# AARGnews 7

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Derrick Riley: off to Europe with Otto, 26 June 1993
(photo: Chris Cox)
It is with considerable sadness that I report that Derrick Riley died on 22 August 1993 after a short period in hospital. Not only was Derrick one of the pioneers of air-archaeology (to use his 1946 term) but he produced more work in his retirement than most manage during their employment. AARG members may recall the broad range of topics he covered in lectures to us (see also Books of Interest? in this issue) and may, like me, have benefited from discussion with him – not always agreeing, but never without value. This summer Derrick carried out photographic flights with Otto Braasch in eastern Europe, was writing up his work in Israel, and pursued his campaign through the CBA Aerial Archaeology Committee concerning the non-publication of excavated crop marked sites. Derrick was active (and I mean active) in education, on committees and in his correspondence and leaves much for us to continue and complete. Derrick had lately taken to closing his letters to me, 'Your old friend'. It was a friendship that I will always value.

Another of aerial photography's old brigade who has been working away in comparative silence is Arnold Baker. I first met him when I worked for RCHME's fledgling APU in the late 1960s and Arnold was one of the few private fliers on the books. His summer holidays were the time for flying, sometimes sharing time and costs with Jim Pickering as these were the days before RCHME grants were available. One result of these many years' photography is that Arnold has recently been awarded a PhD for work on the aerial evidence in the Severn Valley. He sent me a copy of the abstract and Contents which, together with a thoughtful letter, give an indication of the scope of his research, the reasons for so doing, and comment on the relatively dismal state of our speciality. His letter in particular echoes many of my own thoughts (and words) on our need for directions and aims for the future.

Copies of Baker's thesis have been deposited at Southampton and Birmingham in the hope that they may serve as reference documents and aid teaching of the subject. Unless I have forgotten somebody (in which case, sorry!) I make this the third successful doctoral thesis to be written from an aerial viewpoint but perhaps the first to cover techniques and applications. Although not explicitly in two parts the thesis deals firstly with the data and data collection (crop marks and aerial photography) with, to judge from the Contents, considerable in-depth study of crop response and a chapter on 'other techniques including far infra-red' (see a prehistoric version of the latter by Baker in D R Wilson (ed) 1975. Aerial Reconnaissance for Archaeology. CBA Research Report 12, 46-51). After that it's down to the archaeology with chapters on soils and crop mark distribution in the Severn Valley and its watershed, settlement sites in the Severn Valley, Roman military installations and roads, and then three chapters on Wroxeter in which the aerial and ground evidence are combined and the value of sound aerial interpretative input to a field project are demonstrated. My comments skirt over much and, being based on the Contents, may not fully reflect the thesis – if so I apologise to Arnold.

Baker's abstract and parts of his letter raise several points that are (always) worth repeating:

It requires demonstration of the power of aerial reconnaissance, be this to guide field work on a single site or to study an otherwise inaccessible landscape, to encourage and bring about the necessary fusion and interaction between parts of the discipline. If, when, this happens it will bring, or brings, tremendous benefit to our study of the past. Unfortunately it remains up to us, the aerial specialists, to provide the necessary demonstrations, something that we seem reluctant to do.

Baker notes that his thesis constitutes part of a programme of aerial reconnaissance undertaken over the period 1952 to 1978. Is this why we are so reluctant? Twenty-seven years of photography, five years 'post-reconnaissance' (and short at that), three volumes, 480 illustrations and 110,000
words .... how many of us have the foresight to conceive a project of that scale and persistence to keep at it..? Yet the nature of aerial photography and its application to archaeological problems require long-term projects. Derrick Riley's *Early Landscape from the air* (1980) took ten years from his return to flying to its publication (and he was helped by the backlog of photographs at CUCAP). Rowan Whimster notes that his *Emerging Past* (1989) was a four year project (which took another four to get into print.....). My million acres of Wessex for my non-PhD took almost three years of which two were full time photo interpretation, rectification and mapping. From that project 10% was worked up (in about two years) to become *Danebury: an aerial photographic interpretation of its environs* (1984). Part-time work spread over four years allowed me to undertake photo interpretation of the Fenlands of Cambridgeshire (almost in the press!) while flying to 'fill in the gaps' and record the gradual destruction and loss of that area will keep me going for ever. Current progress mapping the Lincolnshire Fenland, which provides me with quite the most difficult interpretative problems I've ever encountered, averages out at some 2.5 km squares per day but that is only because there are empty areas on the northern edge. If things go well progress on the real Fenland sites may just run at a rate of 1 km square per day – but some squares have taken a week.

All have been, and are, long-term projects – necessarily so as their publication and the thinking that forms the basis of the archaeological comments therein require areas of interpretative mapping to serve as their basic data. Short-term studies can be covered by notes such as 'an interesting crop mark at Cowpat Farm', but, quite honestly, without an element of field worked input or some comparative analysis, so what? The developer-funded side of aerial studies provides other opportunities since photo interpretation is tested by field work. As an example, our (Air Photo Services) reports, or the letters which accompany them, comment on the mapped archaeology and indicate parts that we consider to be key areas for field investigation. We provide a map plus some considered thinking about it that can then be tested in the field and the results enable us to modify (or not) our future thoughts.

Martin Godja writes of his first season of aerial reconnaissance in Bohemia and his plans and concepts for the future. Why the great interest you may ask, why comment on *one* season, why won't old Palmer let the rest of us write about our exciting crop marks (not that I've been overwhelmed by such offerings....)? The reason is mainly because Godja has taken the trouble to learn about the game from us (mostly from the Royal Commissions' teams) and can thus build his programme with full knowledge of 70 years of mistakes and successes. My first thoughts on learning this were along the lines of, "What an opportunity!", and to note that this is not an isolated case. AARG and the CBA Aerial Archaeology Committee are offering full support to the proposed symposium on 'aerial archaeology' in Potsdam in 1994 and expect to send a working contingent in the hope of providing a firm base from which aerial work in Eastern Europe may take off.

Following Gwil Owen's adventures with a balloon in Egypt (*AARGnews* 6) we include further use of the method with Geoffrey Summers' survey in Turkey. According to my calculations Summers' balloon was smaller than that used by Owen and his Turkish work was designed specifically to survey a site – and it has resulted in an excellent plan. It seems as if archaeology in less accessible places than the British countryside has made advances in surveying techniques in a similar manner to the way that practical underwater archaeology has, of necessity, created some site recording methods that could be, and increasingly are, applied effectively on dry sites.

Another non-standard service is offered by Geoff Soden who runs a business called Hi-eye Photographics and contacted us about a year ago. It's not the usual run-of-the-mill aerial photography even though he offers low cost, low level work aimed at the property market, surveyors and architects. Soden made contact to enquire if there were likely to be any archaeological applications for aerial photography from below 500 feet. Yes, it is legal, he 'flies' model helicopters fitted with a
forward-pointing, downward-angled 35mm camera and by using a 24mm lens can achieve good target cover. To improve camera aim he was then in the process of fitting up a larger model with paired still and video cameras. Thinking his type of photography was ideally suited to those who excavate and feel that no report is complete without an aerial photograph of 'the site under excavation' we tried hard to find him a local site to cover. At the time Cambridge Archaeological Unit had nothing suitable, Cambridgeshire Archaeology had but were uncooperative and, for a change, there were no 'outsiders' active in the county. So we lost contact and the chance of a useful (and freely offered) demonstration. His charges seem reasonable so if any AARG members are interested, or have digging friends, the contact address is 18 Pettis Road, St Ives, Cambridgeshire, PE17 4SR (0480 62480). I'd be interested to hear of, and see, any results.

Technological aspects of the aerial world include those covered by John Haigh's contributions. In a letter to me John noted that there seems to be a spate of rectification programs suddenly being published. In the last issue I noted PhotoGIS (AARGnews 6, 18) which I have since chased up and find it (to judge from a quite effective demo disc) a costly and souped-up version of AERIAL plus GIS facilities. In this issue there is a page detailing RECTIFY (which has been adapted for PC from Bonn programming by Zurich) and I have since heard of another written by AARG member Volker Arnold that takes input from scanned overlays. This latter is an as-yet unnamed program, apparently still in late prototype stage and sounding as user unfriendly as my OBLIQUE was in the 70s but I hope to be able to get my hands on a copy in the near future as scanned input has, for a long time, seemed a desirable feature in any rectification program.

