Editorial by Rog Palmer 3
Chair’s piece: by Sara Popović 8
AARG notices: AARG’s news and information in other formats
  Derrick Riley Bursary  
  ISAP Fund  
  Information for contributors 11
Detection of crop mark contrast for archaeological surveys
  by Froelich G. Rainey, John N. Hampton and Bruce W. Bevan 12
Small window of opportunity in the Upper Thames Valley 2020 by Robert Bewley 26
Aerial research in Nord Isère (France - Rhône Alpes region) Panossas “les buissières”
  by Alain Bliez 32
To fly or not to fly - that is the question? by Moira Greig 38
Over Danube meadow with a UAV by Ovidiu Frujină, Cornelis Stal and Catalin Lazar 41
Traces of 17th/18th century fortifications in the terrain by Roland Linck 47
Thermal and Multispectral Monitoring of cropmarks by UAV by Simon Seyfried 52
Cropmarks 56
Books and papers of interest? 60
AARG: general information, membership, addresses, student scholarships 76
Editorial

AARG’s Google group
AARG launched its Google Group in late May this year and membership was boosted by a reminder about a month later but is static at 42 which is about half of AARG’s members. Because of GDPR current members have to join themselves so if you want to reap the benefits of fairly immediate communication please join at [https://groups.google.com/forum/#!forum/aarg-group](https://groups.google.com/forum/#!forum/aarg-group).
The group seems to be an ideal place to ask questions and to post, for example, amusing stories, or puzzling APs in the hope of getting a useful responses from those who may know, comments on books or videos and so on. We need your input and activity to keep it alive and useful. The group is run by our webmistress, Agnes Schneider and managed by the committee and trustees.

Congratulations Lis!
Just before she retired, Lis Helles Olesen was named Archaeologist of the Year by Danish Amateur Archaeologists. During her years at Holstebro Museum, Lis has taken what she calls ‘aerial photo archaeology’ (a term I failed to introduce in UK) to a new level in Denmark: flying and finding stuff, publishing books and, presumably, reaching a wide range of archaeologists and people. It’s good that someone in the aerial world receives more than a ‘silly’ prize and I offer my congratulations to Lis and look forward to seeing her whenever AARG meetings become live.

Burning aerial photographs
Not quite, but notice of the forthcoming publication in October 2020 of Richard Ovenden’s *Burning the Books: A History of the Deliberate Destruction of Knowledge* made me wonder if anything similar had happened to aerial photographs – that they had been destroyed or locked away to hide knowledge of a site. This is not the same as hiding vertical photographs for reasons of ‘security’, or because they were taken of the Etton area by the RAF at a date when they were not supposed to ‘compete’ with commercial companies, even if the flight was done for a mate, but is specific targeted restriction of knowledge. I know of at least two instances in England when there was temporary hiding of photographs so the photographer had precedence of publication and with new images in some collections taking up to three years before they can be accessed by the public there is inadvertent hiding of evidence during that time. Many years ago Jim Pickering showed me a photograph he had taken of an extensive cemetery ‘somewhere in England’, saying that its location would be kept secret until it had been scheduled. Whether it was scheduled or not I do not know, nor have I ever come across that site in any of my visits to HE’s archives. Maybe the NMP interpreters have seen it in their travels across the land?

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1 rog.palmer@ntlworld.com
2 This is worth expanding and the story as told to me was as follows. Many years ago Francis Pryor (the story-teller) had an open day at his Fengate excavation. One visitor was a Group Captain from a local RAF base who was sufficiently impressed to ask Francis is ‘the lads could do anything useful’. The consequence was a set of 1:3,300 scale vertical photographs taken in optimum conditions on 31 July 1979 of the Etton-Maxey area in Cambridgeshire. Peterborough HER has one set along with the original flight maps and another set is held at the NMR in Swindon but does not appear in their cover search lists for the reason given above (Fiona Mathews, pers com, years ago). I am lucky to know of this and the alternative source, but other researchers may be unaware of this excellent set of photographs. We can wonder if similar restrictions apply to other source photos elsewhere.
Can we find BIG from aerial evidence?
The recent identification of a large-diameter post ring around Durrington Walls made me ask how those ‘anomalies’ were identified within a sea of geophysical noise. The report (Gaffney et al., 2020) includes extracts of the geophysics in which their anomalies are big black blobs which suggests they were relatively easy to see (as in Supplementary fig 1.1 in the report which shows the largest area of collected data in a single view) – but then you need to be brave enough to suggest they are linked. An arc of 20 pits has been identified of which four coincide with features mapped by the NMP. Looking at the published figures in the Gaffney report, four anomalies more often suggest a not-quite-straight line rather than a giant arc, so there is little chance of even thinking that four may be part of a circular setting from the aerial evidence.

OneSoil (see Cropmarks) shows that most of the pit fields are cultivated so it would be interesting to know if the NMP identifications came from interpretation of vertical photographs or were things that had been photographed by airborne observers. I would also guess that someone at Historic England has been or will be checking photographs of the area to see what may have been ‘unseen’ by their interpreters. I use that word to mean ‘perhaps noticed but not thought to be of archaeological relevance’, something we all have to do both as fliers/photographers and photo interpreters and which is particularly difficult with pits. Scraps of ditches are easier to believe from the air or on photographs and can be mapped, complete with gaps, and suggested to have been parts of extensive cohesive structures, but an arc or circle of pits that is some 2km in diameter is unlikely to be perceived, especially if the pattern is blurred by the presence of other features.

Gaffney, V. et al. 2020 A Massive, Late Neolithic Pit Structure associated with Durrington Walls Henge, Internet Archaeology 55. [https://doi.org/10.11141/ia.55.4](https://doi.org/10.11141/ia.55.4)

If you are interested in the pits as archaeological features, there is a thoughtful piece by Tim Darvill trying to visualise that landscape and what it may have meant to the population. [https://www.apollo-magazine.com/neolithic-pits-durrington-discovery-near-stonehenge/](https://www.apollo-magazine.com/neolithic-pits-durrington-discovery-near-stonehenge/)

How reliable is our dating of aerial evidence?
Earlier this year, a paper was published by Gordon Barclay and Kenny Brophy in which they ‘…explore the trajectory of interpretative inflation, ‘possible’ > ‘probable’ > ‘certain’ > ‘sensational’. While this paper is nothing to do with understanding aerial photographs it does consider how archaeologists can change, perhaps not consciously, the belief they have in their abilities to interpret. One aspect of this – dating aerial information – has changed considerably during recent years but has not been much discussed within the aerial community. Classification and dating occupied a lot of time in the early years of AARG when there was hope that shapes of enclosures, etc could be related to dates.

One example comes from the way we assign dates. In the 1980-90s we would tentatively estimate dates based on the little comparative material from excavations (eg, Palmer 1983, 47 and an early NMP report by Fenner 1992, 6). Now, after some thirty years of developer-led excavation in Britain perhaps we can be more certain about dates of some kinds of sites and leap straight into a chronological summary with no hint of doubt (eg, Knight, et.al. 2018, 26-63). But should there be some doubt?
In the early years we were attempting to use morphological classification as a means of dating and while it works with some types of site it may not necessarily work for all types. But I wonder sometimes if we have reached that stage of confidence where we believe our dates are right because we believe what we said they were a few years ago. Could this be an example of the interpretative inflation that was flagged by Barclay and Brophy? If so, should it be open to critical review and a statement of uncertainty made in any report that so categorises aerial evidence? Maybe it’s time again to include it in AARG’s discussion.3


Why isn’t AARG making a visual presence?
Among the sub-disciplines of archaeology, aerial related topics perhaps have claim to be the most visual. Yes, I know I rant about aerial photographs being used as only pretty pictures but they, along with interpretations and maps, can also be used for teaching and as a way of informing archaeologists and people about the successes that have come from taking and analysing off-ground images. In the few months since lockdown many other archaeological niches have produced virtual talks, question-answer sessions on social media, and generally made their presence felt. A prime example that has a lot of aerial content is CHERISH which has blogs, colourful and informative newsletters, webinars, videos and frequent updates on Facebook ([http://www.cherishproject.eu/en/](http://www.cherishproject.eu/en/) and [https://www.facebook.com/CHERISHProject/](https://www.facebook.com/CHERISHProject/)). I appreciate that there is a difference between the energy that goes into a funded project and a committee and members of a SIG but it is disappointing that not even a whisper of an idea has been heard within AARG. Perhaps we need a committee member for ‘outreach’?

Space Archaeology defined
Some of us have been a bit confused about Satellite Sarah’s use of ‘space archaeology’ and whether it was just a higher altitude version of what we have been doing for the past 100 or so years. Fortunately, she has provided the answer, so read on and find out.

Transcript from BBC’s *Infinite Monkey Cage*, Series 22 ‘Space Archaeology’ 8 June 2020.

Robin Ince: ‘…but you are using space archaeology. What is ‘space archaeology’?’

Sarah Parcak: ‘Yes, so, so, space archaeology is the use of all sorts of different kinds of sensors, from airplanes to UAVs to drones to satellites … uh, to even pictures taken from the space station, and what you’re doing is you’re looking for two things, you’re looking for

3 I am grateful to Sally Evans (HE, AI&M) for email discussion about this theme.
patterns on the surface of the earth that indicate, uh, things that were built by ancient humans, um, but, sort of, what you’re really doing, think of it like a space-based CAT scan because there’s so many things that are partially to completely buried by soil or vegetation or even modern towns, and what the satellites allow us to do is to look at different parts of the light spectrum that we simply can’t see, um, we’re stuck looking at the visible part of the light spectrum but of course it extends far beyond to the near infrared, middle infrared, far, thermal, uh, and so on and what the satellites do is they record this information in different parts of the light spectrum and when things are buried under the ground they affect the overlaying soils and vegetation and sands, uh, in ways that we can’t detect, w..., in the visible part of the light spectrum but say if it’s vegetation and there is a ditch, of, uh, uh, iron age ditch hidden beneath the ground that that dense moist vegetation, e, or, or, or soil is going to affect the overlaying vegetation in such a way that it’s going to be healthier and in the near infrared part of the light spectrum which is the part where we can see vegetation health it’s going to show up much clearer and you zoom out and zoom out and zoom out and you’re able to see the shape of an iron age ditch and this is why a couple of years ago in England um, I think it was about two summers ago, when there was a massive drought there were hundreds if not thousands of archaeological sites that started popping up in places that archaeologists, um, simply hadn’t seen before. So this technology is used all over the world, it’s used where I work in Egypt, it’s used throughout the middle east, uh, the Americas and even in places like, uh, central America, uh, and south-east Asia where there is dense rainforest.’

[Source: https://www.bbc.co.uk/sounds/play/p08gcgky at 09:50-11:55]

Why Do Modern E-journals Use Excessive Capitals in Titles of Their Papers?
I’ve no idea, but wonder if this results from limited knowledge of the English language by editors. Have a look at titles in Books and papers of interest? to see what I mean.

This issue
Drones, helicopters, fixed-wing aircraft and satellites makes it seem as if this issue may be an aerial photographer’s dream. Dream on, while I start high and fly lower. My highlight has been the unearthing by Bruce Bevan of a 1976 report that pursued an idea of John Hampton’s to test if satellite images could be used to predict good times for crop mark photography. It is not mentioned in the report, but at this date, Landsat’s ground resolution was 80m/pixel which did seem to show local changes of crop growth due to different soils – but you’d go mad trying to assess those images over a wide area. The illustrations in the report show the coarseness of those images and may make us wonder now whether such an idea would have been practical although it is a shame it was ditched for other reasons (see conclusions). I include it to mark the pioneering experiment that it was and to add one more item to John’s short list of publications.

Reducing height, I am grateful to Robert Bewley for offering a brief report of his archaeological flights during summer 2020 – possibly the only person to have done any oblique photography? I had been watching changes on Sentinel 2 and expected the summer to be good, maybe as good as 2018, but then the weather clouded over and Covid-19 seemed to prohibit squeezing into a Cessna 152 cockpit to rub shoulders with my pilot so I made no attempt to book a flight. The photos in Robert’s report show that, in the Thames valley at least, it was a good year. One small excitement among the old committee dates back to a contact from Alain Bliez in August 2020 asking if we wanted a representative in France. Following his request, contact was made that led to his contribution in this issue and also to
further enquiries about other work in France. Those of you who think that aerial history originated in the UK may be interested to read the counter-view that prefaces his contribution that made me realise that each country ought to have its own history rather than the shared one that we often use. Other flying tales were sent by Moira Greig, written at a time when AARG’s committee was looking for ways to entertain members but then it seemed that members were happy not to be entertained (see Google Group numbers above) so we kept Moira’s chopper exploits back for *AARGnews*. Her note shows the problems of trying to keep legal when flying in the UK – maybe this does not apply elsewhere, in which case, elsewhere is very fortunate.

