 15 DVDs) with individual records.

Fig. 2 (upper). Alphabetically arranged collection of digital aerial photographs within the Zoner Photo Studio 14 editor. This advanced software enables detailed description and management of photographs.
Fig. 2 (lower). Description form of a photograph (Zoner Photo Studio editor).
Two alphanumerical databases are available for the AAP digital data collection, namely the list of flights which includes flight tracks as recorded by GPS, basic information on recorded sites, and a list of scanned slides kept in the archive.

Recently, the AAP has been supplemented by collections of digital aerial photographs from the Institute of North-West Bohemian Archaeological Heritage Care in Most, from the Museum of the Bohemian Paradise in Turnov and the Museum of West Bohemia in Pilsen. By systematic gathering of aerial photographs from other institutions the AAP’s administrator intends to ensure their safety and availability in the future, the standardisation of their description and their easier accessibility for the professional as well as for wider public.

**AAP within the AMCR information system**

The above mentioned state of the AAP still reflects the traditional approaches to data archiving and the possibilities of aerial photographs management in the “pre-digital” age. Although important steps have been taken during the past two decades to complete the archive collection, namely in terms of the description, storage and accessibility of the data, they have not been so far processed in a way corresponding to modern standards (Gojda 2008).

Reorganisation of the AAP has started in 2013 within the AMCR project and the parallel research project *From a Find to Structure*. One of the primary intentions of the latter was to integrate AAP information system into the central AMCR information system and to ensure reliable storage of all data in the digital repositories of the IA.

All data of the AAP are now processed digitally. Processing of aerial data has involved:

- creating a data model for the given database segment (type of data);
- creating authority files of sites, flights and photographs and defining mutual links among objects of these files;
- describing all objects in the database using standard methods and AMCR thesauri;
- implementation of data objects from the AAP into the AMCR, i.e. harmonising identifiers (especially those belonging to sites and documents – photographs);
- GIS-based processing of data captured on aerial photographs which aims at the production of standard maps of archaeological sites.

The data model of the AAP resources consists of three interlinked tables: Sites, Flights and Photos. The Sites table identifies individual sites on aerial photographs and assigns them unique identifiers. A “site” is understood as a group of features visible from the air that can be spatially defined as a polygon on a 1:10,000 map (Fig. 3). So-far, two categories of sites are considered: (i) sites intrinsic to aerial reconnaissance and mostly newly discovered by this approach (mainly through cropmarks, etc.) and (ii) sites that were primarily recorded by other methods of archaeological and historical survey where aerial photography provides just additional information or attractive illustrations (mostly standing buildings or ruins surviving above the ground such as castles, hillforts, etc.). In case of the latter category, attention must be paid to the harmonisation of identifiers that must be shared with other parts of the information system. Data like the names of individual archaeological sites, cadastrre (parish), regions, PIAN (spatial polygon) and other information are recorded for each site.
Fig. 3. Prehistoric crop-marked sites identified from the air. The extent of cropmarks is displayed as polygons within a GIS-based archaeological map. This map documents five sites situated around the village of Černuc (Kladno dist.), Central Bohemia.

The Flight table consists of information on the date and time of each flight, location of the flight start/landing, type of aircraft used, visibility, weather conditions, list of photographed sites, etc.

The Photos table includes information on the factual contents of the photographs. This means mainly a formalized description of the visible archaeological features and their potential interpretation and date. Information on the author, date/time of survey and technical parameters of the photograph itself is also present.

Thus, the AAP data model was designed within the AMCR project and the thesauri originate from the same source. If they are applied to aerial images from various other institutions in Bohemia, we can expect to achieve a significant progress in terms of standardisation, comprehensiveness and accessibility of the data.

Among the long-term goals of the AAP upgrading is the preparation of plans of sites and areas with marks (mostly cropmarks) indicating human activities. These plans are gradually vectorised in a GIS environment. Examples of the results are displayed on Figs. 4 and 5. Rectified and vectorised photos will represent a separate layer in the AMCR system. Production of digital orthorectified plans will also continue in the future, most probably for the next several years.