John Haigh and Stanley Ipson's contribution shows, maybe, a future working method for photo interpreters. For the first time I have been able to realise the potential of digital photo rectification – I want to play with it – but there is still a nagging doubt about stereoscopy and the gain in confidence that comes from using stereo pairs for interpretation. John tells me that the note is very much a progress report and we hope to be able to bring you more in future issues on later developments.

We saw an ad in Pilot and Gill Barrett sent us further details (a hint maybe...?) for aerial photography courses in France. For 'only £289' [plus this that and a few other costs] they offered a Friday to Monday course [does that mean two working days?] with the aim 'to teach you all the necessary skills to produce exciting aerial photographs'. No mention was made of the likely duration of flying time but brochure notes that there are nearby lakes, horses and Roman remains as well as the possibility of making one double bed from two singles if weather is bad or distraction needed. Details from Vacance Actives, Chapel Cottage, Norwell, Newark on Trent, Notts, NG23 6JN (0636 86459).

Before the next issue of AARGnews there will be a new editorial address following the expansion of Air Photo Services as I will have been moved out to a new residence with workspace. We will acquire twice the space (at last, somewhere to spread out maps!) and thus the possibility of taking on staff at some stage. Please continue (?) to use the usual address until notified – the vast heaps of AARGnews contributions will still reach me.

[Now, who says I can't be tactful....]
Most of this piece was written before we heard of Derrick Riley's illness and subsequent death. I am sure you will agree that he will be sadly missed both as a friend and as a colleague who was always working on something new. Our thoughts should now be for Marjorie, his wife, and his family.

Fortunately for you and sadly for me this will be my last chance to write this column; pressure of other extracurricula activities and family commitments force me to retire as Chairman. I hope the new Chairman will find AARG in a healthy state and increasing in size. A number of factors have contributed to this; the first is the ever expanding world of aerial photography. This summer the Otto Braasch European Tour continued flying in Hungary and all parts of Germany - and from all reports (some second hand) there have been great discoveries.

Other AARG members have been to Poland (for a variety of reasons), made aerial contacts and Anthony Crawshaw actually went flying with a Polish archaeologist; his photographs might be available for others to see at AARG in Abergavenny. This ever expanding geographical area will take many years to survey and will, I hope, continue to expand. Perhaps it will not be long before we will have reports of flying for archaeology in Russia.

Another event which is evidence of the expanding nature of the subject, was a three-week training course which was run by RCHME staff for budding aerial practitioners in the Units and SMRs who receive RCHME funding. Training courses are, of course, nothing new but the Chairman of the CBA Aerial Archaeology Committee is concerned about education and training for the next generation. The innovation was more the length of the course and its comprehensive nature. It was designed to cover as many parts of air photo interpretation, mapping and recording as possible. Even in 3 weeks this was not possible; it was only the second time RCHME staff had run the course (the first was for internal, new recruits in 1992). So far there has been good feedback; all the participants who were not already AARG members, joined during the course. Further courses, or modules of the course will be run in future.

Why are new AARG members so important? Aerial archaeology is now central to our profession - no longer the mystical preserve of the few. The IFA technical paper by Rog Palmer and Chris Cox, and the RCHME's National Mapping Programme, are signs that the collections of aerial photographs which have built up over the last fifty years (see NAPLIB directory) are being used to a greater extent.

The only way that the process of aerial archaeology (from taking the photographs through archiving them to interpreting and mapping them) can be maintained is by widening the membership of what is becoming a very interesting European 'club'.

Perhaps even beyond Europe too; Adrian Olivier and I were fortunate enough to visit St Louis, USA for the Society of American
Archaeologists 1993 Conference. Survey, geophysics and aerial photography were the topics being discussed and in the USA these techniques are applied in a site specific way; there is a huge opportunity there for aerial reconnaissance and regional surveys.

We did not have to get into the air to find a crop mark in grass at a huge World Heritage Site (called Cahokia (an ancient Indian city); and this was in April! The potential of aerial photography for this one site alone is enormous. But that is another story and will have to wait!

On one hand we say that what we do as Aerial Archaeologists is a specialised technique but on the another we want as many people as possible to become acquainted with the subject.

Is this the eternal paradox - like tourists visiting a wonderfully peaceful and unspoilt place and then rushing home and telling everyone about it? What I think we are trying to do is move from a restricted, slightly separate technique/discipline and say that it is not that we want everyone to do it, but that we do want more people to really understand what it is we do, how we do it and what its purpose is.

There is still a long way to go in making the case that we are not a bunch of myopic obsessives. To show that we have a broad and international view the Amiens Conference was a great example. A future international proposal for a working symposium has been suggested for Potsdam in Autumn 1994; the opening discussions are just now taking place and we have Otto to thank for planting the idea;

AARG should be well represented as I am sure many other organisations will be.

Early indications from the Brandenburg Minister of Culture are good, he is keen to promote a meeting on aerial archaeology and has even offered some financial support.

Finally, thank you to all AARG members who have helped with all the various activities over the past years; long may the spirit of cooperation in the Research Group continue.
AERIAL ARCHAEOLOGY IN BOHEMIA:
The programme of air reconnaissance and image data processing in the Institute of Archaeology of the Czech Academy of Sciences

Martin Gojda

Introduction

This contribution gives an outline of the concepts, methods and results of the aerial archaeology programme in the Institute of Archaeology of the Czech Academy of Sciences in Prague. It also provides the first general information about the air photography in Bohemia for experts from abroad.

We are aware that air photography can be, under specific conditions, a very effective (relatively quick, qualitative, complex, and non-destructive) method of collecting new information about archaeological structures. Its application may serve to provide crucial evidence of sites, of their protection, research and publication. We feel its significance has been stressed by the coming of landscape archaeology which is focused on the reconstruction of links between settlement units and their environments.

The inclusion of the programme of aerial archaeology in the policies of the Institute of Archaeology seems to be an important step towards the development of the strategy focused on the research of archaeological structures in the context of their environment. Results will be incorporated into a systematically constructed database of archaeological evidence that may serve for theory, protection, and public purposes.

1. The conditions for the development of aerial archaeology in Bohemia

The principal reason why it was impossible to practice aerial archaeology in Bohemia before the revolution of 1989 were the legislative limitations which de facto did not allow us to open such a programme in a meaningful way. By summer 1990 all such obstacles had disappeared and the author submitted a proposal for the introduction of aerial archaeology to the director of the institute. We started to look for contacts with foreign institutions specially involved in this field and also with Czech experts in photography and image processing. The preparation period was finished by the author's short study stay in Swindon and York (RCHME), and Edinburgh (RCAHMS) in December 1991. Our thanks must be expressed to R. Bewley, and M. Brown who kindly did their best when co-operating with us in the preparation of flight strategy. We also thank O. Braasch who, arriving with his own Cessna 172, helped us with the very first flights. A special thanks must be expressed to R. Featherstone whose practical assistance here in Prague, as well as his methodological lectures both in Swindon and in the Prague Institute, was really helpful.

The year 1992 became, in a sense, a milestone of Bohemian archaeology as it marked the first systematically performed air reconnaissance of archaeological sites and historical monuments.

2. The strategy and objectives of aerial archaeology in Bohemia

The main objective of our programme is to establish a central body of evidence of detected and (or) documented sites of archaeological and historical interest, and of landscape transects, photographed from the air. Such evidence will be in two forms: an archive of photographs and slides, and a computer databank compatible with the central archaeological sites evidence owned by the Institute. Data collected in both forms will serve all the purposes listed in the Introduction and we plan to make them accessible to each archaeologist and museum in Bohemia co-operating with us in the programme.