Finally, we descend to drone height. I continue to be uncertain whether the way drones are used has anything, or much, to do with AARG’s interests. They tend to be very small-scale looks at the land and illustrate rather than interpret – in much the same way that aerial photographers did/do with pictures of ‘crop marks’ or, to broaden things out, geophysicists who show us ‘anomalies’. One contribution is here in return for an AARG-funded scholarship to our meeting in Constanța, the other is more interesting work but leaves questions unanswered. Dave Cowley’s piece in *AARGnews* 56 (reproduced from *Drones*) showed that much use of drones were to illustrate rather than explain and there are questions raised by Roland Linck’s contribution that were not answered, maybe were not asked, but which would have been dealt with if an interpretation or line drawing had been made or perhaps if the site had been visited on the ground. Questions arose from my viewing of Figure(s) 4 where there is a small raised dog-leg feature immediately E of the profile line in Figure 4c. A first question is whether this feature is contemporary with the defence line (or with the golf course), a second question is to ask what it is. Of course, these questions may have been asked and answered when undertaking the survey – but it would have been useful to be given an explanation (yes, I did ask).

Use of aerial thermal detection in archaeology has quite a long history but it is only in the last few years that sensors have been designed for use in drones. Jesse Casana has perhaps pioneered use of thermal over stone-built structures (see past *Books and papers of interest?*) but in Europe we have levelled sites under crop to try it over. Ulrich Kiesow worked on this more than 15 years ago⁴, and it has been taken up by John Wells in Scotland whose up-to-date web pages include lots of links and references⁵. This issue includes a short paper by Simon Seyfried, based on a poster he presented to CAA in 2019, who used a drone for thermal and MS imaging and made some comparisons. After I received Simon’s paper I had a chat with Bob Evans (of SMD fame) who mentioned that some of his late 1970s thermal experiments showed that some wavelengths could also include parts of the visual spectrum – making the image not wholly thermal – but I have not been able to find out more about this. One of you thermal experimenters may know the answer – and a solution if one is needed.

I note with some amusement that drones can now carry geophysical equipment. Does this mean that AARG now needs to take over ISAP or that we have to consider more of those painful joint meetings between geophysical and aerial specialists? No... let’s leave them to their nose-on-the-ground world while we have higher-level fun. It does, though, spoil Michael Doneus’s definition of ‘remote sensing’.

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⁵ [http://www.armadale.org.uk/aerialthermography.htm](http://www.armadale.org.uk/aerialthermography.htm)
Chair’s piece

Sara Popović

Ten years ago, just few months after AARG’s training school in Serbia, Darja Grosman rented a van, packed in most of the students of that school (me among them) and we drove to the Annual Meeting in Poznan. Most of us were amazed to hear many diverse and interesting presentations given from this group of professionals, very open to let us join their family. Since then, I haven’t missed a meeting and aerial perspective became essential in my research, mainly focused on archaeology in karstic landscape and shallow waters. I couldn’t imagine that ten years later I will have the privilege to be appointed Chairman and I would like to take this opportunity to thank all of you who voted for me on our first, and hopefully last, virtual AGM.

The reason why I decided to accept the nomination for Chairman position were our somewhat repetitive discussions in last few years about declining membership and also on some level comparing ourselves unfavourably with bigger associations and bigger conferences. On the other hand, one of the arguments for turning AARG meeting to biannual format was the collision with ICAP. In 2019 these two conferences were 10 days apart and I thought that it’s a good time to see how many of AARG members did choose to go to ICAP. In their programme were 66 oral presentations, given by 261 authors + 4 keynote speakers of whom only 4 or 5 are AARG members. A few of our members were maybe missing from AARG but were definitely not at ICAP. Those few who attended ICAP had topics of their presentations about geophysical prospection which fit better on that conference, and as mentioned in our AGM, the combination of two conferences, already tried, doesn’t go well.

What I think we need is to return to basics, understand that we are a small group of specialists which only needs to be more active as a group. All the planned activities, which I’ve formulated with the help of few long standing AARG members, are not really new to AARG, just maybe reactivated. The crucial thing for every idea I’ll present here is active participation from our members. This will hopefully keep us in contact in these times when the date of our next personal meeting is uncertain.

TEACHING

At many AARG meetings we’ve discussed that we should start again with the teaching programme. The last school was in 2015 and after this 5 year break, I think we all agree that it’s time to activate again.

There are many different formats how schools can be organized – as workshops with special topics (which require less money for flying) or training (which needs substantially more money). To draw from the experience of Darja and Rog, the main people behind workshops and training schools run under Arcland and earlier, the most successful were ones where ‘students’ had been selected on the basis of their knowledge of the area and were taken through steps towards mini-projects within that landscape (working from archives, forming questions that may be solved by short flights, conclusions (see reports in AARGnews 48)).

We would hope these can be continued under AARG and would aim initially to identify places and local archaeologists who may be favourable to support and (partly) finance such
workshops. For now, we would like to focus on those aimed at specific archaeological questions or specific environments rather than those which involve a lot of flying.

We are aware that these are uncertain times for planning schools and travelling in general but if we start preparing now, we will be ready when a chance for implementation presents itself. We already have 2 proposals for schools which would be co-financed by local institutions. All members are invited to give their proposals.

WORKING GROUPS
Second proposal for the next 3 years is the re-establishment of the AARG working groups. These would be smaller groups consisting of a few AARG members working on a specific subject. The idea is to produce results but also to keep us connected and active as a group.

Here you will find description for 4 groups that I’ve talked about with some members.

Archives
The aim is to extend the survey of archives of aerial photographs/images started under the ArcLand project. An initial need would be to add to the ‘what is where’ sources identified and listed by ArcLand (http://www.arcland.eu/archives). A second phase would be to obtain more information about means of access to those collections. We propose that AARG’s working group would start by providing a timeframe for this work and an estimate of costs. This project could/should eventually expand into the digital archive idea that was earlier discussed for drone images although it is probably more important first to concentrate on unlisted aerial photo collections.

Uses of Sentinel 2 for archaeology
The aim of this WG is to evaluate the value and use of Sentinel 2 scenes as a means to help the timing of flights to record archaeological targets. These could be from light aircraft, vertical surveys, high-resolution satellites, or specific drone targets. Sentinel 2 could also be used as an indicator of field and crop conditions prior to buying old images.

We have designed a process for evaluation and seek international membership of this working group who will assess the value of Sentinel 2 in a range of climate, soil and crop differences and using a range of archaeological test cases. Each proposed evaluation should not take more than half a day per site and we seek members who have either photographed their test sites or know them from images taken since the beginning of Sentinel 2 cover (from mid-2015 in parts of Europe). This is a short-term WG which should result in a multi-authored publication. Other applications of Sentinel 2 have already been proposed and may either follow this WG or be run in parallel.

AARG YouTube
As part of AARG’s reaching out, we propose to create a series of short AARG YouTube teaching videos with different topics such as:

- Why aerial photography? What does it do for archaeology?
- What can be seen and how it becomes visible?
- How do we collect and interpret that information?

We can present photo reading examples and case studies which should come from many AARG members. These videos would be AARG badged as a mark of their credibility. We
can advertise them on our webpage and social media and give the group more visibility. You are again invited to express your interest and participate.

**AARG visual identity**

This WG came from the idea to make few changes to the design of *AARGnews*. Since our website and social media pages also need an uplift, we decided to work on the whole AARG visual identity. A few of our members who have the knowledge in web design came forward and volunteered after the AGM so this WG is already formed and is meeting every 2 weeks. We can expect the ‘new look’ of AARG with the beginning of 2021 and for *AARGnews* with the spring issue.

These 4 working groups can be just a beginning and new ones can be formed as we go along. The topics can range from technology to whatever members come up with, they can be short-term or longer. Again, you are all invited to propose ideas for another working group or volunteer to participate in ones I described.

**DISCUSSIONS, DISCUSSIONS**

I started my Chairpiece with an idea that we should return to basics. One of the main reasons that AARG was formed was to discuss and exchange experiences. Many, if not almost all, of our members are still coming to AARG meetings because we provide a good platform for discussions on topics we agree are relevant for us. Our Constanţa conference showed just that, and that’s why I think we should make more slots for debate on our yearly meetings. For example, the first session after the AGM can be reserved for summaries from working groups with an open slot for discussion.

We will also reserve a session or sessions (depending on the interest) aimed to discuss a specific question raised by members. A call for discussion topics will be sent with the call for papers. The aim of these changes is to bring back the focus of the group to archaeological problems that aerial images may help solve. This would also take a load off worrying every year whether we will have enough submissions for presentations.

Our debates usually continue from formal sessions to coffee breaks and beer time. The informal part of AARG shouldn’t be overlooked and seen only as a beer time. Over beer lots of projects, flying schools, exchanges were planned and later successfully executed. For the last couple of years a lot of you have been saying that you miss the informal session so we will not forget that.

**MONTHLY DISCUSSIONS**

In order not to wait the whole year or even more in these ‘no travel’ times to make our meetings possible I would like to propose monthly Zoom meetings. These will be hosted by a few members of the Committee, and don’t worry I know some of us will be willing to do this every month. Some of these meetings will be focused on the specific working group reporting its progress but others will be open for all AARG members to join, participate, suggest new activities or ask questions arising from the WGs. We can start with this next month and will see if members are interested and build from there.

This is an attempt to become an active group again where all the members have opportunities to participate.
AARG notices

AARG’s news and information in other formats

Twitter account: @AerialArchRG

Facebook page: https://www.facebook.com/aerialarchaeologyresearchgroup/

AARG’s Google Group is here: https://groups.google.com/forum/#!forum/aarg-group. This is for AARG members only and all requests to join will be approved (or not) by the administrator of the Google Group. After having joined the group you are free to start new topics about anything you want to ask or discuss with AARG members!

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 is an application form at the link below 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.

https://www.sheffield.ac.uk/archaeology/derrick-riley-fund

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

ISAP have 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’.

Guidelines and application form from the ISAP web site:

http://www.archprospection.org/isap-fund

Information for AARGnews contributors

AARGnews is published at six-monthly intervals. Copy for AARGnews 62 (April 2021) needs to be with me no later than March 31, 2021. 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 may serve as a guide or more information can be sent on request.

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

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

Address for contributions: rog.palmer@ntlworld.com
Detection of crop mark contrast for archaeological surveys

Froelich G. Rainey, John N. Hampton and Bruce W. Bevan

[Edited from its original 24 pages by Rog Palmer]

Bruce Bevan is the surviving author of the report that follows and it has come to light after 45 years thanks to ISAP’s Google Group where he and I recently ‘re-met’ after our brief contact in the mid-1970s. John Hampton first collaborated with Froelich Rainey in September 1971 when he and Beth Ralph came to England from the University Museum at Pennsylvania to undertake a geophysical survey at one of the sites of his multispectral experiment (Hampton 1974). John’s contact with Rainey continued as the paper below demonstrates. It seems likely that the idea in this report was John’s and technical expertise came from Pennsylvania and NASA. But what an idea it was at that time – to use satellite images to predict optimum times to fly to photograph archaeological marks, something we are only beginning to do now in 2020.

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Preface

Shallowly buried archaeological features such as ditches and walls can cause anomalous growth patterns in the overlying vegetation. These markings in the vegetation are visible for at most a few weeks during the growing season. Ancient buried river channels also cause vegetational growth patterns and they do so at the same time as nearby archaeological features. Landsat resolution appears to be good enough to detect the river channels, allowing the optimum time to be determined for photographing the archaeological marks from an airplane.

Photographic enlargements of the red image (Band 5) provided the greatest amount of information on the growth of the vegetation. Some additional detail was obtained by comparing the red and infrared images (Bands 5 and 7) with color diazo transparencies.

The test site near the Thames River at Dorchester, England, is obscured by clouds or haze in all Landsat photographs taken during the period of critical growth in mid-summer. The 1976 photos should be examined when they become available in the hope of a clear atmosphere. A related test could also be tried in the Mississippi-Missouri river valley.

Introduction

The resolution of the photographs from Landsat-1 and Landsat-2 appears to be good enough to detect ancient meanders of the Thames River near Dorchester, England. However, no clear photos are available which show the area at the proper time in early summer during which growth patterns in the crops could reveal the earlier course of the river. Therefore the usefulness of the satellite for determining the optimum time for archaeological reconnaissance from aircraft is as yet unproven.

Archaeological Background

Archaeological structures, even those buried at a shallow depth, can sometimes be discovered and mapped with aerial photography. Ancient ditches, refilled by nature or man, and buried walls and roads are often detectable by the patterns of anomalous growth in the overlying vegetation; these patterns are called crop marks (1).

Crop marks indicating refilled ditches and pits are particularly visible in areas which have a thin but rich topsoil which covers barren subsoil. The river valleys in southern England are examples of this. Gravel is often found only a few decimeters under the surface. Early man dug holes through the topsoil into the gravel; when these holes were refilled, a pocket of richer soil would often result. Crops, such as wheat or barley which send their roots into this pocket of rich soil, can grow differently than the surrounding crops. The most pronounced effect appears to be due to the greater amount of moisture in the soil of the refilled hole: the crop there can still be green when the surrounding crop is golden and matured. An example of this is given in Figure 1; the many ring-shaped ditches, rectangular enclosures, and other marks in this photo are the result of a long period of occupation by early man from the Bronze Age and Iron Age through the Romano-British Age (2). The camera which took these photos used panchromatic film and a yellow filter.
Figure 1. The time factor in crop mark visibility.
One of the big difficulties in archaeological reconnaissance is the short period of time in which crop marks are visible. The two photos in Figure 1 were taken 15 days apart. These marks will vanish when the crops are harvested.

The optimum time for photographing crop marks lasts for only about one week, although sometimes traces are detectable for a month or more. This optimum time varies from year to year primarily because of changing weather; in addition, differences in the soil cause the best time for photography to vary from region to region.