The AAP offers materials that can be primarily used for archaeological research and heritage management. It may also serve as a unique record of the state of the Czech cultural landscape at the turn of the 2nd and 3rd millennium. Currently, aerial archaeology as such is going through complex conceptual changes at the IA. After two and a half decades of practicing aerial survey over Bohemia, the heuristic phase is now over (for at least some period). In the
following years the project will be aimed at gathering photogrammetric data of chosen sites using drones. This kind of activity will lead to a decreasing inflow of new photos from newly discovered sites and it will allow the AAP staff to focus on processing the existing contents of the archive. We are convinced that the collection aerial survey data, processed according to the currently valid standards, will, nevertheless, continue to represent one of the main sources of information for archaeological heritage management in the Czech Republic. We do believe that the standardisation of methods and metadata from aerial reconnaissance will enhance cooperation among various institutions and the results of their activities will find their way to the IA’s AAP integrated within the central AMCR.

Fig. 4. Račíněves (Litoměřice dist.). Several rectified and redrawn oblique images placed over an orthophotograph. Red spots (maculae) and the line can be interpreted as buried Prehistoric features (sunken houses and pits), white features are of uncertain origin. The darker area in the upper right corner of the map represents accumulated arable layer making archaeological features situated in that area invisible as a result of missing cropmarks.
Fig. 5. Třeboutice (Litoměřice dist.). Fortification system from mid-19th century. Violet lines represent interpreted cropmarks of two completely (A and C) and one partly (B) ploughed-out artillery forts, an infantry fortlet (D - lower part of the image/map), a defensive ditch-and-rampart lines connecting forts into one fortification unit. Three forts still completely preserved as earthworks (F, G, H) are marked by dark red lines.

References


A KH-9 satellite photograph of Soviet-era landscape graffiti

Martin J F Fowler

The interpretation of declassified intelligence satellite photographs taken by the US photoreconnaissance satellite programme during the 1960s and 1970s has become a well-established technique of aerial archaeology (Fowler 2013). In addition to being used to investigate landscapes in the arid regions of Asia Minor and the Middle East, as well as in more temperate regions, they have also been found to have a utility in the investigation of Cold War material culture, particularly that of the former Soviet Union which was one of the main targets of the photoreconnaissance missions (Fowler 2008).

Whilst browsing a declassified KH-9 HEXAGON satellite photograph covering the Kapustin Yar Missile Test Centre to the east of Volgograd, my attention was drawn to a series of clearly visible, dark, linear features that ran broadly parallel with the River Volga. The photograph had been taken on 25th August 1977 by the mapping camera carried on KH-9 Mission 1213-5 and covers an area of approximately 120 by 240 km (Figure 1A). With a spatial resolution estimated to be of the order of 5 m, this photograph has a lower resolution than the CORONA photographs that have been used extensively in archaeological studies, but is nonetheless able to show relatively small manmade features in the landscape.

A quick check of a small-scale aeronautical chart (1:500,000 Tactical Pilotage Chart sheet E-4C, Edition 5 (1994)), followed by Wikipedia (2015), showed the linear features to be shelter belts of trees planted to act as windbreaks to reduce soil erosion as part of Joseph Stalin's late 1940s 'Great plan for the transformation of Nature'. Stretching over 175 km from Volgograd to Kamyshin, the features on the photograph comprise three, and occasionally four, parallel plantations of trees approximately 100m wide and separated by approximately 300 m and follow an erratic, zig-zag, course on high ground approximately 10 km to the west of the river Volga (Figure 1B).

While continuing to explore the image by following the courses of roads and railway lines, which tend to be good indicators of promising areas for the presence of Cold War installations, I came across an example of ‘landscape graffiti’ (Figure 1C and D) in the form of the word LENIN that is clearly visible beside a road junction near Gornyy Balykley (49° 35.9’ N, 45° 3.5’ E). The characters are approximately 20 m high, dark in tone, and are orientated for overhead viewing from the north east. They are not present on Google Earth satellite imagery acquired in 2015, where the location appears to be scrubland. Whilst the nature of the characters is unknown, their dark tone suggests that they could be formed from vegetation planted to spell out Lenin’s name. Compared with something made out of a manmade, or mineral, material, such transient features would account for them not being visible on present day Google Earth imagery. Although it cannot be said with any degree of certainty, it is likely that the characters were made sometime after Lenin became the head of government of the Russian Soviet Federative Socialist Republic in 1917.