Another aim of the programme is the evaluation of the methodological relationships of aerial archaeology to other
non-destructive and prospection methods. For that purpose we have started the practice of testing the results from air reconnaissance by field walking and geophysics. We also plan to introduce test pitting and sample trenching at selected sites. Research excavation of single sites detected from the air will soon be discussed among a wide archaeological community.

As one of the principal ways of gaining information, aerial archaeology is related to many disciplines which are involved in the reconstruction of historical landscape. Landscape history is considered a main objective of our research.

3. Material equipment: cameras, hardware, software

Recently the Institute supported the programme of aerial archaeology by buying cameras, computers, and maps.

*Cameras:* We now use a Pentax 67 (55x70mm) for black and white photography and an Olympus OM 101 35mm (Zoom 35-70mm) for coloured diapositives. We also have at hand a video camera Olympus VX-42 (8mm).

*Hardware:* We now use PC 486/RAM 16 MB, hard-disk 520 MB (in the near future we will be equipped with a more effective computer), a 20 inch monitor (Alpha Scan LC), an A4 scanner (Microtek 600 Z) for scanning positive images (600 DPI), an A2 digitizer (CalComp-Drawing Board II), and a plotter.

*Software:* We will buy AERIAL within a short time so that we can start to convert data from oblique photographs into plans. We currently use Aldus PhotoStyler which has been utilised for the modification of scanned photographs and for the establishment of a collection of snaps which will serve as representative files documenting our results. To create a database we use two compatible programmes, dBASE IV and DB Picture.

4. Data processing

We are aware that there is a range of steps which must be passed in order to have the information from the primary data (photographs) at hand as soon as possible so that it may be included in different landscape projects and utilised immediately. Our records are held in two related forms:

1. The archive of photographs, maps and slides;
2. Three databases: sites, flights, negatives: completed by images included in single files of each site.

5. First results

In summer 1992 it was inevitable that we focused on crop marks and so we turned our attention to the gravels and light soils of the Elbe and Vltava (Moldau) basins in central Bohemia where we photographed 84 sites within 69 village cadastres. Of these 54 were detected as crop marks (and one as soil marks), the others are archaeological, urban and other sites of historical interest (villages, castles, monasteries, solitary churches, excavated sites, etc.) which, as visible structures, were just documented by photographs and slides.

The most important results of the first air reconnaissance season are as follows:

1. The highest quantity of sites detected as crop marks were those represented by the *macula* type of a feature. In a few cases these sites were complemented by other features, such as enclosures. Apart from one exception (the site of Ledčice – cemetery?) all of these sites can be described as settlements with tens or even hundreds of features, mostly pits.
2. A category of feature almost unknown in Bohemia was identified. These are circular or rectangular enclosures with a centrally placed *macula*. This category has been identified in many parts of Europe including the neighbouring Bavaria and Moravia where such features have been excavated and their chronology ranges between the old Bronze Age and Iron Age.
3. In central parts of Bohemia the best medium for crop marks was barley and wheat in the late phase of ripening, close to the harvest (first half of July) while in north-west Bohemia, in the Ohre basin, the crop mark season started in early-mid June. Most features showed as lighter-coloured lines (crop reversal marks).
6. Vertical photographs and historical maps

The use of vertical photographs (military ordnance survey) is basically limited by their small scale (mostly around 1:25,000 or even less) and by the fact that, in most cases, they have been taken at a wrong season and time for useful archaeological purposes. They may record linear systems, but not the most common kind of site – those indicated by maculae. On the other hand they may serve as a good source of information about past hydrogeological patterns within a territory under investigation. They are also useful in the process of reconstruction of the traditional landscape pattern which was destroyed at the turn of the 1940's by the communist collectivisation of cultivated fields into large co-operative farms. The search for the ancient land-use pattern is inevitably linked with the study of old cadastral and military maps (the oldest being dated to the 18th century) which may also reveal sites and monuments that attracted the then surveyors' attention and were marked on the maps, and later their above-ground visible parts disappeared.

7. The geophysical survey and field walking

These two prospection methods have been considered as an integral part of the aerial archaeology programme. In the future we plan to involve some other non-destructive methods (for instance thermal survey).

In 1992 two sites were geophysically surveyed (Černouček and Straškov). We used a Fluxgate Gradiometer which obviously is a good standard machine but not perfect.

Important results were gained by field walking carried out in November 1992. Ten sites, the existence of which had been identified by air reconnaissance, were plough-walked and provided a quantity of pottery fragments (and also a few flint flakes and one late neolithic stone implement – an axe). This pottery evidence confirmed that the sites identified by maculae are real archaeological sites. On most of the walked sites the pottery indicated occupation of more than one chronological phase of prehistory/early history.

8. ALRNB: The first landscape project in which air reconnaissance has been included

An international landscape project "Ancient landscape reconstruction in north Bohemia" (run jointly by the Prague Institute of Archaeology and by the Department of Archaeology, University of Sheffield, GB) has included a programme of aerial archaeology from its beginning. Results of the first-year's reconnaissance will be published this year in the journal Památky archeologické.

9. Future intentions and conclusion

We believe that the beginning of the programme of aerial archaeology deserves the attention of the Bohemian community of archaeologists. With appropriate funding we are able to offer aerial reconnaissance and photographic services to regional and district archaeologists who will then be able to follow up any new aerial discoveries and use photographs as a record through which the destruction of the historical landscape can be monitored. Our central archive of negatives and slides will be expanded by these flights and copies of prints and slides made to assist local work. We also intend to discuss widely the problem of managing sites and features detected by aerial archaeology. In general, we think that it is the endangered sites that should be excavated in the first instance while the other should just be tested by limited sampling. The primary strategy in getting as much information as possible about single sites or features should remain in the application of non-destructive methods.
A FLIGHT IN POLAND

Anthony Crawshaw

In June I had the opportunity of a short flight in Poland. This was by courtesy of Dr. Stepien from Lodz, via the good offices of Dr. Piotrowski of the State Archaeological Museum in Warsaw.

In the morning of my visit Dr. Stepien told me about his work, the aerial component of which is mainly photography of standing monuments and buildings. He flies about 50 hours a year and is apparently the only aerial archaeologist working in Poland.

The afternoon finds four of us aboard the Wilga, a curious--looking Polish built tailwheel aircraft, for a quick jolly around the Lodz area. After an excellent demonstration of a short-field take-off we are soon cruising along behind the large radial engine at 100m. altitude. I now begin to see how Dr. Stepien gets some of his good photography of buildings, without the use of telephoto lenses. To be fair, they go up to 200m. over towns, but I was still glad that there did not seem to be the low-flying military jets that we get in the U.K..

However, AARGnews is not a vehicle for pilot's reminiscences, even of the 'there I was at 100m.' type, so what did I see? The flight confirmed my impression from the train between Warsaw and Lodz, that there were huge fields, making the most of the largely flat landscape in that part of central Poland. To add to this difficulty of lack of control for mapping, there were a mass of tiny crop divisions. Thus only ten metres of crop mark might be visible before it disappeared into a different crop. I don't know how permanent the small crop divisions are, so accurate plotting of any sites would be difficult. A GPS would be most helpful for general location, but not good enough for plotting from one year to the next, as would be required. There were crop marks showing, but mostly drains, as here, although some marks were probably archaeology. A plus point was that the agriculture seemed to be less intensive than in the U.K.. That suggests that the crops will be more responsive to the conditions below ground, rather than the sheer weight of fertilizer applied.

A later road journey from Warsaw to Biskupin showed a gradual change in the landscape. The soil became lighter and sandier, with gentle hills, and the small crop subdivisions in the fields began to disappear. The fields were still huge, but at least more of any site would be visible. Indeed, crop marks could be readily seen from the coach, but to make something out of that low a view would have been a testament to one's imagination, or the Vodka, or both.

In short, I feel that Poland has great potential for aerial archaeology, if a few frustrations along the way. I am most grateful to Drs. Stepien and Piotrowski for their hospitality and kindness - Poland is a great place, well worth a visit.
PHOTOGRAPHY WITH A TETHERED BLIMP

GEOFFREY D. SUMMERS

The use of aerial photography in Turkey is extremely restricted for reasons of national security. Likewise, it is next to impossible to gain access to large scale maps (anything above 1:200,000). In order to overcome some of the restrictions a project has been initiated to record a number of individual sites by taking photographs with a tethered blimp. There is nothing new in using balloons for archaeological photography either in areas where the use of aircraft is impractical or in association with a particular excavation; a brief outline of their use in Anatolia is given below. The aims of our projects, however, are more ambitious in scope than anything that has been undertaken before.