**The Dorchester Area**

The course of the Thames River in southern England is shown in Figure 2. At Dorchester, the Thames flows around a bend 2 km in diameter; a map showing this smaller region is given in Figure 3.

This area is rich in crop marks; the shape and position of many of them are mapped in Figure 4. The line of the Thames is indicated on this map to show the correspondence to the base map in Figure 3.

In addition to the archaeological crop marks, large bands appear in the fields. Some of these bands are shown in Figure 1; the time of their appearance coincides with the time of visibility of the archaeological crop marks. From aerial photographs taken in 1970 and earlier, the shapes of some of these large bands have been mapped (see Figure 5).

The position and size of these bands indicate that they might mark earlier courses of the river; in a flat-bottomed valley like this, river meanders are to be expected. The variable bands of soil left behind by the shift in a river cause large geological crop marks; the greener growth of the bands implies that there might be a thicker layer of topsoil over the gravel subsoil.

It is the presence of this gravel which endangers the archaeology in the Thames valley; the gravel is being excavated for industrial use (3). Several gravel pits are located on the northeast side of the map of Figure 3.
Figure 3. A map of the fields and river at the test site.

Figure 4. Archaeological crop marks.

Figure 5. Channel marks of previous river meanders.
The Satellite
Landsat-1 (formerly called the Earth Resources Technology Satellite) was launched in July 1972; a second satellite, Landsat-2, was launched in January 1975 (4). These satellites have sensors which scan the earth and generate pictures line-by-line, much like the raster on a TV screen. From an altitude of 914 km, the width of the strip which is photographed is 185 km (100 nautical miles). The orbit of the satellite is synchronized with the rotation of the earth so that the photos are taken at about 9:30 AM local time.

The primary "camera" is called the Multispectral Scanner. It makes four images of each scene in the visible and infrared spectrum. The red image, Band 5 (600 to 700 nm), and the infrared image, Band 7 (800 to 1100 nm), were the most useful for this project. The green image, Band 4, and Band 6, between Bands 5 and 7, were of lesser value.

On command, pictures are telemetered to earth as a stream of numbers; almost eight million numbers are required to generate each completed photo. The area covered in these photos is illustrated in Figure 2, which outlines two photos used in this project. The image is a parallelogram because of the oblique path of the satellite relative to the earth.

Each satellite can photograph an area once every 18 days. The Thames River at Dorchester is visible in either of two photos taken on consecutive days during each 18-day cycle.

The photographic resolution of the satellite is good enough to allow objects larger than about 100 m to be detected. Smaller objects, if they have very high contrast or are long, can also be seen.

Photographic Interpretation
A list of the 19 satellite photos which show the Dorchester area is given in Figure 6. Of the photos taken in 1975, only the one taken on July 29 and the companion photo on July 30 have a small amount of cloud cover. In fact, these are the only clear photos of the test site which have been taken in the summer.

The EROS Data Center furnished these two photos as 9.5 inch positive transparencies. One set of these was enlarged by a factor of about 15.5 and negatives were made of the area of the test site around Dorchester.

Contact (positive) prints of the red and infrared images are shown in Figure 7. The scale of these photos is about 1:64,300; if the entire satellite photos were enlarged to the same scale, they would be 2.9 m wide. The ground area shown in these photos is 6.8 km by 5.2 km, somewhat larger than the area shown in the map of Figure 3. Band 6 was quite similar to Band 7, but had a lower contrast. Band 4 was very low contrast because of thin haze and atmospheric scattering.

Photographic subtraction of the Band 7 image from the Band 5 image was of no help in interpreting these photos. Instead, it was found that a color composite constructed with diazo film was excellent for comparing Bands 5 and 7. (5). A qualitative map of the ratio of red to infrared brightness as determined from the false color image is given in Figure 8. The key to the symbols shown in that figure is listed in Figure 9, along with the estimated cause for each spectral ratio.
Figure 6. Landsat photos of the Dorchester area.
This map and the original photos show no trace of the crop marks due to the river meanders. During 1975, the archaeological crop marks, and the associated geological ones, had their highest visibility during the first week in July and had disappeared by mid-July. On July 29 when the satellite photo was taken, most of the crops were golden or were harvested.

The July 29 photo does show that one field within the bend of the river was still quite green then. This photo also shows that the ponds of water which indicate gravel pits cover a larger area than is shown on the base map of Figure 3.

Two satellite photographs taken in 1973 were also examined to see if there was any trace of the geological crop marks on them. However, it was found that the Band 5 image, by far the most useful for this task, was obscured on both dates. On March 8, a heavy haze was responsible. One June 7, thin cloud cover, at an altitude of about 9 km, seriously reduced visibility in Band 5. However, on both dates there was fair visibility of the ground in Band 7 (6). These satellite photos are shown in Figures 10 and 11; the scale is the same as those in Figure 7.

The resolution of these three photos is indicated by the field boundaries which are visible in them (see Figure 12). The crops growing in 1970 in some of these fields are mapped in Figure 13. The broken lines in the figure indicate boundaries which are not shown in Figure 3. Since some of the detectable fields are smaller than the size of the geological crop marks, it is surmised that these geological marks will be visible on photos taken at the right time.

The cloud cover probability for southern England in summer is about 60%. Therefore, it is poor luck that no photos are available from the June 24 or July 12 overflights of Landsat-2, or from the six other times during the period from April through August for which pictures would have been valuable.
Figure 7. Landsat-2 photograph; red (Band 5) and infrared (Band 7) images are at a scale of 1:64,300.
Figure 8. Red and infrared brightness of the photos in Figure 7.

<table>
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<tr>
<th>SYMBOL</th>
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<th>POSSIBLE CAUSE</th>
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<td>water</td>
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<tr>
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<td>r I</td>
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<td>Ri</td>
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<tr>
<td>R&gt; I</td>
<td>both high, but red brighter</td>
<td>matured field crops</td>
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Figure 9. Interpretation key for Figure 8.
Figure 10. Landsat-1 photograph; scale 1:64,300.
Figure 11. Landsat-1 photograph; scale 1:64,300.
Figure 12. Field boundaries detected on Landsat photographs.

Figure 13. Farm crops in 1970.
Future Work

It is hoped to be able to continue this experiment in the 1976 growing season. If a photo taken at about the right time becomes available, it might be important to get the highest possible resolution from it. As a start, photographic combination of the two pictures taken on consecutive days may decrease the loss of resolution due to film grain and the raster pattern (stereoscopic parallax should be no problem). Also, it might be possible to make a digital contour map of the brightness ratio of Bands 5 and 7; since only about 1000 pixels are necessary, the processing of the Computer Compatible Tapes might not be too difficult.

It might also be possible to examine other areas along the Thames River if a greater selection of June and July photos becomes available. If an anomalous pattern within a known field becomes visible during the growing season, it might indicate the partial maturity of that field's crop; this would mark the best time for aerial photography.

Hopefully, it will also be possible to investigate other river valleys which have a known appearance of archaeological crop marks; the Mississippi-Missouri would be the prime example.

Conclusion

Since the 18-day periodicity of Landsat imagery has a unique capability of aiding archaeological reconnaissance, it is hoped that cloud and haze cover are more favorable in the future. The 9.5 inch positive transparencies of the red and infrared images have been excellent for detecting patterns in the growth of crops.

Acknowledgment

This project was made possible with the help of the National Aeronautics and Space Administration, both for getting the satellite photos taken and in furnishing them for this investigation. A grant from the National Science Foundation, SOC-75-04203, funded the interpretation of these photos and the publication of this report.

References

Small window of opportunity in the Upper Thames Valley 2020

Robert Bewley

The Endangered Archaeology in the Middle East project (EAMENA - https://eamena.arch.ox.ac.uk/) has recently curtailed many of my aerial reconnaissance activities, as well as flying as a pilot. Then, in 2020, despite some great spring weather, the dreaded COVID-19 grounded general aviation until July 2020. Being stuck at home and in semi-retirement, with the summer (July) conditions looking good, I thought I would see if there were any suitable aircraft available at the local Cotswold Airport (also known as Kemble).

I could not believe there would not be cropmarks; yes, we had had the wettest February on record but the famously free-draining soils of the Upper Thames valley would surely not disappoint? So, in the not-so-suitable Citabria aircraft (Figure 1), on July 12th we set out to reconnoitre the local area – and was pleased, and surprised by what was visible; just to the south-west of the village of Ashton Keynes, one of the first villages along the Thames, there were cropmarks showing better than I had ever seen them (Figures 2 and 3); there was a reason for selecting this area to explore, as it is next on the list for gravel extraction. The photographs have been sent to the County Archaeologist for Wiltshire.

This area is within the euphemistically called “Cotswold Water Park”, stretching from Oaksey (in the west) to Lechlade (in the east) there are over 170 “lakes” – gravel pits – and the largest stretch of non-natural freshwater in Europe, covering over 40 square miles. Archaeological sites, on river gravels and their destruction has been the subject of many books (RCHME 1960), articles and excavation reports; for the Upper Thames valley worth looking at Benson

Figure 1. The configuration of the Citabria, not perfect but with the door off it worked well. © R Bewley

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Figure 2. Cropmarks of a field system and perhaps an Iron Age round house, near Ashton Keynes, Wiltshire. © R Bewley

Figure 3. Ground view of the cropmarks near Ashton Keynes, Wiltshire. © R Bewley
Figure 4 (left). Cropmarks in the Thames valley, east of Kempsford (Manor Ham Barn).
© R Bewley

Figure 5 (below). Asthall, Oxfordshire near Burford: Roman camp and possible Iron Age enclosure. © R Bewley
and Miles (1974) for starters. The Thames Valley was also one of the pilot projects for what was called the National Mapping Programme (https://research.historicengland.org.uk/Report.aspx?i=15670); it was chosen because of the importance of the archaeological landscapes that were under the greatest threat from gravel extraction, agriculture and the expansion of towns and villages (see Hind et al. 2019, available as an online resource, and Morigi et al. 2011). (See also https://historicengland.org.uk/research/methods/airborne-remote-sensing/aerial-investigation/).

To prove that the Thames gravels still have some stunning palimpsests of cropmark features, the fields in Figure 4 were showing as well as I have seen them, revealing remnants of ridge and furrow, possible iron age enclosures and Bronze age ring ditches (Figure 4).

For the second flight, having spotted a few high-wing microlights at the Kemble Flying Club, I explored a trial flight in a smaller high-wing microlight (never having flown a microlight). My destination this time was along Akeman Street (a Roman Road linking Cirencester (Corinium) with St Albans (Verulamium). I had spotted the cropmark outline of the Roman camp on my way back from Oxford (on my motorbike – as you are able to see much more from a motorbike than a car). Figure 5 shows this site (Asthall) which was originally discovered by Roger Featherstone in the 1994, and whenever I pass it (on the road or by air) I check to see if it is showing; this is the first time I had seen it since Roger had showed it to me in 1994 (Featherstone 1994. p.814, Figure 2. and Welfare and Swan 1995). For other sites along Akeman Street, see also Featherstone et al. 1999: Plate 3.

As those with microlight experience will tell you – it can be a slow, bumpy ride; so different to flying in the steadier and sturdier Cessnas but it means you have longer to “look” and the aircraft is more manoeuvrable around the target; as with the Citabria the microlight (a Skyranger Swift, Figure 6) had struts – making a clear shot harder to get, but both suitable as reconnaissance aircraft. The pilot of the microlight was very interested in what I was doing, and not only was he a photographer, he had also spotted some cropmarks near Malmesbury. By the time we had photographed the Roman Camp at Asthall and orbited many other cropmarks, earthworks and Cotswold houses, but with the head wind we did not have time to recce his cropmarks, that evening.

This then provided the excuse for a third flight on July 30th. This was a proper instructional flight, so I had to be pilot (first) and archaeologist/photographer (second), and our direction of travel was towards Malmesbury. There was a slight southerly cross-wind at Kemble (a common occurrence as there is only one very long east-west runway) making the first-time take off in a microlight tricky but we survived it, and it took me a few minutes to get the feel of the flying characteristics; we practised turning, climbing and descending on the way to Malmesbury. The cropmark sites duly appeared (Figure 7), well-known ones along the Fosse Way (another Roman Road – from Exeter to Lincoln, and a brilliant navigation aid for returning to Kemble as it does a dog-leg at the airfield en route to Cirencester. On returning the cross-wind made the final approach and landing a challenge, but a good test of my skills (and the instructor’s nerves).

So, in summary – three flights totalling 3 hours and 20 minutes, 77 targets were recorded (some not strictly archaeological), 438 photographs taken, covering c 200 square miles. However this was a demonstration of the lost opportunity – surely – that was the summer of 2020. I know the Historic England team were doing what they could to fly – often remotely –
Figure 6. Microlight Skyranger Swift, as the registration suggests – built by female students to encourage interest in science and engineering. © R Bewley

Figure 7. Cropmarks alongside the Fosse Way, near Malmesbury, Wiltshire. © R Bewley
but it would be good to know if others experienced that huge sense of lockdown frustration – with bright cloud-free days in May, June and July but very restricted access to the air. Drone pilots may have fared better?