Interestingly, this is not the first time that graffiti appear to have been observed on photoreconnaissance photographs. Curtis Peebles (1997) notes that the installation at

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Figure 1. KH-9 satellite photograph of Soviet-era landscape graffiti near Volgograd, Russia. (A) Footprint of KH-9 photograph; (B) Shelter belt plantations to the north of Volgograd; (C and D) graffiti visible beside a road junction near Gornyy Balykley. *KH-9 photograph (entity ID DZB1213-500121 L001001 available from the USGS EarthExplorer website: [http://earthexplorer.usgs.gov/](http://earthexplorer.usgs.gov/).*

Tyuratam in Soviet Central Asia was a prime location for what were termed ‘funnies’ on intelligence photographs. Because of its use as a space centre and missile test site, the Soviets knew that the US photoreconnaissance satellites would have kept a regular watch on the area. During one winter, the following greeting was apparently stamped out in the snow in letters around 5 m high: ‘F**k You Spies’. However not all greetings were so rude as troops at a
surface to air missile site under one of the Berlin air corridors apparently stamped ‘Merry Christmas’ in the snow and which was photographed by an aircraft flying down the corridor. With the potential for such ‘funnies’ to be present on declassified intelligence satellite photographs, the search for evidence of Soviet Cold War material culture has now taken on a new perspective!

References


Wikipedia. 2015, *Great Plan for the Transformation of Nature*,
Cropmarks
Harvested by Rog Palmer

Cheap hyperspectral kit?
Here are two projects worth keeping an eye on. The first below is from collaboration between the University of Washington and Microsoft, the second from Vienna University of Technology. The first device appears to work by lighting a subject with different wavelengths and recording that – so this is not practical for aerial work. The second (two web links) may work by use of diffraction gel and requires exposures of several seconds to capture an image. Mathematics were used to reconstruct a range of spectra from the captured data. So again, this also is not very practical for flying. However, the fact that people are experimenting with low cost ways of securing hyperspectral data may eventually provide a camera that can be used for aerial tests.

http://petapixel.com/2015/10/18/hypercam-is-a-low-cost-hyperspectral-camera-that-captures-what-we-cant-see/

Another aerial artist
Kacper Kowalski is a Polish aerial photographer who wins awards for his work and published a picture book, Side Effects, in 2014 that shows some effects of human impact on Poland’s environment. The link is one that was active in November 2015. Many are not and a google search ends each page with a note that some results may have been removed under data protection law in Europe. But seeing his work is worth a bypassing a few dead sites searches – or buy yourself a copy of the book (£45 from Amazon).


(Thanks to Lidkz Żuk and Wojtek II)

Geoglyphs in Kazakhstan
Some 50 to 260 geoglyphs (depending on the source) have been identified on Google Earth by an economist in Kazakhstan. The usual range of loony theories is being aired and NASA have offered support so the tale may unfold. The first link below has more illustrations of the things, but no locations for us to check the original material.

I did, of course, waste half an hour searching GE images of Kazakhstan and found no geoglyphs although, perhaps of less-spectacular interest are a number of embanked enclosures and a ‘field system’ that seems to be defined by ‘spots’ or maybe cairns. There is also a cardboard city which can be seen if you go to Astana, Kazakhstan and zoom in a bit.