So far we have carried out one balloon survey, at a site called Çevre Kale situated close to the village of Yaraslı on the northern corner of the Salt Lake (Tuz Gölü) in the Central Anatolian Plateau (Fig. 1). It is a major settlement dating to the Late Bronze Age (Second Millennium B.C., the period of the Hittite Empire) and the Pre-Hellenistic Iron Age (Mid-First Millennium B.C., the Phrygian Period). The site comprises three major elements (Fig.2): a flat-topped citadel at the north end, the main enclosed area which forms an upper town and a lower town on the south-west side. It measures approximately 400 by 800m. The citadel and upper town are both enclosed by a massive rampart, wall and ditch. At its maximum the top of the rampart, of which perhaps the upper 8m is artificial, stands c.25m. above the ditch. The stone wall on top of the rampart is 3.5-4.5m wide. The tops of stone walls, sometimes obscured by field clearance, can be seen in all three of the component areas. A full description of the site, discussion of the dates and a number of plans and photographs have been published elsewhere (Summers 1992).

The team members were Koral Ahmet (archaeologist), Tugrul Çakar (BIAA photographer) and Françoise Summers (architect). The Representative of the Turkish authorities was Bey Kubilay Yener (Yalvaç Museum). We would like to thank Feyzan Erel, Michael Ballance and David French for much help, advice and encouragement.

The Equipment.

The equipment belongs to the British Institute of Archaeology at Ankara. It was purchased for the Institute with a grant from the Programme Budget of the Assistant Undersecretary of State to the Foreign and Commonwealth Office. The blimp (Cameroon Balloons Ltd., Bristol) has a capacity of 20 cubic m. and a net lift of 9.5 kg. The camera, remote control and sling were designed by John Allen of Manchester University, originally for use with a kite.

Costs.

The capital cost of the basic equipment was in the region of £1,600. The price of enough
helium, which is readily available in Ankara, to fill the blimp and keep it inflated for several weeks was £500 and a deposit of roughly the same amount has to be placed on the cylinders for which there is also a modest monthly rent. The current low value of sterling will increase these costs. Further capital expenditure is needed to repair and replace parts damaged in the field, for better cameras (i.e. larger format), specially made tether line for flying above 150m. and, perhaps, a video link through the camera lens. Other costs in the field are the same as for any other archaeological survey.

**Aims.**

We had no experience of flying blimps and, thus, no firm idea of what we might be able to achieve. The initial aim was to take a series of record photos of the site from different elevations and with the sun in different positions. It was very difficult, if not impossible, to identify buildings on the ground even though the tops of stone walls could often be seen, but we expected to see the outlines of buildings on the photographs and to be able to draw plans of them from the photographs.

**Techniques.**

Two axial base lines were laid out at right angles on the ground. Along the base lines, at 50m intervals where the terrain allowed, crosses with 2m. arms were marked on the ground using powdered lime (cheaply and locally available). In addition, a number of points were selected at convenient places and these too were marked with large spots of lime and plotted onto a base map using a total station. The crosses and the points with spot heights are shown of Fig.2. We expected that it would be possible to print the vertical photographs to scale using the crosses and points marked on the ground. It was further anticipated that if three or more of the known points could be seen on each frame it would be possible to draw accurate plans from the photos. To the best of my knowledge, this is the first time that any attempt has been made to mark a grid and survey points on the ground before taking photos from the air.

Photographs were taken from heights ranging between a few meters and c.850m. Photography began as soon after dawn as light allowed and continued until dusk. In practice it was rarely possible to fly the blimp after 11a.m. because a strong wind regularly blew up. Photographs taken with slanting sunlight were better than those taken when the sun was directly overhead because shadow enhanced features on the ground and because the shadow of the blimp itself was less likely to intrude on to the photographs. The blimp is very maneuverable in still conditions but in strong wind it is very hard work to bring in and the risk of damage is great. Flying above c.150m. entailed replacing the tether line with kite string because the weight of the rope restricted lift. At the most we were able to fly at a vertical height of c.850m using the kite string but came close to losing the blimp when a strong wind suddenly blew up. We would not attempt to fly at that altitude again without a proper tether line and a mechanical winch. Judging where the camera position, and thus what might be captured on any particular frame, was fairly easy at low levels but hit and miss at high altitudes.

There are a number of simple improvements
Fig. 1 Map of Turkey showing phases mentioned in the text
to be made. Firstly, the camera sling was designed to hang vertically from a slanting kite string. The tether rope hangs vertically for some distance below the blimp so that when the sling is attached it does not hang as intended. Fixing the sling to a separate kite string improved matters but an independent sling attachment needs to be designed so that it will hang vertically from the blimp, will not continually spin and will avoid the tether line appearing in the pictures. Larger format cameras could be used (with courage) for better definition and less distortion. A video link with the camera could be established to allow the operator to control the camera position (Heafitz 1992). A boat trailer could be adapted to take the inflated blimp from site to site. The blimp needs to be very securely tethered in a position well shielded from wind, preferably in a garage, when not being flown. Everything is a balance, on one hand, between the net lift and the weight of the equipment and, on the other, between the complexity of the equipment and having a system that is simple enough to operate in remote places without anything going wrong or needing replacement.

**Drawing from the Photographs.**

The base line and the other fixed points were plotted onto a base plan. The photographs were printed, or projected to scale. No attempt was made to use Aerial or any other computer aided method of rectification. With hindsight many more fixed points with spot heights should have been plotted. It was a relatively easy if time consuming job to draw the overall site plan and fairly simple to trace off stone by stone plans of selected areas (Summers 1992: Figs 5, 6; Pls XLIV b and XLV a). Colour slides were especially helpful in distinguishing between stones and cushion-like plants, less useful for actual drawing.

**Future Prospects.**

Beginning in the summer of 1993 is a major project at the mountain top Iron Age city of Kerkenes Dag (Fig. 1). Balloon photography will be combined with computer aided mapping on the ground, detailed contour mapping and geophysical survey. Kerkenes Dag is a very large site with a circuit wall some 7km. long. It would seem to be of one period. The whole of the interior was occupied and streets, building platforms and, in many places, the tops of stone walls can all be seen. By combining a number of different but complimentary techniques we expect to be able to produce a plan of the whole city in a few months rather than many years of traditional survey and excavation.

A balloon can also be used throughout an excavation season for regular recording and for photographing sites on a more traditional type of survey. Potential for discovering previously unrecognized sites remains to be tested.

**Other Balloon Photography in Turkey.**

Tethered balloons have been used for archaeological photography in Turkey for a considerable number of years. Some of the major contributions and different techniques maybe briefly mentioned. All instances, to the best of my knowledge, have been connected with a particular excavation and the basic approach has been to supplement the normal excavation record with balloon
photographs. Cevet Erder, of the Dept. of Architecture at the Middle East Technical University (METU) at Ankara, pioneered photography with a hydrogen filled blimp in the 1960's. Excellent photographs were taken of the Middle Bronze Age (early Second Millennium B.C.) Anatolian city and Assyrian trading colony (karum) at Kültepe, ancient Kanesh, at a major Phrygian city between Ankara and Gordion called Haci Tugrul and at the classical city of Aphrodisias. These can be seen in the Architecture Dept. at METU. They have not, unfortunately, been published. Since 1973 J. Wilson Myres and Eleanor Emlin Myres have taken photographs in many countries, including Turkey, using a large hydrogen filled blimp. The Myres' have made many innovations including a sophisticated sling and a back pack for the tether rope winch. They have concentrated on photographing groups of closely related sites and under water sites but have also taken some stunning images in Turkey (Myers and Myers 1993). The German excavators at Pergamon have been using a small, spherical, hydrogen filled balloon for photographing excavated areas and reports including at least one photograph appear annually in *Archäologischer Anzeiger*. In 1991 a helium blimp was used to with a large format calibrated camera at the Hittite capital of Bogazkale and elsewhere (Neve 1992: Pls 8, 15 38, p.338). Balloon photography on excavations has become standard practice on many excavations. Just reported at the annual symposium held in Ankara, during the last week of May, was a new survey at the Iron Age mountain top site of Göllüdag (Tezcan 1992: especially the aerial photograph Pl.1 taken in 1968), near Nigde, where Prof Wulf Schirmer hired a hot air balloon from a tourist hotel and took some exciting pictures.