Finally – to continue the impact of COVID theme, and the news that British Airways had grounded their entire fleet of Jumbos (Boeing 747s); their final resting place is Kemble; that long runway being long enough to land a Jumbo on. Here they will be slowly taken apart, recycled bit by bit or re-used as party venues or film studios (Figure 8).

Figure 8. The final resting place of British Airways Boeing 747s – Kemble Airfield. © R Bewley

References:


Aerial research in Nord Isère
(France - Rhône Alpes region) Panossas "les buissières"

Alain Bliez¹

Introduction
Aerial archaeology dates back to the earliest days of aviation. The inventor of aerial archeology is considered to be Antoine Poidebard (1878 - 1955), alternately a missionary, ethnologist, aviator officer and archaeologist. Antoine Poidebard carried out an aerial reconnaissance mission over Syria in May 1925 aboard a Breguet XIV plane piloted by an officer of the 39th aviation regiment of the French army and during this flight, he was able to appreciate and understand the contributions of the aerial view of a territory to discover very clearly traces and other remains. The idea of using observation and aerial photography for archaeological research came naturally to him. The great adventure of archaeology was born!

For years all over the world, the use of light aircraft has been essential in developing aerial archaeology. In France, several big names in this activity have made many discoveries: MM. Roger Agache in the North of France, Jacques Dassié in the Center Ouest region, or René Goguey in Burgundy etc ...

Today aerial prospecting can also be supplemented by studying photographs taken by satellites, and a new tool has been appearing recently with drones. Each method of prospecting complementing each other.

In France, there are several pilots who carry out aerial prospecting. Theoretically, they must have an annual prospecting authorization issued by a regional directorate of the Archaeological Service (Ministry of Culture) and provide an annual report of their activities. Their findings being the subject of a site declaration. In theory, therefore, archaeologists who carry out excavations in a specific area can consult these reports and have valuable information for their work.

As aerial prospecting is a special and rare activity, the researchers are isolated and work locally and I think it would be useful to have a national entity so that we all come together to exchange our findings annually.

Panossas "les buissières"
The commune of Panossas is located in the north of the department of Isere and about 30 kilometers east

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Figure 1. Map of part of France showing the location of the commune of Panossas.
of the city of Lyon and equidistant to the east of the city of Vienne (Figure 1).

In the 1960s, various notices published in local bulletins mentioned the presence of Gallo-Roman tiles in plowed fields at a place called "les Buissières" in the town of Panossas (Chauffin - 1960), supplemented by a pedestrian survey carried out in 1969 by Mr Yves Burnand (Nancy University).

In the 2000s, this information caught my attention and I made several overflights with a Rallye 110-ST flying at an average altitude of 1,500 feet above the ground. The photographic equipment of the 2000s was far from having the technical performance of today's cameras, but I was able to take several series of usable shots. No structure appeared in the photos despite repeated overflights of this sector of North Isère throughout the year.

On May 31, 2004, during an overflight carried out in conditions of strong southerly wind and turbulence, after a period of drought of several days, several very clear traces of buildings could be photographed as well as other traces clearly visible at about 200 meters from these buildings (Figure 2).

![Figure 2. Oblique aerial photograph showing the double warehouse and some adjacent structures. Photograph by author, 31 May 2004.](image)

I was able to photograph a complete set of several buildings whose walls seemed superimposed suggesting several periods of occupation, including a large rectangular construction measuring at least 50 meters in length that I interpreted as wine cellars or
warehouses. Other photographs have highlighted linear ditch-like hollows, as well as a very clear apse on the edge of a grove to the west (Figure 3).

Figure 3. Oblique aerial photograph showing, centre frame, the apse next to the grove. Photograph by author, 3 July 2004.

Despite the turbulence, the photographs were usable, because at the time there was not yet the technical means of image stabilization. In the following days, I carried out several more overflights but no traces that had been seen on May 31 reappeared. It just goes to show that aerial archeology requires perseverance.
The photographs were immediately sent to the Regional Archaeological Service, but it was not until 2012 that the first archaeological excavation operations were carried out by MM. Matthieu Poux and Aldo Borlenghi (Université Lyon 2) and an excavation program spread out between 2012 and 2016 was set up.

The excavations brought to light several storage buildings including a rectangular building measuring 52 meters by 18 meters. This building is made up of three distinct parts: its central space, covering an area of nearly 500 m² outside the work, is framed by two lateral bastions with a square plan of approximately 211 m² each. Their interior space is subdivided into six bays by five parallel low walls, 40 cm wide and spaced 1 m to 1.50 m apart. They are delimited by massive walls 90 cm thick (three feet), interrupted by 50 cm wide openings along the west and south facades. These characteristics identify the building as a double warehouse of the horreum or granarium type, with suspended floors ventilated as an underpinning (tabulata) in order to protect the stored foodstuffs from soil moisture and pests so that should be your answer (Figure 4).

At the same time, excavations have brought to light another prime sector in the grove where the apse had been spotted during overflights.

The eastern part of the site, protected by a grove that has preserved the masonry on 2 to 4 m in height, is occupied by a vast thermal complex which extends over more than 900 m², with several cold or hot rooms (aula thermarum, frigidarium, caldarium, tepidarium, sudatio, large latrines) entirely decorated in marble. The dimensions and monumentality of this complex
have no equivalent in the corpus of private villae baths identified to date in the surroundings of Lugdunum and Vienne, or even on the larger scale of the Gaule Narbonnaise (Figure 5).

This Panossas complex has not yet revealed all its secrets and it will certainly take further excavation campaigns to gain an interpretation of this vast ensemble (Figure 6).

The discovery of this site of great importance in France is mainly due to the contribution of aerial photographs taken as part of repeated aerial prospecting in this geographical sector of the Rhône-Alpes region. Obviously, other vestigies or traces appeared in the North of the department of Isère during these overflights: ancient circles, traces of enclosures ... and even today the aerial prospecting continues with sometimes luck to discover other traces hitherto unknown.

Technology has evolved since the early 2000s, notably with the advent of drones and their high-resolution photographic sensors. Light aircraft or ultralight overflights are always preferred to cover a large geographical area, but the use of drones makes it possible to target searches on a smaller sector with lower overflight heights and especially by hovering, impossible in plane.

Reference
Figure 6. Plan showing excavated features (black) and those interpreted from aerial photographs (grey).
To fly or not to fly - that is the question?

Moira Greig¹

Prior to 2001 the majority of ‘Flying Archaeologists’ in Britain flew under special exemptions, which meant flying was relatively cheap. If you were lucky, like me, to have a Flying School nearby, with lots of pilots with Commercial Licences needing to keep their hours up while they waited for jobs, it also meant you could generally get up at short notice if the weather suited.

Suddenly in 2001 this all came to an end, when the Civil Aviation Authority in Britain decided that our aerial photography flights should be termed ‘Commercial flights’, although the majority of us took the photos for our own work, not for selling on. Many of you will remember this, or, maybe I should say, at least some of you will. They stopped our Special Exemptions. This meant that in future we would have to fly with Commercial Companies with Commercial Licences, unless you were an archaeologist with your own plane. Disaster, we were grounded!

At that time there was no company in Scotland with a suitable small plane, like a Cessna 152 or 172. I tried my Flying Club to see if they were going to apply for a Commercial Licence but they said there was too much paperwork and higher costs, so- no.

A year later we finally heard there was one company near Edinburgh who had a suitable plane. Big problem for me is that I couldn’t phone and book a flight at short notice if the weather was looking good. Bigger problem for me - RCAHMS was on the doorstep and they nearly always had first chance! So what to do, as I wanted to keep flying if possible? I did eventually manage to persuade a certain Mr Cowley to fly the plane to Dundee, after he had finished a reconnaissance summer flight, and stop off there and give me a chance to pick it up. At handover I was told it was a poor flight with very few & poor marks showing, so that wasn’t promising for me. However, as I approached the Montrose basin area, low and behold marks suddenly started to appear. The pilot did say that a certain gentleman would be mad that he hadn’t flown further north! Got a Roman camp showing too!

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However, things couldn’t go on trying to get a flight when I needed it and not being able to, so I had to think of something else. No other companies had small planes, so think again. How about a helicopter? I had heard mixed thoughts on using one for aerial photography but decided to enquire. Almost on my doorstep to the west of Aberdeen was a company with a number of different types of Robson helicopters. Prices were more expensive than what we had paid before with Exemptions, and varied greatly, so naturally I decided on the cheapest to start with, a Robson R22.

To my mind it was basically a ‘flying bubble’. Door was taken off at the start to give me a clear view, but there was no place to stow bags, so everything had to be hung round my neck. Not easy, but I quite liked the view and being able to stop & hover over a site, which was a new experience. Problem was it didn’t have the range I needed, so I decided to step up to the next Robson, an R44. More room, but more expensive and again you couldn’t open the door to get clear shots, so off with the door again before flights. Good platform though.
Summer was great and I did manage a reasonable number of flights, which kept our programme going nicely. Then winter came and I booked my first snow flight. OK to start with, though a bit chilly, but the pilot turned up the heating as we moved towards the mountains. Had taken some shots nearer the coast so had not really thought about it being a ‘wee’ bit colder the further into the hills we flew. As we approached my target the camera batteries froze up, so we had to abort the flight!

Rethink again. SO, what was available that I could fly in without having to take doors off? Answer - a Robson R66! More expensive again but I could open & close the door – great!

SO this was what I ended up using - but naturally fewer flights because of costs, but for me worth it to be able to keep flying till I retired. I was one of, if not the last Regional Flier in Scotland.
Over Danube meadow with a UAV
Ovidiu Frujină¹, Cornelis Stal² and Catalin Lazar³

Abstract
The development of unmanned aerial vehicles (UAV) and close-range photogrammetry facilitates the fast and accurate micro-topographical mapping and analysis of archaeological sites.

Considering these aspects, archaeologists increasingly implement the use of UAVs for mapping known archaeological sites and of course for discovering new areas of interest. These techniques have been used to collect new data for various Eneolithic sites, located in the flood plain of the Danube. These data are used to formulate new theories about the archaeological landscape of these communities.

Introduction
In recent decades, the rapid development and availability of advanced data acquisition and processing techniques in various academic fields has been a driving force in archaeological research. By using these new techniques in applied archeological research, new sites or areas of archaeological interest may be identified (Trampier, 2014, 67).

The development of unmanned aerial vehicles (UAV) and close-range photogrammetry facilitates the micro-topographical analysis of archaeological sites. With the use of compact global and inertial navigation systems (GNSS, INS) that are incorporated in those platforms, in combination with flight planning software, the speed and accuracy at which areas with a high archaeological interest are mapped, has significantly increased (Eisenbeiss & Sauerbier, 2011; Field, Waite, & Wandsnider, 2017).

Study area and archaeological background
For this research project, an accurate documentation of the current state of the archaeological sites and their conservation status has been generated using UAV-based photogrammetry.

In the summer of 2018 and 2019, various sites in the Danube meadow (Romania) were visited, aiming at the systematic documentation of archaeological sites in those regions. During these field visits, an UAV was used, resulting in a large collection of new data. The larger study area is situated between the towns of Oltenița and Călărași (Fig. 1). The target sites are (from west to east): Gumelnița, Ulmeni, Spanțov, Chiselet, Vărăști, and Cunești. All these sites are tell-settlements that belong to Kodjadermen-Gumelnița-Karanovo VI culture (c. 4600-3900 cal. BC). Most of these sites have been archaeologically investigated in the past (Dumitrescu et al, 1933; Morintz et al, 1968; Comșa, 1973; Ștefan, 2011). The site of Gumelnița is still under intensive investigation (Lazăr et al. 2017).

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Preparatory data and data acquisition:

The sites were documented using a Phantom 4 DJI (Table 1). This UAV is a middle category platform with the rotary wing system (vertical take-off and landing). In order to provide a good flight accuracy and a high flight safety, the Phantom 4 DJI is equipped with an integrated GNSS that provides absolute coordinates. This GNSS also allows the geotagging of collected images. Although the relative accuracy of the processed models is directly correlated with the resolution of the acquired images, it is important to mention that the absolute accuracy provided by the UAV-based GNSS is limited to 5 m. Hence, for the correct acquisition of airborne data, aiming at an absolute accuracy of 1 to 5 cm, the use of additional ground control points (GCP) is required (Cowley et al., 2013, 119). At the site of Cuneşti, a series of GCPs was acquired using a total station.

<table>
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Table 1: Properties of the Phantom 4 DJI and integrated camera. Source: www.dji.com

Considering the properties of the UAV instrument in Table 1, corroborated with the requirement to obtain an orthophoto with a ground sampling distance (GSD) of at least 2.5 cm/pixel, a maximum flying altitude was established at 30 m above ground level (AGL) with the flight being in a systematic manner with a single exception made at the Gumelnita site.
where the flight was made from 200 m AGL resulting in a GSD of 8.7 cm (Fig. 2). To achieve an overlap of 80% from a given GSD, it is necessary to perform a certain number of parallel flight lines. These lines are automatically calculated using flight controlling software, like DJI Pilot, for a given area to be covered (Fig. 2). In order to reduce the effect of motion blur, it was decided to limit the platform velocity to 5 m/s at maximum. The velocity is obviously reduced as the flying altitude reduces.