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Wheel structures in the Middle East
We know of these from David Kennedy’s research but recently a team from the USA has taken an interest in these things and is claiming a date of c.6500 BC for a hearth in one of them. The web links below (both pretty much the same) offer a ‘public’ write up of the things and compare them to the Nazca Lines and anything else that can be seen from the sky. However, something more scientific may be appearing in Antiquity.

http://news.discovery.com/history/huge-shapes-in-middle-east-may-be-prehistoric-151202.htm#mkcpgn=rssrws1

A drone for you?
Ehang in China have made a prototype drone, the Ehang 184, designed to carry a person. For any of you who want to jump around the country in 23 minute (10 mile) hops and have a spare $200,000 to $300,000 plus a mobile phone to control the thing, it sounds ideal. It will be interesting to see what CAA, FAA, etc, say about use of this.

http://www.ehang.com/ehang184

Use of SAR to indicate ‘disturbance’
A note from NASA shows an example comparing ‘standard photography’ and SAR of the hummingbird glyph at Nasca. It is claimed that darkness in the SAR image indicates disturbance. Images – or at least the SAR ones – came from an overflight by NASA’s UAV. The note refers vaguely to a publication in the journal Conservation and Management of Archaeological Sites but I was unable to find it in a search made on 1 February 2016.


Shipwrecks from Landsat
Use of Landsat 8 images to identify shipwrecks through the plumes of sediment that certain tides can create. The full article is published in Journal of Archaeological Science, March 2016.


Culture under threat map
Any of you wanting to keep an eye on the destruction of World Heritage sites in the Near East can now do it interactively using the layered map provided by The Antiquities Coalition which mentions that those sites it shows are among the 3-5 million estimated number in that region.

https://theantiquitiescoalition.org/culture-under-threat-map/

Online training
While trying to find out current names for bits of HE, I discovered an aerial online training site that is worth spending a few minutes with. It is well presented with the user having to give answers before they can move to the next page.

http://historicengland.org.uk/services-skills/training-skills/onlinetraining/
Review article by Toby Driver¹:


This handsome hardback Festschrift celebrates the life, achievements and archaeological work of Professor Bill Hanson, recently retired from his teaching post at Glasgow University after 40 years. Bill has always been a staunch and vocal advocate for the values of aerial archaeology, particularly at AARG meetings. He has always pushed at - and challenged - the boundaries of the discipline, not least when he began the first aerial reconnaissance programme exclusively for archaeology in Transylvania, Romania, in 1998 or when he set up the Centre for Aerial Archaeology at Glasgow with Kenny Brophy and Ioana Oltean which ran from 2007-12. This volume focuses upon Roman Frontiers with a healthy mix of archaeological and historical papers, and studies which range across landscapes, individual sites, or even finds and documentary sources. The book has a pan-European perspective and will become a valuable source book for those seeking comparative sites, studies or bibliographies for Roman Europe. The cleverly chosen front and rear cover images perfectly illustrate the reach of the Roman military machine, showing virtually identical aerial views of the Roman frontier, but from opposite ends of the Empire (Romania and Scotland).

Produced in secret, the volume presents 26 papers across three themed sections. It begins with a useful list of the contributors, with short biographies, and then moves to an appreciation of Bill’s life and works together with a select bibliography. Readers who know Bill just from his aerial archaeology work, or through meetings and conferences, will learn a great deal about his personal and professional achievements from this section and will also admire the energy and tenacity with which he has approached his professional career.

Part 1 of the book deals with Frontiers and Their Operation. Papers in this section include Sommer’s discussion of gates and gaps in the Raetian wall, clearly answering a challenge from Bill from some years back, and drawing upon excavation, geophysical and field evidence. There is a useful paper on the planning of the Antonine Wall by Graafstal, Breeze, Jones and Symonds, and a paper by Symonds on the problems and occurrence of Roman fortlets in the Pennines, at least one of which was recently discovered from a LiDAR survey. Papers like this are instructive to those involved in the ongoing task of active and desk-based reconnaissance for unrecorded ephemeral earthworks in regions such as these.