Heafitz, A.

Myers, J.W. and Myers E.E.

Neve, P.

Summers, G.D.

Tezcan B.

Middle East Technical University, Ankara, TURKEY
Fig. 2 Plan of Çevre Kale, Yarağlı at 1:5,000. Drawn from photographs by Françoise Summers
Copies of two papers have been sent to me via Otto Braasch and Rowan Whimster – to whom thanks. Details are at the end of this note, meanwhile I’ll refer to them as *Thailand* and *Stonehenge* and take them as an excuse to review some current applications and achievements using remote sensing.

*Thailand* I found interesting. The meat of the paper lies in its comparison of features interpreted from conventional air photographs (and, in cases, field survey) and those detected on Landsat imagery. The paper begins with a necessary (to me) resume of the known archaeological features, their locations and relationships, and illustrates this with schematic diagrams and conventional APs. Compared to UK archaeology these Thailand sites are fairly basic – moated ringworks, mounds, canals, reservoirs and dams – and examples of all can be seen on verticals of scales between 1:15000 and 1:50000. Detection of sites on air photographs followed a more closely determined scheme than is possible with crop marked features. The latter remain as defined by Riley (1946) – essentially positive and negative differences in crop growth, but which appear in an almost infinite range of plan forms within which a number of 'types' can be established – while the Thailand sites show by virtue of their water-filled features and by contrasting vegetation in an otherwise paddy field landscape. Also they ‘...are visible at all seasons and all times of day.’. Thus photo interpretation sought to detect five types of site that could be matched to schematic key diagrams of 'vegetation contrast marks'.

Use of colour infrared composite Landsat images enabled the vegetation and water differences to be emphasised. Luxuriant growth along canals, on mounds and within moated sites provided magenta signatures ('modern' vegetation is less vigorous and can rise to only pale pink or mauve) while water was either azure (with suspended sediment) or cyan (clear). Interpretation of Landsat imagery was undertaken using projected images that could be matched to a map at 1:250,000 or zoomed to 1:50,000 for extraction of detail. Results were compared with those obtained from air photo interpretation and/or field survey in four sample areas. Identification of moated sites was excellent – but these are massive features that ought not to be easily missed. (The paper does not give size ranges of any features sought but an illustrated moated site, 'one of the largest in the region', had a diameter of about 900m.) Mounds (varying in size between 'small' and 800m) scored less well with some 75% detected while the one sample area with canals produced a meagre 23% success rate in detecting the seventy identified from air photo interpretation.

It is good to see archaeological use of remoter sensed images. *Thailand* analyses the methods and problems and shows, perhaps, the current level of attainment possible using satellite imagery. I found it slightly lacking in the information I wanted to know – mostly related to the size of the features (like just how wide were the canals he couldn't find?) which is a crucial factor in their detection, by both the sensor and the image interpreter. One method of digital enhancement was used – as a last-ditch attempt to find canals rather than as a routine part of the image interpretation method – but offered little advantage over the standard false-coloured scene. Interactive image enhancement and digital classification found so useful by Cox (1992, 257-260) to aid detection of wetland areas (at scales up to 1:100,000) was not undertaken and may, or may not, have improved recognition of some of the minor features.

*Stonehenge* presents an altogether different approach and notes observations made from study of a 10 x 8 printed extract from a single SPOT scene which covered most of my Danebury area (Palmer 1984 – was it really that long ago!) and that around Stonehenge (RCHME 1979 and unpublished mapping completed in 1991 by RCHME). SPOT panchromatic imagery has a resolution of 10m so quite what was expected to be achieved is unclear. Major modern features are clearly visible, especially those with long linear characteristics (Boscombe Down airfield) and individual fields show by virtue of reflectance from different crops, but the
archaeology...? All hillforts in the area could be identified by means of their shape rather than by their ramparts and Stonehenge was pinpointed as an ovoid feature – the visitor footpath! More interesting was the ability to trace Roman roads as linear features, usually reflecting modern field divisions, which suggests potential for the detection of other linear features of earlier date.

It would be easy to scorn Stonehenge as the work of an amateur with a magnifying glass but this work is really testing the limits of resolution of the available imagery. Correspondence with him (in the hope that he may be steered towards looking for parts of the linear ditch network) provided an update on the published paper. Using a larger SPOT panchromatic picture as well as a Landsat TM image (resolution at 25m) he is now able to identify grass-covered round barrows in cultivated fields and notes that the inner ditch of Figsbury Ring is visible on both sources. That, I think, is progress.

The work described in both papers is still at the level of identifying the known rather than discovering the unknown but is of no less value for that as it provides yardsticks on which to base future work on 'unknowns'. This sort of thing needs a bit of encouragement and broadcasting so that, when the resolution is sufficient, we are at least used to the methods of searching for, and interpreting, the media. My current opinion – for the UK and much of Europe – is to forget the archaeological features and use the range of remotely sensed data to define natural features. I would be very interested to see just what could be done in terms of roddon and soil mapping in the fens to continue that begun by Donoghue and Shennan (Donoghue 1989) or to identify and map the alluvial deposits that offer patches of good preservation on, for example, gravel terraces.

References
CLUES ABOUT CROPMARK FORMATION

Anthony Crawshaw

English Heritage have recently started a programme of monitoring burial conditions at an arable site near Market Deeping. This is with a view to choosing the best conditions for reburial and to help predict the state of preservation of organic remains at sites. The parameters being monitored include acidity, water table, oxidising/reducing conditions and soil moisture content. This last is being measured directly by neutron absorption, as opposed to the indirect calculation of soil moisture deficit (SMD) by the Meteorological Office. Soil moisture content ties in with the quality of cropmarks. SMD squares are quite large, so correlation with any particular cropmark site may not be very good. Measurements over a period (the experiment is due to last ten years) at a cropmark site could be most useful in determining the stage in the crop growth cycle at which water shortage is important. Trouble is, we don't know if there are any cropmarks in the field..... !

Editorial note:

Oh yes we do.... The site is one that was identified by the Fenland Management Project (FMP) as a target for further work following its identification during the Fenland Survey. Field walking for the Survey produced sherds of middle iron age and Roman date and the site, covering at least 0.5 hectares was noted to span a watercourse. It lies on an alluviated gravel terrace of the river Welland and was designated Market Deeping 2 (MAD 2) by Hayes and Lane (1992, 187-188). Small-scale excavation was undertaken as part of the FMP and produced an embarrassment of finds – waterlogged organic material as well as ceramics, stone and metalwork (Lane 1992). The monitoring noted by Crawshaw above is a result of this work.

The Market Deeping area is part of the Lincolnshire Fenlands that I have mapped for the NMP and the relevant extract is illustrated as a composite AERIAL plot. The actual area around MAD 2 shows several features which I had mapped as 'dubious archaeological'. With the knowledge now available these should perhaps be reclassified as 'archaeological'. I have inked over them in the illustration to aid recognition. The area was photographed as an archaeological target on two dates, 18 May 1979 (TF1511/1/104-105 and 1511/2/108-109) and 25 July 1979 (TF1511/4/335-338) with the latter providing the more distinct prints on which nearby features (ditches) produced light-coloured crop marks. MAD 2 (the black blob) lay under, and within, a large dark area (stippled), presumably damper and/or deeper soil which is possibly also mixed with the typical darker settlement spread common to Fenland sites. Irregularities can be seen within this dark area (the sites was identified as 'mounded' during field work) but little was showing clearly enough to be confidently interpreted as 'archaeological'. The density of adjacent features mapped from aerial photographs suggests the possibility of more ditched features within the MAD 2 area and the excavation located ditched enclosures. Crop marked enclosures certainly exist in adjacent areas and may well be subject to the same variables that are monitored at MAD 2 itself.