![Figure 2: The first grid for the survey of Gumelniţa site with flight lines made in GSP (source: DJI Ground Station Pro)](image)

Given the maximum operational time of 28 minutes, including take-off and landing, the area that can be covered is mainly limited by the available batteries. Especially when the complexity of the site does not allow automated operation, and the UAV has to be operated manually, the operability of the platform is limited in time. For example, at the site of Gumelniţa, were we flew automatically, (Fig. 2) 22 strip lines were flown at an altitude of 200 m. In order to obtain required photos, 4 sets of batteries were used.

**Data processing**

In order to obtain useful information from airborne imagery, thorough data management and data processing are required. This involves the development of a sustainable data management systems and methodologies, as well as the implementation of a photogrammetric processing. The latter will result in a series of deliverables, like DEMs, orthophotos, 3D models and point clouds, which can be used as a starting point for further archaeological desktop studies and of course for further excavations.

For this project, image processing took place using the Agisoft Metashape. This is a commercial software based on structure from motion and multi-view stereo photogrammetry (SfM-MVS). Prior to processing photos and generating the desired deliverables, a thorough evaluation of the images is required. This process is initially done manually, followed by an automated analysis of the image quality using contrast-based parameters. Once the image
evaluation is complete, the images are processed in accordance with the following steps. At first, the image alignment takes place. Image alignment is the step in which the software identifies feature points in each image and matches these feature points with corresponding points in other images. These matching points allow the reconstruction of the image scene geometry, also called the bundle block adjustment. Building a dense point cloud and a mesh are the following steps in the process. Then, the images are draped onto the 3D model, resulting in textured mesh (i.e. photorealistic virtual 3D reconstructions). The last two steps consist of the construction of the DEM and the orthophoto. These calculations are based on either the point cloud or the previously generated node mesh.

Because models are georeferenced in a common coordinate reference system, in our case EPSG:31700 (Romanian national grid) or EPSG:4326 (WGS84), it is possible to continue data processing using geographic information systems (GIS). When these data are supplemented with additional thematic (spatial) data, the results play an essential role for spatial analysis of sites and landscapes. Based on the orthophoto and DEMs, new deliverables are generated, such as contour maps, sky view factor (SFV) maps or hillshade maps.

**Limitations of mid-range UAVs**

As mentioned above, the use of UAVs for the acquisition of airborne imagery of archaeological sites has various advantages, such as relatively easy platform accessibility, flexibility of data acquisition and direct data processing. However, these platforms are limited by their operational range. For example, the Phantom 4 DJI has a 28-minute flight time including take-off and landing. With a maximum horizontal speed of 5 m/h, each flight should be divided into strips with a maximum length of 1 km, assuming optimum environmental conditions (e.g. no wind at operational altitude). Optimization of these parameters is possible when using flight control software and autopilot functionality.

During the site visits, the conditions did not always allow an ideal implementation of UAV-based photogrammetry. The reason for these limitations is different from site to site:

1. **Coverage of (dense) vegetation in late spring and summer:** it is noted that photogrammetry does not allow documentation of the surface when this surface is covered with vegetation. The result of this limitation is the partial or full absence of topographic heights. This is clearly visible in the orthophoto and DEM from the Ulmeni site (Fig.4), in which several small bushes and large trees are present. These features result in a very irregular (and erroneous) surface. This disadvantage is inherent to photogrammetry, and can be eliminated using LIDAR, which allow canopy penetration of the signal. Also, the utilization of thermal cameras is useful, since it allows the better identify of crop marks in high vegetation;

2. **Building modern construction over the site** (Fig. 3);
Conclusion

Research of the current landscape is a way to increase our understanding of prehistoric societies and their lifestyle in terms of land-use ways. Furthermore, the virtual reconstruction of the past landscape could be a solid tool for further investigations, and it is achieved only through various interdisciplinary methods such as aerial photography. Orthophoto and DEMs are deliverables that can be used at large-scale for prospecting and analysis of archaeological sites or entire landscapes. Using this kind of data and the corroboration of them with the data collected by other non-intrusive research methods (such as magnetometry or GPR) gives us a possibility to find new areas of archaeological interest. For detailed terrain observation and the interpretation of these data, GIS provides spatial analysis tools and topographic enhancement techniques, such as hillshade or SVF.

The current anthropic impact on the environment and the recording of spatial data can be the beginning of some steps for the creation of a database that allows the exploitation of field data. The complexity of the situations as well as the limits we have hit highlights the need to apply several types of technologies (e.g. LIDAR) to ultimately achieve a higher yield in spatial data collection.

Acknowledgements

We want to thank the AARG 2019 Committee for the scholarship granted to Mr Ovidiu Frujina for participating in the conference in Constanta from September 2019.

The field works were supported by a grant of the Romanian Ministry of Research and Innovation: contract no. 15PFE/2018.
References:


Traces of 17th/18th century fortifications in the terrain

Roland Linck¹

Introduction
A huge advantage of drone photogrammetry is the high resolution of the resulting digital elevation model (DEM). Hence, the method is very successful in mapping height differences caused by former fortification systems that are still slightly visible in the modern terrain. One example of a palisade-ditch system in Southern Bavaria near the village Farchant (Lkr. Garmisch-Partenkirchen) will be shown here. The data was acquired by a DJI Inspire 2 drone with a high-resolution Zenmuse X4S camera (Fig. 1). Due to the terrain and several trees, a flight height of 70 m was chosen that resulted in a resolution of 3 cm for the DEM.

Especially in the 17th and 18th century, the small “Werdenfelser Land” that belonged to the prince-bishopric Freising acted as a theatre of war because it was in-between the powerful Habsburger and Wittelsbacher territories (Brandner, 1993; Spichtinger, 2003). In this time, the region north of Farchant that is relevant for this study mainly consisted of marsh that was only cut by the Loisach River and a small road leading to the dukedom of Bavaria. Hence, normally it did not need any further defence systems, as only the road had to be defended. Nevertheless, during two of the big wars in this time, a huge fortification system was built.

The so-called “Schwedenschanze”
The first entrenchment was erected during the Thirty Years’ War in 1646-1648 to protect the Werdenfelser Land from the Swedish troops approaching from the north. As the war ended in 1648 before the Swedes attacked the region, actually it was useless and was abandoned shortly afterwards (Brandner, 1993; Spichtinger, 2003).

Nowadays, this entrenchment is only slightly visible in the marshlands. Nevertheless, it is possible to trace it in the drone DEM over a length of 400 m (Fig. 2 & 5). Especially in the eastern part near the conjunction with the newer “Neue Schanz” (see below), the “Schwedenschanze” is nearly completely levelled. Towards the western end, a triangular

¹ Bavarian State Department of Monuments and Sites, Archaeological Prospection & Aerial Archaeology, Hofgraben 4, 80539 Munich (Germany), roland.linck@blfd.bayern.de
bastion can be detected that is pointing northward against the approaching Swedish troops. Partly visible is another triangular bastion ca. 180 m further in the southeast.

The so-called “Neue Schanz”
The “Neue Schanz” depicts a second entrenchment that was constructed 1702/03 during the War of the Spanish Succession by the dukedom of Bavaria to protect from the Austrian army and is located south of the “Schwedenschanze”. Therefore, in contrary to the “Schwedenschanze”, this construction faces south south. This time, the entrenchment really was in use, as there was a battle on 27th August 1703, when more than 11,000 Austrians totally overran the 900 Bavarian soldiers defending the “Neue Schanz”. It consisted of a palisade wall, a ditch that automatically filled with water via two cuttings to the rivers Loisach and Röhrlbach and 8 triangular and trapezoidal bastions towards the south. The “Neue Schanz” ran through the whole Loisach valley from the mountain Fricken in the east to the mountain Heuberg in the west (Brandner, 1993; Spichtinger, 2003).

The “Neue Schanz” is cut in two parts by the river Loisach. The western part running nearly east to west can be traced by the drone DEM over a length of 520 m. It still shows three bastions; two of them in trapezoidal shape and one triangular shaped (Fig. 3a & 5). Another one near to the modern railway route could not be covered by the drone flight due to legal reasons. The western trapezoidal bastion is very well preserved and has a size of 16x9 m. The second trapezoidal one has a similar size, but is more destroyed. A height profile through the trapezoidal bastion based on the drone DEM shows that the wall still has a height of 1.2 m and the ditch a depth of 1 m. Hence, a total height difference in the terrain of 2.2 m gives an indication of the former extent of the entrenchment (Fig. 3b). The visible triangular bastion measures 17x10 m. The small earthen bridges over the ditch in-between the bastions are modern and used by the farmers to access their hayfields south of the entrenchment. The interpretation in Fig. 5 also shows that the whole defence system is not completely straight,
but has some small bends, perhaps due to the construction from different segments dug out at the same time.

Fig. 3: (a) Digital elevation model of the western part of the “Neue Schanz” showing clearly the wall-ditch-system and two bastions, a trapezoidal and a triangular one. (b) Profile through the trapezoidal bastion from north to south illustrating the good state of preservation in this part. Resolution of DEM: 3cm.

The eastern part on the other side of the Loisach is still visible over a length of 500 m between the river in the west and a modern golf course in the east. Near the Loisach, the entrenchment again runs in east-west direction. Here, the “Neue Schanz” is nearly completely destroyed and only the wall is slightly visible in the terrain. One trapezoidal bastion in this part cannot be detected in the DEM, as it is covered by modern vegetation. This is the only disadvantage of photogrammetry compared with Airborne-Laserscanning, as the method cannot look under vegetation. After the first 330m, the “Neue
Fig. 4: (a) Part of the orthophoto in the area of the triangular bastion in the modern golf course. (b) Digital elevation model. (c) Profile through the triangular bastion from northeast to southwest illustrating the preserved height difference of 2.3 m. Resolution of DEM: 3cm.

Fig. 5: Interpretation map of the entrenchment system near Farchant showing both construction phases. Legend: green = “Schwedenschanze”, red = wall of “Neue Schanz”, orange = ditch of “Neue Schanz”. Dashed line marks the parts of the entrenchment that is nearly completely levelled today.
Schanz” bends towards southeast and is very well preserved here. In the area of the golf course, another triangular bastion of 19x10 m size can be identified in the orthophoto and the DEM (Fig. 4a&b & 5). The good state of preservation is visible in the profile of Fig. 4c that shows a height of the wall of 1 m and a depth of the ditch of 1.3 m. The small elevation east of the profile in Fig. 4c is modern; its actual use could not be determined, as the bastion lies within the golf course that could not be accessed during the drone flight.

Conclusion
This case study of the entrenchments near Farchant shows the high potential of drone photogrammetry in mapping structures preserved as terrain differences. Due to the much lower flight altitude that is possible with drones, the corresponding photogrammetry result has a much higher resolution than most of the standard products of Airborne-Laserscanning acquired with normal airplanes. So even small and faint height differences can be resolved, as long as they are not blurred by modern vegetation. Another advantage of photogrammetry is that beside the DEM also a high-resolution orthophoto can be acquired in the same flight, so both information is available for the analysis of the archaeological structures. In total a comprehensive map of the archaeological remains, like the two entrenchment systems in this case study can be drawn.

References

Thermal and Multispectral Monitoring of cropmarks by UAV

Simon Seyfried

On a well-known medieval site near Frankfurt (Germany) several UAV-flights were performed in the summer 2019. The aim was to capture multispectral (RGB, near infrared (NIR) and longwave infrared (LWIR)) data to monitor and understand the development of cropmarks. Nowadays, the area is utilized as an agricultural crop land – in 2019 for wheat. The survey flights of the drone took place on four different dates in June and July between midday and 5 pm. At this time, the crop was ripening and changed colour from green to yellow. During the crucial vegetation phase in 2019, the weather conditions were drier and hotter than previous years.

To carry out these flights a self constructed hexacopter was used (Tarot 680 pro), equipped with an old, but solid GNSS-supported APM 2.5 flight controller, offering auto waypoint missions etc. Three different sensors were attached to the drone: 1. a simple RGB camera (Canon S100); 2. an NDVI-camera (Mapir Survey 2, sensitive for RED and NIR); 3. a self-assembled thermal camera (using FLIR Lepton 2.5 LWIR sensor, designed by Max Ritter, "DIY-Therocam"). The entire system cost less than 1,300€ in total.

The Flights were performed over a deserted medieval village with the remains of a church, it’s yard, a road network and traces of houses. Additionally, there are remains of post holes, pits and ditches, partly of prehistoric origin. In this article, I’m focusing on the church and the surrounding area. The images displayed here are not manipulated in any way, e.g. histogram stretching, for the purpose of comparison.

Fig. 1: Resistivity measurement of the church area, showing foundations of the church, it’s yard and a part of the road network. (M. Gottwald et al. 2017).

Fig. 2: Thermal image from June 19th 2019.

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1 seyfried.simon@gmail.com
Only the thermal and RGB images of July 8th and July 17th are depicted differently due to the changed camera settings.