Part 2 shifts the focus of the volume to look at Life in and Beyond the Frontier Zone. Although not a paper linked to landscape survey, Ian Hayes’ discussion of ‘temporality, routine and cohesion in Rome’s armies’ is particularly illuminating and takes the reader beyond the physical archaeology of a military site to consider issues such as the soldier’s daily routine, discipline, health, meal times and the problems of boredom on frontier postings; all these are factors that the aerial archaeologist can muse upon when overflying or mapping often spectacularly remote military works on the frontiers. This central section of the book then pursues the detail of Roman military finds and their stories; papers follow on artefact

¹ Royal Commission on the Ancient and Historical Monuments of Wales  Toby.driver@rcahmw.gov.uk
studies, the styles and fashions of military small finds, dress styles revealed on Roman funerary portraits and issues of food supply and gender politics. Fraser Hunter’s paper on ‘denarius hoards and relations across the frontier’ shifts the focus back to the link between finds and landscape archaeology in Scotland and the Scottish Borders, with case studies of excavation and geophysical survey focussed on the environs of coin hoards. He concludes (p.264) that the wider landscape setting of coin hoards is critical to their interpretation, and this is something that aerial archaeologists working in tandem with museums or finds specialists can often appreciate.

Part 3 of the book focuses on Roman Frontiers: Prospection and Perspectives in the 21st Century, and includes well-chosen papers focussing on aerial survey and remote sensing, landscape survey and management. Pete Wilson begins the section offering thoughts on the subject of ‘Romanization’ and the impact of the Roman army on the Iron Age and Romano-British rural landscapes of north-east England; much of the understanding of site distribution in this region has changed over the last twenty years, particularly through aerial discoveries. A fabulous paper by Gordon Maxwell then provides personal reflections and more thorough discussion of the Roman fort at Mollins, including the circumstances of its discovery towards the end of a long prospection flight in July 1977. Maxwell recounts how those onboard the aircraft had drifted off to sleep on the final run back to Edinburgh airfield following the ‘…effects of unaccustomed exposure to the noise and physical stress of almost continuous aerial recording.’ (pp. 286-7). So often the personal recollections of the key moments in national reconnaissance programmes like this can be lost without record.

Clive Bridger discusses the discovery of a Roman fortification on the Lower Rhine at Alpen-Drupt, finally revealed through geophysical survey after many years of fieldwork and finds discovery. Jones and Leslie look in greater detail at the contribution of geophysical surveys to understanding Roman Frontiers, and stress the role of this non-invasive approach in tandem with aerial and LiDAR survey. While again focussing principally on military sites in northern Britain the comparison of different survey approaches, particularly magnetic survey and a small number of GPR surveys, provides a useful case study. Simon James provides a pertinent paper on Roman monuments in Syria, assessing the remote sensing of wide-spreading structures across an ancient ‘conflict landscape’ and drawing conclusions which will have wider resonance from those studying the field archaeology of the Roman conquest elsewhere in the Empire. Steve Bodecker reviews 50 years of aerial reconnaissance, excavation and LiDAR analysis for Roman landscapes on the Rhineland, building on Irwin Scollar’s original studies and showing the potential for ongoing ALS survey of some of the heavily wooded landscapes here. The volume concludes with a paper by Dobat on digital reconstruction of Roman frontier installations, and a paper by Lesley Macinnes looking forward to the aspiration to create a World Heritage Site for the Frontiers of the Roman Empire.

Overall this is a thorough, wide-ranging and up to date study of Roman Frontiers with an international perspective, handsomely presented with a healthy balance of retrospect and review, alongside the publication of new data and challenging discussion. The deep appreciation every author feels towards Bill’s long contribution to the discipline is evident throughout. While only some parts of the Festschrift may appeal directly to AARG readers keen to catch up with issues of prospection, discovery and field archaeology on Roman sites across Europe, they will no doubt find themselves exploring new aspects of the topic by delving into the papers on people, histories and artefacts presented alongside. This is a fitting tribute to one of AARG’s most proactive members.
Review article by Rog Palmer¹


PCA is Post-Classical Archaeologies (http://www.postclassical.it/Home.html) who publish the European Journal of Post-Classical Archaeologies and occasional Studies, of which this book is the second. Its origins were a 2013 summer school although the book has been expanded to cover a broader range of topics. There are 16 chapters: the first two introductory, then four of techniques which are relevant to any period, and a further ten which are based more in ‘post-classical’ periods. The authors’ brief was to include separate box features and case studies and to end each chapter with ‘suggested further reading’ – the main bibliography being in a block at the end of the book. In the main, this works well with some authors using the box to describe techniques or processes, while others include short case studies. I confess to wondering just what Post-Classical Archaeology is and whether it can be practised in those places that didn’t have a Classical Archaeology – and does this affect the contents of the book. Perhaps we’ll find out…?