The EH monitoring programme may thus produce results of some relevance to crop mark formation and it would be worth trying to link a formal aerial element into that study and it
will certainly be added to my list of targets for future reconnaissance and recording. This site must provide a case for photography whether or not anything is showing. As with most (all) Fenland sites it is probable that their survival in waterlogged condition is more dependant on the artificially maintained water level of the drainage systems than of any causes due to nature or farm management.

References


[Fenland Research can be obtained from Cambridge Archaeological Unit, Department of Archaeology, Downing Street, Cambridge CB2 3DZ]
A new issue of AERIAL - Version 4.20
John G.B. Haigh

On seeing this title, those who are acquainted with my AERIAL program may be inclined to ask the question: Why on earth should we need a new version of AERIAL? For anyone who is not so acquainted, I shall start by filling in a little of the background. I wrote the first version of the program some dozen years ago, in response to a direct request for a simple program that would take digitised outlines from an aerial photograph and rectify them into map co-ordinates. Almost immediately there was substantial interest in the program, and I began to receive requests for versions that operated in slightly differing ways on a variety of different computers. The program acquired its name because at one stage I intended to produce alternative software, applying similar plotting techniques to terrestrial archaeological survey. The second program was rapidly made redundant by commercial developments, but the contrasting name AERIAL has conveniently stuck.

Over the years, in response to the comments of regular users, the nature of the AERIAL program began to change quite rapidly. It was transferred between a variety of different computer systems, each representing the commercial standard for its day; currently it is recommended for a fast, modern PC-compatible machine, with a good colour display, and running under a recent version of DOS. It acquired the ability to account for reasonable variations in contour height, rather than assuming a simple plane-to-plane transformation. Its flexibility was increased by the incorporation of various graphical facilities, not strictly concerned with the process of rectification. It was modified to interface to a variety of digitising tablets (which provide the outlines from the photograph), and to a variety of plotters. The first steps were taken towards producing output files which could be transferred to commercial CAD or GIS systems.

The last major revision, Version 4.13, appeared early in 1992, incorporating all these developments, some of them perhaps in a rather piecemeal fashion. In answer to my opening question, I felt that the time had come to produce a new, definitive version of the program, with the aims of rationalising the developments and giving the best possible response to users' comments. Having taken several opportunities to consult regular users, in Autumn 1992 I circulated a specification for the new issue, which I provisionally designated as Version 4.20. I have to say that I was somewhat daunted by the prospect of making a complete revision to the program, together with the user's manual and the supporting utilities, but it eventually appeared around Easter 1993. I have now circulated over thirty copies, and I trust that most regular users have received either the program or notification of its existence. Users who received early copies will be aware that there were several minor revisions before all the bugs were eradicated!

Following users' comments, I have incorporated into AERIAL 4.20 a host of detailed improvements from earlier versions. There seems little point in attempting to list them all, but I think the following are particularly significant:

- The menu structure has been modified to help users, particularly inexperienced ones, find their way through the program's many levels. I have made discreet use of colour (I hope users agree!) to emphasise the significance of certain parts of the textual display.
The use of the configuration file, called AERIAL.CFG in Version 4.20, has been greatly extended, to enable users to match the operation of the program to their precise requirements, by specifying the interfaces to the digitiser and plotter, and some details of the graphics display.

In particular, you can now configure AERIAL to show your choice of colours (including background) on the graphics display; for example, you are able to set line colours corresponding to those used by AutoCAD.

Some editing facilities are now available as you digitise information from a photograph or map. When you realise an error has occurred, you can back-track through up to the last forty points to remove the error, and then replace it with the correct outline.

There are improved facilities for inputting outlines and discrete distributions, in any combination, direct from maps, to provide a visual check on the rectified co-ordinates.

Although AERIAL 4.20 normally expects map information to be given in the form of British National Grid References, it may be configured to operate entirely in terms of numerical co-ordinates, which overseas users are likely to prefer. Although I strongly advise users to stick to one mode or the other, I have tried to ensure that files produced in one mode are readable in the other. The internal operations of the program, as well as many of the files it produces, are based entirely on numerical co-ordinates; grid references are produced solely for the benefit of British users.

The reliability and efficiency of the routines which account for variations in contour height have been improved. The search for the co-ordinates of the camera station, needed to establish a 3-D projection, is much more flexible and, in the unlikely event of its sticking in an infinite loop, you can escape without crashing the program.

I have made every effort to improve the quality of the User's Manual. The main body of the manual provides a step-by-step guide through the operation of the program for inexperienced users; it gives a complete listing of all the menus, in the order in which they are likely to be encountered. For the more advanced user, there are a series of eleven appendices, covering such topics as: the overall menu structure; the structures of data files produced by AERIAL; the structure of the configuration file; setting up the interface to the digitiser and plotter; converting results to DXF (Data eXchange Format) files.

In addition to the AERIAL program itself, I supply users with several small utility programs. The first, CONVAER, converts data files from older versions to the current format, and is unlikely to be of interest to new users; the second, COMIN, provides a straightforward means to check communication with the digitising tablet, essential for the successful operation of AERIAL; the third, PLOTAER, provides a simple way to obtain hard copy from output files; and the fourth, CADDXF, allows results to be converted into a DXF format, which is acceptable to the majority of CAD and GIS systems.

Output from AERIAL 4.20 may be obtained in either of two forms of computer file. The first is in Hewlett-Packard Graphics Language (HPGL format), and may be transmitted to any Hewlett-Packard plotter, of size A3 or larger, using the PRINT command described in the MS-DOS User's Guide; since the great majority of plotters on the market are HPGL-compatible, almost any plotter is suitable. The advantages of using an intermediate data file, rather than direct output to the plotter, are that multiple copies may be readily obtained, and that
the output can be transferred to any PC computer with a plotter. A minor disadvantage is that
DOS PRINT needs hard-wired handshaking, which is difficult for some users; the purpose of
my PLOTAER utility is to allow software handshaking to be used instead. Some modern word
processors, such as WordPerfect and Microsoft Word, allow HPGL files to be incorporated into
their documents, providing an alternative form of hard copy, an example of which is shown
below.

The second form of output file contains a stream of rectified map co-ordinates, interspersed
with ASCII messages, and tagged with colour information. These I refer to as CAD files,
although they are not intended to be directly compatible with any CAD system. You can
re-input them to AERIAL, which allows you to combine and modify their information, until the
screen display assures you that you have a satisfactory record of your site. My CADDXF utility
allows you to convert your final CAD file into DXF format; the DXF file should be compatible
with your CAD or GIS package, which you may then use for further enhancement of the results.

The development of the CADDXF utility represents the final stage of the AERIAL project as
it was specified a few years ago. It has quite reasonably prompted another question in the minds
of some users: Why do you not use DXF files for the transfer of information directly into and
out of AERIAL? I think there are two significant answers. First, my CAD files are much more
compact than DXF files, which have a cumbersome structure; typically a CAD file is only one
third of the size of a DXF file, containing equivalent information. Consequently CAD files
provide much more efficient data storage, and better speed of transfer to and from AERIAL.
Secondly, although DXF is recognised as a universal standard, it is a very diffuse standard, and
different software houses implement it many different ways. By maintaining CADDXF as a
utility, separate from the main program, I am able to develop the interface to DXF, without
having continually to issue new versions of AERIAL.

In fact, CADDXF has developed considerably since the appearance of AERIAL 4.20. It can
now provide DXF files with outlines represented either as continuous POLYLINEs, or
alternatively in 'exploded' format, where everything is broken into separate line segments, and
which seems to be preferred by some GIS packages. The new CADDXF utility is also capable
of performing the reverse process, converting certain types of DXF file into AERIAL CAD files; this facility has already been tested by importing digitising maps from GIS to AERIAL. The variability of DXF standards can make the process quite tricky, especially when pen colours are to be retained, and the new version of CADDXF has not yet been generally issued, but I will be happy to supply a copy to any registered users of AERIAL who request it. The important point is that AERIAL is now capable of been used both as a free-standing system and as an accessory to almost any GIS package.