<table>
<thead>
<tr>
<th></th>
<th>RGB</th>
<th>NIR</th>
<th>LWIR</th>
</tr>
</thead>
<tbody>
<tr>
<td>June 19th</td>
<td><img src="June_19th_RGB.png" alt="Image" /></td>
<td><img src="June_19th_NIR.png" alt="Image" /></td>
<td><img src="June_19th_LWIR.png" alt="Image" /></td>
</tr>
<tr>
<td>June 29th</td>
<td><img src="June_29th_RGB.png" alt="Image" /></td>
<td><img src="June_29th_NIR.png" alt="Image" /></td>
<td><img src="June_29th_LWIR.png" alt="Image" /></td>
</tr>
<tr>
<td>July 8th</td>
<td><img src="July_8th_RGB.png" alt="Image" /></td>
<td><img src="July_8th_NIR.png" alt="Image" /></td>
<td><img src="July_8th_LWIR.png" alt="Image" /></td>
</tr>
<tr>
<td>July 17th</td>
<td><img src="July_17th_RGB.png" alt="Image" /></td>
<td><img src="July_17th_NIR.png" alt="Image" /></td>
<td><img src="July_17th_LWIR.png" alt="Image" /></td>
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</tbody>
</table>

Fig. 3: RGB, NIR and LWIR images of the church area from June 19th to July 17th.
This study is focusing on a simple visual comparison and interpretation, even if a GIS and pixel based analysis would be possible, for instance a comparison of temperature of certain areas.

<table>
<thead>
<tr>
<th>Weather conditions &amp; other parameters</th>
<th>Visual interpretation of RGB images</th>
<th>Visual interpretation of NIR images</th>
<th>Visual interpretation of thermal images</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>June 19th, 11:00 am</strong> &lt;br&gt;radiation: high (sunny) &lt;br&gt;Air Temp. (5 cm)&lt;sup&gt;1, 9&lt;/sup&gt;: 36°C &lt;br&gt;Air Temp. (2 m)&lt;sup&gt;6, 9&lt;/sup&gt;: 30°C &lt;br&gt;wind speed&lt;sup&gt;6&lt;/sup&gt;: 17 km/h</td>
<td>weakly visible negative cropmarks</td>
<td>clear visible negative cropmarks</td>
<td>positive and negative cropmarks of very good visibility</td>
</tr>
<tr>
<td><strong>June 29th, 12:00 pm</strong> &lt;br&gt;radiation: high (sunny) &lt;br&gt;Air Temp. (5 cm)&lt;sup&gt;1, 9&lt;/sup&gt;: 33°C &lt;br&gt;Air Temp. (2 m)&lt;sup&gt;6, 9&lt;/sup&gt;: 27°C &lt;br&gt;wind speed&lt;sup&gt;6&lt;/sup&gt;: 7 km/h</td>
<td>increasing visibility of negative and positive cropmarks</td>
<td>decreasing visibility of negative cropmarks</td>
<td>decreasing visibility</td>
</tr>
<tr>
<td><strong>July 8th, 2:00 pm</strong> &lt;br&gt;radiation: low (cloudy) &lt;br&gt;Air Temp. (5 cm)&lt;sup&gt;7, 9&lt;/sup&gt;: 19°C &lt;br&gt;Air Temp. (2 m)&lt;sup&gt;6, 9&lt;/sup&gt;: 16°C &lt;br&gt;wind speed&lt;sup&gt;6&lt;/sup&gt;: 17 km/h</td>
<td>no positive cropmarks visible any more, visibility of negative cropmarks decreases</td>
<td>less details visible, but no significant change</td>
<td>almost no structures visible</td>
</tr>
<tr>
<td><strong>July 17th, 5:00 pm</strong> &lt;br&gt;radiation: low (cloudy) &lt;br&gt;Air Temp. (5 cm)&lt;sup&gt;7, 9&lt;/sup&gt;: 28°C &lt;br&gt;Air Temp. (2 m)&lt;sup&gt;6, 9&lt;/sup&gt;: 23°C &lt;br&gt;wind speed&lt;sup&gt;6&lt;/sup&gt;: 15 km/h</td>
<td>negative cropmarks visible</td>
<td>almost no changes</td>
<td>only few structures still visible</td>
</tr>
</tbody>
</table>

Table 1: Weather and other parameters for dates of image capture and subjective assessments of features recorded.

On the different dates, the varying conditions of the cropmarks were visible in the differential spectra. The thermal data shows clear structures and provides, compared to RGB and NIR data, more information, despite of high differences in quality of the perceptibility between flights. It looks as if thermal aerial archaeology can provide new options to gather more information. Thermal cropmarks are probably affected by the transpiration of and the accessibility to water by the crops. This results in different surface temperatures depending on cooling by the evaporating water.<sup>10, 11, 12</sup>

For a better understanding of the phenology of thermal cropmarks more frequent monitoring would be necessary. The role of different factors still have to be understood, for example soil humidity, soil temperature, air temperature among other.

As a final note, thermal aerial archaeology can open new possibilities to gather more information. It will enable an additional tool in the tool set of aerial archaeology and archaeological remote sensing.
Notes and references


(4) Hexacopter with RGB and thermal camera. The mapir NDVI-camera was provided by the Environmental Informatics lab of Geography department of University Marburg.

(5) W. Kuther, Die Wüstungen bei Hungen. In: Magistrat der Stadt Hungen (Hrsg.), Das Buch der Stadt Hungen (Gießen 1961) 186-197.

(6) The colour deviation is caused by manual trimming of the raw data. This was necessary due to different internal camera interpolation, colour ramp and icon settings.

(7) Temperature of air 5 cm above ground, provided by Kachelmann GmbH.

(8) Temperature of air 2 m above ground, provided by Kachelmann GmbH.


Cropmarks

Harvested by Rog Palmer

(web links were accessed on various dates between April 2020 and mid-October 2020)

AutoGR-Toolkit
Gianluca Cantoro recently announced the release of a rewritten version of his AutoGR-Toolkit – free software to assist and speed-up the georeferencing of (mostly) aerial and satellite images. It can be downloaded from:


Drone art
Winners of the 2020 Drone Photo Awards (arty aerial stuff, nothing to do with archaeology) can be seen at the link below, as can winners from previous years.

https://droneawards.photo/gallery

Archéologie Aérienne
An English translation of a French introduction to aerial archaeology including pages on history, maps, protection and Roger Agache.

https://archeologie.culture.fr/archeologie-aerienne/en/research-europe

Ofek 16 satellite
Israel’s Ministry of Defence has announced the testing stage of a new satellite that may offer images to anyone working in parts of the world that Israel may photograph. The press release issued on 25 August 2020 includes images of the Syrian WHO site of Tadmor but gives away no useful information regarding image resolution other than: ‘The camera has the best performance and weight characteristics available on the market.’


Thermal cameras
Those of you with a drone and the urge to try thermal cameras may be interested in new lightweight models from TeAx Technology. For example, a resolution of 640x512 pixels weighs 65g and the smaller, 384x288, model is a mere 62g. Tech specs, prices (sit down first) and case studies are at:

https://thermalcapture.com/thermalcapture-x/

Advances in AI extraction from satellite images?
From the blurb: Ecopia Global Feature Extraction (GFX) Powered by European Space Imaging is a unique partnership that utilises the freshest, highest quality satellite imagery along with the most

1 rog.palmer@ntlworld.com
advanced artificial intelligence from Ecopia.AI (Ecopia) to offer accurate geospatial feature extraction at continent-wide scale.

I’ve noted this because in the categories it claims to identify are grass, bare land [whatever that is] and sports fields. It’s intended for work in urban areas but may have something to offer those seeking to use AI for archaeological extraction, perhaps if used in conjunction with the One Soil, below.


**Agricultural OneSoil Map**
This site claims to be the ‘first interactive map with AI detected fields and crops’ and it seems of considerable use to people using aerial images or contemplating buying archive high-resolution images. Starting in 2016 is offers field boundaries, crop types, soil moisture, VI, and more for 59 countries including all of Europe. At present its free content is for 2016-2018 – later years require a form to be completed and may need payment. This seems useful to identify crops and conditions that have produced a range of archaeological information.

https://map.onesoil.ai

(thanks to Iris Kramer)

**Aerial Martians…**
NASA’s latest Mars mission (launched 30 July 2020), which should be on the way by the time this issue is published, includes a <2kg UAV. This autonomous solar-powered machine will have a maximum flight time of 90 seconds and will be equipped with colour and black-and-white cameras. The link below was updated on 17 July 2020 and may be expected to change. It includes links to more detailed pages.

https://www.nasa.gov/feature/jpl/6-things-to-know-about-nasas-ingenuity-mars-helicopter/

…**and Moonmins**
I don’t think this is new news, but NASA, with their usual generosity, have made available ‘aerial’ photographs of that Ranger missions (1964-1965) took as they impacted on to the moon. Accompanying documentation explains each mission and gives details of trajectories, cameras, TV systems, etc. This may be of interest to those who follow the development of all types of aerial imaging systems.

https://www.lpi.usra.edu/resources/ranger/

(thanks to Bruce Bevan)

**Fox Talbot**
Continuing the history of photography, Fox Talbot’s book *The pencil of Nature* (published in instalments between 1844 and 1846) has been copied and released by Project Gutenberg. It includes a ‘Brief Historical Sketch on the Invention of the Art’ and 24 plates with his accompanying comments.

http://www.gutenberg.org/files/33447/33447-h/33447-h.html#toc6
Archaeological Aerial Archive of Romania

From ‘About’: This web site seeks to make the basic reconnaissance data from various aerial surveys [which means, at least initially, only those by Ioana Oltean and Bill Hanson] available to a wider audience with potentially different research interests from those of the authors. Accordingly, it presents a selection of aerial photographs of archaeological sites, whether previously known or newly discovered, and of potential sites. In the first instance these derive from the multi-season programmes of survey in south Dobrogea, north Dobrogea and south-western Transylvania. In due course material from other survey programmes will be added.

The photographic data may be searched by map location or by site name ... [and] it can be interrogated for more specific characteristics such as site type (e.g. fort, tumulus), attributed date (e.g. Iron age, Roman), the nature of the remains (e.g. extant, cropmark), or even a particular RAN number.

http://aerialarchaeologyromania.exeter.ac.uk/

Planet’s SkySat network

Currently this satellite network is of 15 sun synchronous satellites with a further 6 planned for equatorial orbit. Their website mentions 140, but doesn’t say whether this number included exiting satellites. In any case, revisits are frequent – up to 12 times a day with a global average of 7 – more than archaeologists need although they may help to avoid moving clouds and shadows. The important bit for us is that highest image resolution is 72cm, although the second link below announces 50cm, achieved by lowering the orbit height. There remains the problem of convincing archaeological users that this resolution may serve some of their needs.

https://www.planet.com/products/hi-res-monitoring/
https://www.planet.com/pulse/tasking-dashboard-50cm-12x-revisit-announcement/
https://geoawesomeness.com/planet-50cm-imagery-12x-revisit-tasking-dashboard/

An explanation from ESA why you need to use satellite images

A piece titled 30cm satellite imagery as an alternative to aerial data outlines how satellites can be more efficient, avoid restrictions that apply to aircraft, offer multispectral and stereo as part of the package and have an archive dating from 2000.


Searching ALS during lockdown

Chris Smart, University of Exeter, has led a survey by ‘archaeology volunteers’ who have been analysing ALS images of the SW of England to find archaeological remains. The report doesn’t identify the knowledge level of the volunteers or whether they are using basic ALS (such as available from https://houseprices.io/lab/lidar/map) or doing any manipulation to enhance the views, but they seem to be finding new stuff that is not on the HER.

http://www.exeter.ac.uk/news/research/title_796334_en.html
UK Met Office info
As well as moving weather maps, the UK Met Office compile summaries of monthly and 15-day trends of (for example) temperature and rainfall that are put on their twitter account. These may be useful to help decide when and when not to fly for archaeological photography. There is more, and different, information on their web site (and the UK Met Office also has a pilots’ weather site) but the twitter account seems to home in on the visuals and may be easier to understand. I am assured that there is similar information available in Poland (Lidka Żuk, pers. comm.), so presumably also elsewhere where anyone may be flying.
https://twitter.com/metoffice  https://www.metoffice.gov.uk/  
(thanks to Toby Driver)

All sorts of good data, including regional stuff, available on the met office website:
https://www.metoffice.gov.uk/research/climate/maps-and-data

Good opportunity to plot long term weather trends against rates of recovery and potential patterns of diminishing returns in some areas? See graphs/observations in these papers:

- https://www.academia.edu/41851500/Aerial_Photography_and_Reconnaissance_for_Archaeology_in_the_21st_Century_achievements_and_challenges
- https://www.academia.edu/29517514/Creating_the_Cropmark_Archaeological_Record_in_East_Lothian_South-East_Scotland

(thanks to Dave Cowley)

…more exciting, engaging and effective than traditional mapping solutions
Says the slogan at AerialSphere’s website. This is nothing to do with archaeology but gives an interesting twist to what we know as aerial survey and shows where technology can take us.
https://www.aerialsphere.com/
Books and papers of interest?

Rog Palmer

There is so much relevant or vaguely-relevant stuff being churned out now that the following are usually little more than titles, links, and bits of the published abstracts.

Price seems to vary between a promotion of 30.00 zł² (c £7.50) and €45.00³ so it's worth potential buyers browsing the web.