The opening two chapters are written by the editors and look firstly at the processes involved in detecting and understanding historic landscapes (Chavarría). For example, whatever the date range of our particular interest it is necessary to see, identify and understand the natural and anthropogenic processes that preceded and followed it – developing Chris Taylor’s (1974) concept of ‘Total Archaeology’. The chapter continues and discusses the role of standing structures in landscapes and how effectively modern societies are at destroying or masking parts of landscapes; noting that our usual ways of protection are geared to ‘sites’ and not ‘extents’. Final parts of the first chapter introduce the rest of the book’s contents and use these to show the range of ‘research processes and competences’ that are used to study (historic) landscapes.

Chapter 2 uses examples of Anglo-Saxon date to scan ‘new directions in medieval landscape archaeology’ (Reynolds). A main theme concerns travel and communication in those times – itself a research project at UCL which is endeavouring to reconstruct the road and riverine transport networks in Anglo-Saxon England. These build on Roman road networks of which conventionally-published evidence (maps, for example) usually indicate only the major routes. This is where I would have expected air photo interpretation to help with an answer but, perhaps because of the sometimes vagueness of dating, the author seems to favour ‘joining dots’ (my phrase) between dated features. But perhaps this is more necessary in the shorter timescale of A-S studies than in the ‘late-prehistoric to roman’ period in which I usually work.

The four following chapters deal with techniques, usually in a general way rather than anything specific to Post-Classical Archaeology, and their contents will be familiar to those of us working with aerial images: Dave Cowley (Aerial photographs and aerial reconnaissance for landscape studies), Simon Crutchley (Using ALS for interpreting archaeological landscapes), Rosa Lasaponara and Nicola Masini (Reconnaissance of archaeological marks [yuk!] through satellite SAR) and Armando de Guio (Vegetation indices in archaeology). I lump them together because they are capable, used effectively, of providing considerable...
information about past and present landscapes – but in these chapters they don’t. The nature of much of the data collecting by observers ties the resulting images to (usually) single sites while interpretation of existing evidence (ALS and SAR, etc) tends to move from one ‘site’ to another. Cowley and Crutchley mention mapping – which for me is how you progress from images to landscapes – and there is one illustration of about 1 sq km of Roman Newstead (Scotland) but the bulk of those chapters is about data collecting and (basic) image examination. Both include comment on ‘false positives’ and Cowley includes an example illustrating bias. Useful stuff for beginners but with little suggestion on how to build up a landscape. Perhaps I was expecting too much. Lasaponara-Masini is almost completely about technique, illustrated with some examples of ‘archaeological marks’. This reluctance to interpret makes me cross and is akin to geophysicists finding ‘anomalies’, GIS people mapping ‘lines’ and aerial photographer photographing ‘crop marks’. We are supposed to be archaeologists… It’s a guessing game… We expect to be wrong so please be wrong proudly and with as much accuracy as is possible. De Guio’s paper offers a mix of ideas, based around uses of vegetation indicies. He begins by noting the agricultural erosion of archaeological contexts in the eastern Po Plain, where he has been working for the past 30 years. Next he ask whether it is possible to get away from the mainly visual interpretation that has remained virtually unchanged for the past 100 years? Use of VIs enable specific manipulation of images and various techniques for this are noted, along with numerous examples, in the chapter. After all this technology, I was anticipating an ending that introduced the possibilities of automated ‘interpretation’, but this was not to be.