Perhaps one more question remains to be answered: Are there likely to be any further significant revisions of AERIAL? The answer is almost certainly yes! As I have already said, I produced Version 4.20 in response to the comments of users of earlier versions; almost all the new features - the simplified menu structure, the editing of the data stream from the digitiser, the ability to change the colours on the graphics display, the creation of DXF files - came from users' suggestions. I have been unable to satisfy at least one request within a reasonable time-scale, namely a facility to edit control information without having to abandon the current file, and perhaps to quit the AERIAL program.

I regard the editing of control information as a very desirable feature of the program, but to provide such a facility presents difficulties from two different viewpoints. The first is in providing an interface which gives the user a clear view of the control data, and makes apparent what changes are being introduced, to ensure that the final state of the data is no worse than the initial state. The second is to guide the user into making appropriate changes to the data. When you examine the errors introduced by fitting a particular set of control data, it is usually far from obvious which particular value is causing the greatest problem. A bad control point may pull the other data out, without itself showing a particularly large error; furthermore it is not usually clear whether it is the map co-ordinates which are incorrect or the photograph co-ordinates.

My current interest is in the rectification of digitised raster images, of which I hope to write in a separate article. The mathematical processes are essentially the same as those used in AERIAL, but any errors in the control information become even more glaringly obvious. Consequently, I feel a pressing need to investigate the editing of control data, and I hope that my conclusions will eventually be fed back into AERIAL itself. Hence I expect a new version to appear in due course, incorporating this and other features which will almost certainly have occurred to users in the meantime.

The AERIAL program will almost certainly continue to develop in response to the comments of its users. I do not intend to issue new versions with each minor modification, but I shall try to offer new definitive versions from time to time, probably at roughly annual intervals. Although I cannot claim to be other than a mathematics teacher, I am keenly interested in archaeology, especially in the application of techniques of remote sensing. AERIAL has brought me into close touch with a wide range of aerial archaeologists, and I always try to be sensitive to their requirements.

It would be inappropriate for me to conclude an article on this subject without expressing my grateful thanks to the Aerial Photography Unit of the Royal Commission on the Ancient and Historical Monuments of Scotland, whose continued financial and personal support has provided the main resource for the development of this work.
RECTIFY: a program package for the rectification and interpretation of aerial archaeological photos

RECTIFY has been adapted for IBM-PCs by the Kantonarchäologie Zürich, Switzerland from programs developed by Irmela Herzog, Landesmuseum, Bonn, Germany. The package combines a geographic information system (Mapix) and a database (Superbase), both of which can also be used separately.

Photographs and plans are scanned to provide input and thus provide greater accuracy than if digitised. Each raster image can be corrected for geometrical errors in the paper and, using plans of 1:500 or 1:1000 in which one pixel size represents 0.1 x 0.1 m, accuracy can be extremely high. After selecting the area to be rectified and the border of the photograph at least three points must be identified on the plan and the photograph. Up to six different methods of rectification are available depending on the number of control points defined and whether digital terrain modelling is included. The program makes suggestions as to which method will provide optimum results. (Technical details and illustrated examples may be found in Chapter 5 of Archaeological Prospecting and Remote Sensing – see 'Books of Interest?

The package is capable of rectifying a whole photograph or lines, points and areas representing interpreted archaeological information. Several photographs can be processed and combined to make a composite image showing features recorded at different dates and any combination of these results can be printed or plotted at almost any scale thus allowing maximum flexibility. The ASCII files resulting from interpretation can be read by other programs and the scanned images are stored in standard PCX format enabling their easy import to many other programs.

Features
- orthophoto production
- overlay of orthophoto and plan
- rectification of interpretations without the orthophoto
- no special camera is needed to produce the photographs
- a minimum of three control points is necessary and they can be even outside the border of the photograph
- use of digital terrain model if available
- direct control of all parameters (even resolution) by the user
- menu-driven Windows program
- allows the representation and management of a database in the GIS environment

Minimal requirements
- 386 processor (486DX, 33 MHz is highly recommended
- 3 MB free extended memory
- VGA card capable of representing 256 shades of grey (a resolution of 1024 x 768 is highly recommended)
- at least 40 MB free disk space
- Windows 3.0 or higher
- mouse
- scanner to input plans and photographs (256 shades of grey)

Costs
25’000.- SFr. (package, Superbase and Mapix) with installation and training on site.

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Towards the rectification of digital images

John G.B. Haigh and Stanley S. Ipson

One of us (JGBH) has described recent developments of his AERIAL program elsewhere in this issue. AERIAL aims to provide a straightforward technique for extracting outlines from aerial photographs and rectifying them into map co-ordinates, with the aid of equipment which is likely to be within the budget of almost any group of aerial archaeologists. In the present paper we look at the possibilities for rectifying the whole image, as opposed to outlines extracted from it.

The idea of image rectification is far from new; Dr Irwin Scollar was already applying it to archaeological photographs during the 1970’s, but he used some of the most advanced computers available at that date, in conjunction with highly specialised imaging equipment. Programs derived from those developed by Dr Scollar are now generally available, but at a very considerable expense. The recent advances in computing hardware and in imaging techniques create the possibility of offering similar facilities at a very much more reasonable cost. We are attempting to produce simple software, which may put such facilities within the reach of most aerial archaeologists.

For a number of years, one of us (SSI) has been developing a suite of software for the purposes of general image processing. This suite reproduces the facilities of several commercial packages but, because we have access to the source code, it has the crucial advantage that we can adapt it for any particular purpose. We therefore decided to combine the relevant subroutines from AERIAL with the appropriate sections of the imaging suite.

In the first instance, the images were captured at a resolution of 512 x 512 pixels and 256 grey levels, using a CCD video camera, and were held in the computer by means of a Matrox PIP1024 framestore. The usual AERIAL transformations were applied to the captured image, to produce a rectified image, again of 512 x 512 resolution, in another of the four partitions of the framestore. We were able to adjust the program to display any section of the rectified plan at any desired scale, and we were well satisfied by the initial results.

It was obvious, however, that there were some difficulties with our initial approach to the problem. The most conspicuous difficulty was that images captured by the camera lacked sharpness and resolution; this could be due to a variety of courses, including our failure to optimise the lighting conditions to the characteristics of the camera. Although it is possible to restore the images to an extent using standard sharpening techniques, the results are disappointing compared to those from the flat-bed digital scanning devices which are now widely available. We are currently concentrating on scanned images; the main disadvantage of the majority of scanners is that they are applicable only to photographic prints, and not to transparent materials. Generally speaking, it is necessary to use more specialised devices, to obtain images from slides or negatives.

There is no particular reason why scanned images need to match the 512 x 512 image format appropriate to the PIP1024 framestore. For a picture of given dimensions, scanners usually offer a range of digital images, whose sizes vary according to the selected resolution. We have
found that, for typical images from aerial archaeology, it is appropriate to choose an image which is a little smaller than 1000 1000 pixels. Such an image is small enough to be stored and manipulated conveniently, and yet is usually capable of giving a precision of 1 metre in the rectified plan. The systems based on Dr Scollar’s work are capable of providing a much higher precision, but aerial archaeologists should ask themselves whether they really need such high precision and, indeed, whether it can be justified when compared with the accuracy of the majority of working maps.

In order to accommodate the range of differing image sizes, we modified our program to allow the image to be held in extended computer memory, using the framestore simply as a display device. With a size greater than 512 512, it is possible to view either a selected section of the image or the entire image at reduced resolution. At present, the software still produces a 512 512 image showing any section of the rectified plan at any chosen scale, but it could be modified to produce an image of any desired size.