Unseen before publication of this issue – I was sent a copy of the cover by the author and did some web chasing. It will be good to have something up-to-date that may include some of the more recent methods and applications. More info in *AARGnews* 62.

https://doi.org/10.1016/j.jas.2020.105126

*From the abstract:* ... demonstrates the effectiveness of RPA [drone] thermography in archaeological feature detection in an Arctic-tundra setting. Thermal detection of several previously unidentified subsurface features in Foxe Basin suggest that surface feature visibility is lower than previously anticipated, calling attention to potential judgemental biases in pedestrian archaeological surveys in Arctic contexts. Based on the utility of low-altitude thermography for visualizing the internal structures of Tuniit dwellings, this paper proposes that thermography facilitates archaeological spatial analysis beyond feature prospection. RPA thermography is a non-destructive and economic remote-sensing solution to some of the persistent logistic challenges to fieldwork in remote locations that often inhibit large-scale archaeological analyses not only in the Canadian Arctic, but remote Arctic-Alpine regions worldwide.

Deodato Tapete reminded me he is editor of a special issue in *Geosciences: Satellite, Aerial and Ground-Based Remote Sensing for Archaeological and Heritage Research* that includes two papers that were winners of the AARG/Geosciences competition (Kalafatić et al. and Starková below). Other papers in that issue seem more about geophysics and have not been listed here.
https://www.mdpi.com/journal/geosciences/special_issues/archaeological_heritage


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¹ rog.palmer@ntlworld.com
² https://www.ksiegarniaonline.pl/s/s/list_cat_id288.html
An interesting use of a range of image sources and some geophysical examination to study six Neolithic settlement sites. The number of sites and their organisation enabled the authors to come to archaeological conclusions about these settlements and their village-like forms.

*From the abstract:* Here, we present the Neolithic sites Gorjani-Kremenjača, Koritna-Pašnik, Gat-Svetošnice, Ivanovac-Korodvar, Klisa-Groblje and Brdo, whose size and shape were defined through a combination of the analysis of aerial and satellite imagery and geomagnetic survey. Experience in combined research strategies will help us in our efforts to define parameters in recognizing regularities in the remains of settlement organization visible only from the air. Our results showed a complex network of densely populated settlements with elaborate internal organization and infrastructure varying in size from 10 to 50 ha. All settlements were surrounded by at least one set of ditches. Their internal organization was complex and suggests dense habitation. Many sites have several ditched spaces organized in complex systems. Obtained data and results provide a comprehensive review in a wider European context.


Development and discussion of a workflow used to process historical and contemporary aerial and satellite images in order to identify and extract features of archaeological interest. Filter visualisation algorithms were applied to produce apparently clearer-looking images although I suspect that equally valid interpretations could be made from the original (as illustrated in figure 5). DEMs were made and compared from UAV and stereo satellite image sources and these were further processed using Local Relief Model and Sky View Factor with, at some stage, Principal component Analysis being used. Comparison of images taken between 1959 and 2015 were made, both visually and by semi-automatic extraction, to understand attrition to the site during that time and the poor success rate of AI is noted and explained. However, the most successful result came from use of images with the UAV DEM so work of this kind cannot be carried out on archive images alone. The in-depth discussion of methods in this paper may help guide others with similar projects to go directly to the most informative techniques rather than reinventing the whole lot again and again.


*From the abstract:* Identifying bare-earth or ground returns within point cloud data is a crucially important process for archaeologists who use airborne LiDAR data, yet there has thus far been very little comparative assessment of the available archaeology-specific methods and their usefulness for archaeological applications. This article aims to provide an archaeology-specific comparison of filters for ground extraction from airborne LiDAR point clouds. We have compared nine filters [on archaeological sites from Austria, Slovenia, and Spain] implemented in free or low-cost off-the-shelf software, six of which are evaluated in this way for the first time. The results of the qualitative and quantitative comparison are not directly analogous, and no filter is outstanding compared to the others. However, the results are directly transferable to real-world problem-solving: Which filter
works best for a given combination of data density, landscape type, and type of archaeological features?


*Because I haven’t had time to read it - From the abstract:* Airborne and spaceborne remote sensing in archaeology generates at least two important issues for discussion: technology and visualization. ... This discussion is framed in relation to Martin Heidegger’s understanding of technology and a dichotomy of naturalism versus antinaturalism.


*From the abstract:* [A] multidisciplinary study carried out in the SE area of Ceggia, in the eastern part of the Venetian Plain. The area has been characterized, since ancient times, by numerous morphological transformation, due to the presence of lagoon and marshes, and interested by repeated reclamation. Aerial and satellite images have identified many natural and anthropogenic traces [wow – finally some AI?] ... The multidisciplinary approach adopted in this context, with the results obtained thanks to the contribution of aerial and satellite images, historical cartography, archaeological survey, geophysical measurements, geomorphological characterization, and 14C dating, allow us to suggest a possible interpretation of the different traces highlighted in the studied area. ... [and to] suggest new hypotheses for reading the complex history of this understudied area.

Examination and mapping of APs taken on five dates between 1937 and 1999 plus old maps, a small-scale geophysical survey (located using the AP evidence) and coring that provided a piece of wood for radiocarbon dating.


*From the abstract:* In August 2018, a group of experts working with terrestrial/marine geophysics and remote sensing methods to explore archaeological sites in Denmark, Finland, Norway, Scotland and Sweden gathered together for the first time at the Workshop ‘Sensing Archaeology in The North’. The goal was to exchange experiences, discuss challenges, and consider future directions for further developing these methods and strategies for their use in archaeology. After the event, this special journal issue was arranged to publish papers that are based on the workshop presentations, but also to incorporate work that is produced by other researchers in the field. This paper closes the special issue and further aims to provide current state-of-the-art for the methods represented by the workshop. Here, we introduce the aspects that inspired the organisation of the meeting, a summary
of the 12 presentations and eight paper contributions, as well as a discussion about the main outcomes of the workshop roundtables, including the production of two searchable databases (online resources and equipment). We conclude with the position that the ‘North’, together with its unique cultural heritage and thriving research community, is at the forefront of good practice in the application and development of sensing methods in archaeological research and management.


A paper with the majority of authors from geosciences departments examines use a drone to fly thermal and MS sensors in a poor year for crop responses but in the hope of assessing the best conditions for the acquisition of large area multispectral and thermal data in the expectation that such images will add to our detection and knowledge of crop-marked archaeological features.


*From the abstract:* We present five archaeological sites from different ages located in the Guadiato Valley of Córdoba, Spain, where a series of photogrammetric images were acquired for purposes of both research and dissemination.

… quite why, is anyone’s guess (Ed)


*From the text:* … A systematic review of UAS-based hardware, software and data analysis scenarios relevant to archaeological applications of remote sensing


*From the abstract:* This article presents the results of multidisciplinary research undertaken in 2016–2019 at the German Nazi Treblinka I Forced Labour Camp. … The integrated archaeological research presented in this paper includes an analysis of archive materials (aerial photos, witness accounts, maps, plans, and sketches), contemporary data resources (orthophotomaps, airborne laser scanning-ALS data), field work (verification of potential objects, ground penetrating radar-GPR surveys, excavations), and the integration, analysis and interpretation of all these datasets using a GIS platform. The results of the presented study included the
identification of the burial zone within the Maliszewa Forest area, including six previously unknown graves, creation of a new database, and expansion of the Historical-GIS-Treblinka.


Examination of a 132 sq km area, using a variety of visualisations to detect archaeological features some of which have been checked on the ground to aid the conclusion that use of ALS has increased our knowledge of Classic Mayan (250-800 CE) archaeology.


A copy of the paper costs $20 so hasn’t been seen. However the abstract says:
We used high-resolution, drone-acquired thermal and multispectral (color and near-infrared) imagery, alongside publicly available lidar data and satellite imagery, to prospect for archaeological features across a relatively undisturbed 18 ha area of the site. Results reveal a feature that is best interpreted as the remains of a large, circular earthwork, similar to so-called council circles documented at five other contemporary sites of the Great Bend aspect cultural assemblage. We also located several features that may be remains of house basins, the size and configuration of which conform with historical evidence. These findings point to major investment in the construction of large-scale ritual, elite, or defensive structures, lending support to the interpretation of the cluster of Great Bend aspect sites in the lower Walnut River as a single, sprawling population center...


New ALS survey at 11 pts/m2 was flown, processed and examined. This led to the identification of field systems, burial mounds and other possible archaeological objects. Some of the finds were ‘verified’ on the ground and the authors realised that it takes a lot of time to examine a large area of imaging and wondered if AI may be of help.


Use of vertical aerial photographs (1955-2004), ALS and assorted geophysical instruments to examine the Terramare settlement of Fondo Paviani in Northern Italy.

I don’t know whether this has any practical value or is just an exercise in image manipulation.

*From the abstract:* … To exploit the free availability of Sentinel imagery, it is worth considering deep learning techniques for single-image super-resolution tasks, allowing the spatial enhancement of low-resolution images by recovering high-frequency details to produce high-resolution super-resolved images. In this work, we implement and train a model based on the Enhanced Super-Resolution Generative Adversarial Network (ESRGAN) with pairs of WorldView-Sentinel images to generate a super-resolved multispectral Sentinel-2 output with a scaling factor of 5. Our model, named RS-ESRGAN, removes the upsampling layers of the network to make it feasible to train with co-registered remote sensing images. Results obtained outperform state-of-the-art models using standard metrics like PSNR, SSIM, ERGAS, SAM and CC. Moreover, qualitative visual analysis shows spatial improvements as well as the preservation of the spectral information, allowing the super-resolved Sentinel-2 imagery to be used in studies requiring very high spatial resolution.


Mixing ALS and geophysics is, apparently, not often done. And just to make sure what they’ve found, they dig holes in some of the ‘geophysical anomalies’.

*From the abstract:* … Archaeologists often use near-surface geophysics or LiDAR-derived topographic imagery in their research. However, rarely are the two integrated in a way that offers a robust understanding of the complex historical palimpsests embedded within a social landscape. In this paper we present an integrated aerial and terrestrial remote sensing program at the Johnston Site, part of the larger Pinson Mounds landscape in the American MidSouth. Our work at Johnston was focused on better understanding the history of human landscape use and change so that we can begin to compare the Johnston Site with other large MiddleWoodland (200 BC–AD 500) ceremonial centers in the region. … Our research emphasizes the importance of an integrated remote sensing methodology when examining complex social landscapes of the past and present.


A skim through some of the aerial work undertaken by HE with notes on their kit, their new ability to take vertical photographs (which is still subject to experiments) and use of GPS-IMU to help speed up archiving new images. Perhaps most interesting are their experiments using Pleiades 50cm satellite images, an example of which is used to show its ability to record crop-marked information. All good useful stuff, even if produced in a hurry (to judge by the poor proof reading).

*From the abstract:* [discusses] … the logistical challenges of operating UAVs in the areas of remote (offline) and rough terrain typical of much of Central Asia, and to this methodological issue we offer some field-tested strategies developed in mountainous areas of Kyrgyzstan and Tajikistan. Another significant challenge to UAV-based survey in Central Asia lies in the ongoing development of landscape archaeology as both concept and practice in the region.


Survey of a 735 km-long wall in N China and NE Mongolia. Noted here because of its use of high-resolution satellite images plus the obligatory use of a drone, both being components of a broader research project. This survey increased numbers of clusters of structures, spaced at intervals a few hours apart by ox-cart or on foot. Field walking suggests a date for human activity within the clusters (and hence for use of the wall) to the Liao period (907-1125AD). Dimensions of some structures and the wall are given in the text and uses are suggested. Cluster locations seem to favour lower elevations and may, therefore, not be defensive but seem more likely related to travel routes that the wall controlled.


*From the abstract:* Extensive settlement activity at the Bronze Age site of Mokarta in western Sicily has previously been inferred, but the extent and condition of its subsurface remains have never been established. The authors use geophysical prospection, historical and modern remote-sensing data and soil chemistry to identify previously undocumented structures and activity areas extending beyond those exposed by previous excavations. This exercise not only has implications for the multifaceted social organisation of Late Bronze Age communities in Sicily, but, more generally, demonstrates how minimally invasive investigative techniques combined with existing data can reveal subsurface archaeological sites and the impact of post-depositional processes.


*From the abstract:* … the Nasca geoglyphs in Pampa de Atarco, are object of remote sensing based investigations with the twofold aim to identify and characterize them as well as to analyse and monitor their fragile state of conservation … The approach … includes the integration and reuse of
diverse remote sensing dataset, from multispectral satellite to Unmanned Aerial Vehicle based LSAR data and close range photogrammetry. In particular, a multidate (2002–2013) very high resolution optical satellite dataset has been processed ... using textural indicators, including Skewness, Principal Component Analysis, and automatic classification tools which allowed us to enhance the visibility of disturbance features and to automatically extract them. ... the integrated use of satellite VHR data with UAV-based photographs and DTMs, processed using structure from motion, allowed us to characterize, identify and reconstruct the relative chronological sequence of geoglyphs thus providing new insights and opening new perspectives for archaeological studies.


From the abstract: ... we tested 14 UASs to assess the positional and within-model accuracy of SfM-MVS reconstructions of low-relief landscapes without GCPs ranging from consumer to enterprise-grade vertical takeoff and landing (VTOL) platforms. We found that high positional accuracy is not necessarily related to the platform cost or grade, rather the most important aspect is the use of post-processing kinetic (PPK) or real-time kinetic (RTK) solutions for geotagging the photographs. SfM-MVS products generated from UAS with onboard geotagging, regardless of grade, results in greater positional accuracies and lower within-model errors. We conclude that where repeatability and adherence to a high level of accuracy are needed, only RTK and PPK systems should be used without GCPs.