From those beginnings the book moves to chapters that deal more with results from landscape projects of what I will call ‘later periods’. Although these are probably the ‘meat’ of the book, I’ll deal with them briefly in a review for aerial readers. After introducing historic landscapes and the development of research into them, Stephen Rippon (Historic landscape analysis) looks at characterisation, morphology (or not), retrogressive analysis and how integration of methods is vital to unravel landscapes. His two box examples are excellent case studies of results of these applications. Aerial photographs are an important component in Robin Brigand’s overview of ‘Archaeogeography and planimetric landscapes’ which outlines methods, data and processing before using some ‘types’ (such as centuriation) for further discussion. His box section has seven case studies that demonstrate aspects of, and results from, planimetric methodology. Next, Richard Jones examines ‘Place-names in landscape archaeology’ reminding us that, as with most specialities, it is not necessarily as straightforward as it may seem. Use of place-names can help expand our understanding of landscapes of appropriate periods by indicating, for example, uses that were made of particular places and so bringing past inhabitants more clearly into focus. ‘Landscapes of hydraulic energy in medieval Europe’ (Colin Rynne) is perhaps more about structures (eg mills) than ‘landscapes’ although there is considerable mention of their context in this chapter, or those parts of the landscape that were essential in providing and directing the water to users of its energy. In a thought-provoking chapter (Landscapes, settlements and sustainability) Carlo Citter discusses and criticises methods used to evaluate the role of landscape and context as ways of estimating the sustainability of a site at a particular location. To be practically effective, these methods rely on perhaps more factors than archaeologists are likely to know about a particular site although in post-classical times (whenever they were) it is possible that documentary records may give populations sizes which can only be guessed for prehistoric sites.
The three following chapters take us back to detection and detail to examine ways in which geoarchaeology (Roger Langohr et al: ‘Reading the soilscape …’), archaeobotany (Meriel McClatchie) and zooarchaeology (Naomi Sykes) provide information that can be fed into landscape studies. Next is a chapter (José Mª Martín Civantos) details how engaging rural communities in landscape archaeology can help research projects and also enrich those communities. Tables at the end of this chapter summarise a number of such projects from several countries. The final chapter (Gian Pietro Brogiolo) uses ‘Some principles and methods for a stratigraphic study of historic landscapes’ to outline an historic landscape research process developed at the University of Padua. The final box section in the book is written by Marco Nebbia and shows use of WW2 aerial photographs to investigate to provide information for his landscape study of the Island of Rab, Croatia.

This review is little more than an aerially-biased skim through a text book on landscape archaeology that includes information about some of the methods used to try to understand past landscapes. As should be expected from an organisation called Post-Classical Archaeology a significant number of examples investigate ‘later landscapes’. Reading about some of the many specialities needed to help unravel these landscapes makes me wonder if there is a role for an individual any longer, or if it will need a group of assorted specialists to produce any worthwhile landscape research. In summary, the book is well-edited and produced on good-quality paper with clear text and illustrations and hopefully will help to generate more interest in landscape investigations of all periods.

Reference
Books of interest?

Rog Palmer¹


From the publisher’s blurb:
The study of conflict archaeology has developed rapidly over the last decade, fuelled in equal measure by technological advances and creative analytical frameworks. Nowhere is this truer than in the inter-disciplinary fields of archaeological practice that combine traditional sources such as historical photographs and maps with 3D digital topographic data from Airborne Laser Scanning and large scale geophysical prospection. For twentieth-century conflict landscapes and their surviving archaeological remains, these developments have encouraged a shift from a site oriented approach towards landscape-scaled research. The book brings together a wide range of perspectives, setting traditional approaches that draw on historical and contemporary aerial photographs alongside new prospection techniques, cross-disciplinary analyses and innovative methods of presenting this material to audiences.

Essays from a range of disciplines (archaeology, history, geography, heritage and museum studies) studying conflict landscapes across the globe throughout the twentieth century, all draw on aerial and landscape perspectives to past conflicts and their legacy and the complex issues for heritage management. Organized in four parts, the first three sections take a broadly chronological approach, exploring the use of aerial evidence to expand our understanding of the two World Wars and the Cold War. The final section explores ways that the aerial perspective can be utilized to represent historical landscapes to a wide audience. With case studies ranging from the Western Front to the Cold War, Ireland to Russia, this volume demonstrates how an aerial perspective can both support and challenge traditional archaeological and historical analysis, providing an innovative new means of engaging with the material culture of conflict and commemoration.