Which is slightly related to:


From the abstract: The aim of this study is to evaluate the degradation of the accuracy and quality of the images in relation to the TIFF format and the different compression level of the JPEG format compared to the raw images acquired by UAV platform. ...


This seems to be another case of chucking every technique at a known site and discovering that it’s still there.

From the abstract: ... a combined use of non-invasive methodologies which are used for the first time to study a medieval village in Romania. The focus here will be on ground-based and satellite remote-sensing techniques. The method relies on computing vegetation indices (proxies), ... in order to detect the layout of a deserted medieval town located in southwestern Romania. The data were produced by a group of small satellites (3U CubeSats) ... which catch different images for the same area at moderately short intervals at a spatial resolution of 3–4 m. The four-band Planet Scope
satellite images were employed to calculate a number of vegetation indices such as NDVI, DVI ... and others. For better precision, structure from motion (SfM) techniques were applied to generate a high-resolution orthomosaic and a digital surface model in which the boundaries of the medieval village of Şanţul Turcilor in Maşloc, Romania, can be plainly observed. Additionally, this study contrasts the outcomes with a geophysical survey that was attempted inside the central part of the medieval settlement.


From the abstract: Using a multi–temporal Sentinel–2 dataset between 2016 and 2019, the present study focuses on the hazard risk identification for the Micia and Germisara archaeological sites in Romania as they are endangered by industrialisation and major infrastructure works and soil erosion, respectively. Furthermore, the study includes a performance assessment of remote sensing vegetation indices for the detection of buried structures. The results clearly indicate that Sentinel–2 imagery proved to be fundamental in meeting the objectives of the study, particularly due to the extensive archaeological knowledge that was available for the cultural heritage sites.


From the abstract: The “Riese” project was a huge construction project initiated by German Nazi authorities, which was located in the northeast of the Sowie Mountains (Ger. Eulengebirge) in southwestern Poland. Construction of the “Riese” complex took place in 1943–1945 but was left unfinished. ... The construction was carried out by prisoners, mostly Jews, from the main nearby concentration camps, KL Gross-Rosen and KL Auschwitz-Birkenau. Thanks to the discovery in the National Archives (NARA, USA) of a valuable series of German aerial photographs taken in February 1945, insight into the location of labour camps was obtained. These photographs, combined with LiDAR data from the Head Office of Geodesy and Cartography (Warsaw, Poland), allowed for the effective identification and field inspection of the camps’ remains. The location and delimitation of the selected labour camps were confirmed by an analysis of the 1945 aerial photograph combined with LiDAR data. These results were supported by field inspection as well as archival testimonies of witnesses.


From the abstract: ... the European Union Satellite Centre can be an invaluable instrument for the identification and assessment of the damage in areas occupied by ISIL. A detailed view of the damage suffered by the Nineveh and Nebi Yunus ancient sites, in Iraq, was assessed via visual inspection. The analysis was conducted considering the main events that occurred in the city of Mosul, between November 2013 and March 2018. More than 25 satellite images, new acquisitions and archived,
supported by collateral data, allowed the detection and classification of the damage occurred over time. A description of the methodology and the classification of category and type of damage is presented. The results of the analysis confirm the dramatic levels of destruction that these two ancient sites have been suffering since 2013. The analysis reported in this paper is part of a wider study that the SatCen conducted in cooperation with the EU Counter-Terrorism Office and PRISM Office.


Included here because of uses of historic aerial photographs and SfM to determine height differences with those recorded by contemporary ALS.


From the abstract: This paper gives a presentation of how airborne laser scanning (ALS) has been adopted in archaeology in the North over the period 2005–2019. ... The first archaeological ALS projects gave immediate good results and led to further use, research, and development through new projects that followed various tracks. The bulk of the research and development focused on studying how well-suited ALS is for identifying, mapping, and documenting archaeological features in outfield land, mainly in forested areas. ... Substantial research has also been devoted to the development and assessment of semi-automatic detection of archaeological features based on the use of algorithms. This has been studied as an alternative approach to human desk-based visual analyses and interpretations of ALS data. This approach has considerable potential for detecting sites over large regions such as the vast roadless and unbuilt wilderness regions of northern Fennoscandia, and has proven highly successful. In addition, the current review presents how ALS has been employed for monitoring purposes and for landscape studies, including how it can influence landscape understanding. Finally, the most recent advance within ALS research and development has been discussed: testing of the use of drones for data acquisition.


From the abstract (ie the free bit): ... aerial photography using unmanned aerial vehicles [was] followed by geophysical and soil surveying. Aerial photography in the visible spectrum enables the evaluation of possible settlement boundaries. The wavelet transmission of multispectral aerial photography data makes it possible to disclose the areas of the preserved cultural layer.

Continuing the use of aerial photography for site-specific investigation.

This lot have put three sensors into an ultralight aircraft and taken 67,984 images in visual, multispectral and thermal IR range. After 44 hours of processing they had a DEM and three orthophotos covering 1200 hectares. They conclude that this is a method that should be encouraged.


Another paper by Dave Cowley and associates exploring ways and means of making large area surveys as a prelude to tackling the mapping of Scotland.


A long and technical paper on the use of a Random Forest algorithm to identify mounds on 2-6 points/sq m ALS.

Toby G. Driver, Barry C. Burnham and Jeffrey L. Davies, 2020. Roman Wales: Aerial discoveries and new observations from the drought of 2018. *Britannia* (online) [https://doi.org/10.1017/S0068113X20000100](https://doi.org/10.1017/S0068113X20000100)

Fast turnround from Toby, *et. al.*, following the busy summer of 2018 with photos, maps and descriptions that include new marching camps, forts and stone buildings. Great to see the photos being put to archaeological use after the series of hyped press releases about what a good summer it was, only to be followed by silence and, in places, no access to those photographs. The online edition has poor-quality illustrations, perhaps to encourage us to pay Cambridge Core (publishers) for a pdf version.


A search for big things (>80m diameter) in southern Siberia using PALSAR L-band SAR. Nineteen mounds were identified of which ‘ground truthing’ showed 13 to be false positives. One wonders if this is a useful method.

Yet another demonstration that CNN can find round things on images, this time on open source visible wavelengths (I think). The paper contains lots of technical stuff but minimal archaeology.

**Leiden Corner ~~~~~~~~~~~~~~~~~~~**

Wouter B. Verschoof-van der Vaart, Karsten Lambers, Wojtek Kowalczyk and Quentin P.J. Bourgeois, 2020. Combining Deep Learning and Location-Based Ranking for Large-Scale Archaeological Prospection of LiDAR Data from The Netherlands. *ISPRS Int. J. Geo-Inf.* 2020, 9, 293; doi:10.3390/ijgi9050293

A workflow for detecting barrows and Celtic fields from ALS data that concludes that there is still a need for archaeologist interpreters.


A curiously-titled paper ‘Learning to look’ when it’s all about use of auto detection. More about finding round barrows and Celtic fields in the Netherlands.


*From the abstract:* We here present an innovative integrated workflow that combines machine learning approaches to automated object detection in remotely sensed data with a two-tier citizen science project that allows us to generate and validate detections of hitherto unknown archaeological objects...

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Free ‘accepted for publication’ copy: https://www.academia.edu/39010242/A_protocol_for_mapping_archaeological_sites_through_aerial_4k_videos

The free link gives you the unedited version of this curious paper that seems to be advocating use of UAV videos to extract single views that can then be used to make DTMs and orthophotos for the usual undefined reasons.

71
https://www.academia.edu/40446790/Aerial_thermal_imaging_from_UAV_in_archaeology_a_case_study_the_abandoned_medieval_town_of_Montecorvino_Foggia_Italy_13TH_INTERNATIONAL_CONFERENCE_ON_ARCHAEOLOGICAL_PROSPECTION_28_AUGUST_1_SEPTEMBER_2019_SLIGO_IRELAND?email_work_card=view-paper

As well as this paper that seems to be using thermal imaging as a guide for excavation, the download lists other papers given at the conference among which a careful reader may find a few other aerially-relevant contributions.


Use of a UAV to produce orthophotos of shallow-water ancient harbours. Lots of technical stuff, some archaeology.

or what seems to be an unpaginated authors’ copy:

Using SfM to join those old Biscupin photographs taken from a balloon to make an orthophoto that adds information to the archaeologists’ site plan.


From the abstract: This article offers thoughts on how current trends are changing the traditional objective of aerial prospection – prehistoric and ancient sites detection and the photographic record – into a more complex aim, namely, the integration of a variety of modern digitally-based, remote-sensing techniques applicable to archaeology into a process that focuses on the study of diachronic developments and synchronic patterns of past settlements. The author presents an evaluation of the current position of remote sensing in the study of the past, mainly from a central European (Czech) perspective, based on his long-term involvement in air survey and landscape archaeology in the Czech Republic.

The first sentence of the abstract sets the standard for what follows: Archaeologists around the world have shown that LiDAR has the potential to map a wide range of architectural features built by humans. Which is akin to the pre-technoage claim that aerial photography discovers sites.

After this there are references to more books and papers than anyone needs to read, a lot of ALS visualisations and technical geophysical results, but no interpretation and no maps. Discussion mentions individual sites and acknowledge that ALS by itself does not find everything and I get the idea that the word ‘landscape’ means to the authors ‘the area within which we were looking’ rather than anything of possible past significance.


This paper continues the authors’ work using ALS for recording and heritage management. Here looking at multi-scalar approaches targeting archaeological features of varying sizes across typical terrain and under variable vegetation types. AI seems to be good at finding round pits.


From the abstract: This paper provides an overview of existing and future earth observation sensors, the various levels of interoperability ... and presents some preliminary results from the Thessalian plain in Greece using integrated optical and radar Sentinel images. The potential for archaeolandscape studies using virtual constellations is discussed here.


In the overall scale of things, excavations are often tiny holes claiming to investigate a much larger past reality. On that basis, a survey of an irregular area taking in the east and west mounds at Çatalhöyük and covering some 750 x 900m may seem large but is certainly not a ‘landscape’. Results illustrated show the usual games that come from uses of drones – contours and 3D models – but include an interpretation of ‘cropmarks’ [in reality these seem to be upstanding remains] on the west mound. The authors had so much fun that they intend to go back and do it all again using different sensors.

This paper presents experimentation carried out at the Roman Republican city of La Caridad (Teruel, Spain), where different tools have been applied to obtain multispectral and thermal aerial images to enhance detection of archaeological cropmarks. Two different drone systems were used: a Mikrokopter designed by Tecnitop SA (Zaragoza, Spain) and an eBee produced by SenseFly Company (Cheseaux-sur-Lausanne, Switzerland), [thereby combining] in-house manufacturing with commercial products. Six [different] drone sensors were tested and compared in terms of their ability to identify buried remains in archaeological settlements by means of visual recognition. ... Through [visual] interpretation of the resulting data, our aim has been to determine which drones and sensors obtained the best results in the visualization of archaeological cropmarks. The experiment in La Caridad therefore demonstrates the benefit of using drones with different sensors to monitor archaeological cropmarks for a more cost-effective assessment, best spatial resolution and digital recording of buried archaeological remains.


Fairly old now, this paper takes you through most of the things to do and remember when conducting a survey over a fairly large area, well, 5x5 km. It also shows how long this will take, and how knackering – in terms of ‘flying and post-processing – it can be to achieve a DEM with 4 cm/px resolution. It makes me wonder just who will need this centimetric accuracy over such an area, if users really need a 3D model to play with and whether an off-the-shelf satellite image would provide adequate context for a ‘site. On the latter, the authors claim the UAV system to be an improvement over free satellite cover and much cheaper than buying a commercial high-resolution image, presumably forgetting the cost of getting and accommodating a UAV team from USA to, in this case, Turkmenistan.

Catching upon two HE aerial reports: https://historicengland.org.uk/research/research-results/research-reports/


Survey using aerial photographs and ALS of 374 sq km west of Cambridge that includes fen edge, clay and chalk geologies.


Survey using aerial photographs and ALS of 143 km squares around the IA and Roman centre of Silchester, Hampshire, UK.

I’ve no idea where I found this nor if the 2016 date is correct. However, its topic is familiar to many AARG members even if the title should read ‘photo interpreter’ rather than ‘aerial photographer’. It is based on a military report written in 1918 by a US lieutenant, Homer Saint-Gaudens, *Digest of Camouflage Experiences*, about use of camouflage to deceive photo interpreters. Weems’ analysis of the original report is interesting and, on checking he turns out to be a professor of US art history who has written several books and papers involving aerial photographs. Some of you may like to chase his work as a means of understanding how we see what we see on images.


Our thoughts from 14 years ago in PDF form for those of you who don’t have the paper book.
The Aerial Archaeology Research Group

AARG sees the aerial perspective as integral to the pursuit of key questions in archaeology and heritage, including landscape character, long term landscape change, human ecodynamics, and the experience of place. We are a community of heritage professionals, researchers, students and independent scholars dedicated to education, research and outreach initiatives involving the acquisition and application of data from airborne platforms. AARG provides opportunities for networking, mentorship, and exchanges of ideas on theories, methods and technologies related to aerial archaeology. The organization supports an annual conference, workshops, training schools, and publications.

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

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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 mid-May. Other meetings for which scholarships may be available will be advertised on an ad hoc basis. Support for conference attendance may also come from the Riley Fund (see elsewhere, this issue).