Lis Helles Olesen and Esben Schlosser Mauritsen, 2015. Luftfotoarkæologi i Danmark (Aerial Archaeology in Denmark). Holstebro Museum. ISBN 978-87-87522-13-7. c.€47 hardback (plus postage: can be ordered from sandie.nielsen@kulmus.dk)

This huge book is a result of a four-year research project An aerial view of the past – aerial archaeology in Denmark in collaboration with Archaeolandsapes Europe. Part 1 ended in 2013, part 2 will continue until 2018. The majority of the text is in Danish (chapter headings were given in AARGnews 51, 51) with a 17-page summary plus a list of figure captions in English. Oblique aerial photographs were mostly taken as part of this project although the book includes extracts from the airborne laser scanning of Denmark as well as the project’s experiments to test penetration of high-density surveys over plantations in western Jutland (Chapter 11).

A bonus from the large format of the book is that aerial images are printed at sizes which make their reading easier than usual – and it seems that no expense has been spared to stuff the book with illustrations that help readers understand the book’s themes. And those themes

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are much more than just the Luftfotoarkæologi of the title as there is supporting evidence from field investigation (including collaboration with metal detectorists), maps and documents as well as considerable use of ALS. Based on the English summary and the illustrations it appears that the book would be necessary reading for anyone wanting to understand Denmark’s past. Even with the cost of international postage for the 3kg book, it seems exceptionally good value for money – even if it’s difficult to find shelf space for it!


Prepared in collaboration with AARG, Arcland, ISAP and showing an EU flag, these guidelines ‘aim … to provide an overview of the issues to be considered when undertaking or commissioning geophysical survey in archaeology’. While this topic is of little direct relevance to many AARG members, it can be useful to know what ‘the other side’ is doing especially to those of us whose work may be complemented by a variety of non-invasive investigations.


Michael Doneus presented a version of this paper at AARG 2015. Here it has more technical detail and longer discussion on the way this automated process may assist the workflow of aerial photographers. Geert Verhoeven has put a copy on his Academia page at:

[https://www.academia.edu/22839155/Automated_Archiving_of_Archaeological_Aerial_Images](https://www.academia.edu/22839155/Automated_Archiving_of_Archaeological_Aerial_Images)


[http://zalozba.zrc-sazu.si/p/P09](http://zalozba.zrc-sazu.si/p/P09)

Going cheap (£15) at Oxbow (or it was when this was written):


Abstracts from the Italian 2nd *International Conference of Aerial Archaeology*, held in Rome between 3-5 February 2016, can be found at the somewhat peculiar address below:

[https://www.academia.edu/21314227/Abstracts_-_2nd_International_Conference_of_Aerial_Archaeology_From_Aerostats_to_Drones_aerial_ima](https://www.academia.edu/21314227/Abstracts_-_2nd_International_Conference_of_Aerial_Archaeology_From_Aerostats_to_Drones_aerial_ima)
The Aerial Archaeology Research Group

AARG is a lively and friendly international group of young and old researchers. It provides a forum for the exchange of ideas and experience on archaeology and landscape studies using all forms of remote sensing, especially airborne and satellite based techniques.

AARG is actively involved in promoting the collection, interpretation and application of remote sensing data in fostering research, conservation and public understanding. Its members are among those pushing the boundaries of the collection and analysis of air- and space-borne sensors.

Since its foundation in the early 1980s, AARG has vigorously encouraged discussion and cooperation through its annual conferences, workshops, specialist publications and biannual newsletter, AARGnews.

Membership is open to all who have an interest or practical involvement in aerial archaeology, remote sensing and landscape studies.

AARG is a registered charity: number SC 023162.

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

Membership/subscription rates:

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Subscription reminders may be sent out on January 1

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Please contact the Secretary: aarg.secretary@googlemail.com

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Student scholarships. AARG has a limited number of student scholarships 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 AARG’s Chairman (aargchair@gmail.com) with information about their interests in archaeology and aerial archaeology, as well as their place of study. The annual closing date for applications to the annual AARG conference is 1 June. Other meetings for which scholarships may be available will be advertised on an ad hoc basis.