Another difficulty with our initial program is that, although the Matrox framestore is a cost-effective device for general imaging, it is not something that the majority of aerial archaeologists are likely to possess. In principle, the imaging functions required here could equally well be handled by the VGA card (or better still, by a Super VGA card), which is a common feature of almost all modern PC microcomputers. We have produced another version of our program, which will take a grey-scale image stored as a TIFF file (Tagged Image File Format) and convert its contents to a 640 480 rectified image, which fills the VGA display and which is output as another TIFF file.

This version of our program takes the input information directly from disk file, so that it may run on any PC-compatible computer, equipped with a VGA display. We are also working on alternative versions, which hold the input image in extended memory, and which utilise various standards of Super VGA, up to 1024 768 pixels. The first modification reduces run-times appreciably, and the second allows much more detail to be shown in the displayed images. The disadvantage is that care has to be taken to ensure that the facilities of the host computer match the requirements of the software.

We have found that TIFF provides a convenient format for the storage and transfer of images. It has a fairly simple specification for reading and writing, and is available in the majority of commercial imaging packages. Scanner output can normally be obtained as a TIFF file, and then passed to either of our programs. Even when there is good reason to use other standard formats, say GIF or Targa, for the storage of the image, they can readily be converted to and from TIFF.

An interesting sideline is that the algorithm to rectify a digital image of uneven ground is slightly simpler than that used by AERIAL. This is because the program projects each point in the rectified image to the corresponding point in the photograph, where it determines the intensity. Since the rectified image is equivalent to the map, the contour height may be ascertained by direct reference to the DTM. On the other hand, AERIAL starts with a feature seen in the photograph, and backtracks through the camera system to determine the coordinates of the corresponding point on the ground. For the contour height to be determined, the DTM must be projected onto the plane of the photograph, and then re-initialised over that.
plane. The need to re-initialise the DTM may lead to a small, but discernible, increase in the errors.

Although we cannot attribute their success entirely to dispensing with the need to project the DTM, the new programs have produced some very satisfying results. In order to assess the accuracy of these results, we have to overcome a further problem: How do you compare the rectified plans from several different photographs of the same site? Our first solution was to hold the rectified images in different partitions of the Matrox framestore, and then to flick quickly between them; any differences in the results caused a flicker on the display. This gave us a check the accuracy of our results, but hardly in a manner which we could demonstrate outside our laboratory.

Fortunately we found that commercial software offered a solution to our problem. Most image-editing packages allow three monochrome images to be combined into a single colour image; the package with which we are familiar is Aldus PhotoStyler, but there are several similar products on the market. Given three rectified images of the same site, you may take them to be the blue, green, and red components of the combined image; if you have only two images, take one as the magenta (red and blue) component and the other as the green component. The result should appear in shades of grey, with any differences showing up as colour fringes.

While this is a very good method of assessing the accuracy on the computer display, how can you obtain a hard copy of the results, for record or for publication? Although colour printers are now available at a reasonable cost, we have not found them to be sharp enough for this purpose. Again image editors can provide a solution, by converting the combined colour image into a monochrome image, which will show signs of blurring where there are discrepancies between the rectified images. The monochrome image is readily and accurately output to a laser printer.

Our illustration shows such an image of a site near Stranraer, in southern Scotland, as a composite of two rectified photographs. Two ring ditches are clearly visible, together with a large number of post-holes, arranged in various alignments and curvilinear patterns. The agreement between the two underlying images is so good that it is almost impossible to distinguish between them, except in the corners of the print where some of the image boundaries can just be discerned. Since the post-holes are quite small, precise agreement was necessary to make them clearly visible in the composite image. We have also checked the agreement with the map and found it to be quite satisfactory, allowing for some apparent variation in the boundaries since the map was drawn.

Because rectified images can be obtained relatively quickly, compared with the manual extraction of outlines using AERIAL, and because small discrepancies can be spotted so easily, users are likely to look for better agreement than they might expect from AERIAL. Unfortunately, you are faced with the same problem as in AERIAL, since you cannot expect accurate results unless you have reliable control information. Because the new programs are so sensitive to errors, the control information has to be determined with particular care. For instance, we have experienced difficulty in consistently estimating the centre point of a boundary hedge, which was seen from opposite sides in different photographs.
As yet, our new programs do not deal with control in a 'user friendly' manner; we leave it to the user to construct a file which contains the relevant control information. We are currently investigating how the software can facilitate the construction of the control file, and then allow for adjustment to provide the optimum results. In the longer term, we also hope that the software will also be able to assist in the construction of the DTM, for which we are currently using the AERIAL program.

The progress we have made so far suggests that it will not be long before the majority of aerial archaeologists will be able to take advantage of image rectification. The cost of equipment is no longer excessive: Good quality scanners are available at a reasonable price; the cost of computing power continues to tumble; the computer's internal display is quite satisfactory for most purposes; laser printers to provide hardcopy output are falling in price. On the other hand, the image-editing software is somewhat specialised, and is therefore likely to remain fairly expensive.

Perhaps the major obstacle for many workers will be a slight change in philosophy. The current tendency is to interpret each photograph carefully, producing an overlay with detailed outlines, then to trace out the outlines on the digitising tablet, then to rectify the outlines, and finally to compare results from different photographs. With digital images, the order of operations would be substantially reversed: You would first rectify the images, then you would compare them to produce a composite image from all available material, and finally you would interpret the composite image. Of course, you may refer to the original material during interpretation, but it would only be necessary to interpret one composite image in detail, rather than each of the individual photographs. Consequently the efficiency of the whole process should be greatly improved.

Our illustration is based on original material provided by the Aerial Photography Unit of the Royal Commission on the Ancient and Historical Monuments of Scotland, to whom we are grateful for permission to reproduce it.
Plan of a site near Stranraer shown as the composite of rectified images from two aerial photographs; the area of overlap between the images is apparent from the sharp linear boundaries in the corners of the composite image.
AARGnews 7 (September 1993)

TECHNICAL NEWS

Digital photogrammetry

We gave ourselves a day out at Milton Keynes recently to attend a demonstration of some of the latest photogrammetry equipment at Leica.

The RC30 was very nice but a bit big to fit into a Cessna 150. Used in interface with a GPS all the drudge is taken out of flight planning and management even to the extent that the cover of adjacent runs of photographs can be examined for side overlap while at the target and so allow fill-in photos to be taken, if necessary, on the one visit. Aerofilms have been using RC30s for a while now and were pleased with them and their results. No prices were mentioned (nor for anything else that we were shown) but all equipment can be hired or bought.

Digital photogrammetric stations were what had attracted me on the initial blurbs we received and we were not disappointed by their demonstration. There were two models set up which showed the top of the range equipment and a more basic version – unfortunately we didn’t have time to fully appreciate the latter. The DPW (Digital Photogrammetric Workstation) was a wonderful device. Images are scanned in and linked to camera and ground control information. From here the games begin. We were given polarised glasses and grouped around the screen. The 3-D effect was perfectly clear at all scales (images could be zoomed in or out by keyed commands) and the demonstration included the contouring of a selected polygon. Contours too appeared on screen in three dimensions. The end display was to use the vertical stereo pairs to produce a 3-D model of the target, in this case a town in America. As you will be aware one effect of height distortion is that buildings (for example) at the edge of photographs show obliquely and their elevations can be seen. The software used this information to paint the walls of the modelled structures and allowed the user to fly around the town on screen. Similar demonstrations have been shown on TV recently – I might remember seeing one around the pyramids or Japanese burial mounds (see also Antiquity 67 (1993), 349-354) – and provide quite spectacular demonstrations of the power of technology. The DPW can be PC or SPARC driven and requires huge amounts of memory and disks measured in Gigabytes as well as matched peripherals, like the optically stable scanner. Start saving now....

The ‘low cost entry level’ apparatus, the DVP (Digital Video Plotter), was more within reach, and possibly more useful to the archaeological interpreter. It is also a deskful – rather than the roomful of the DPW – and presumably is equally less in cost. It was designed to serve as a low cost instrument to facilitate rapid production of topographic maps in countries which had the need for them. Thus its scanned input is received from the usual desk-top scanners and the system can be run on the usual range of PCs linked to a digitising tablet. Scanned images are viewed through a mirror-type stereoscope suspended in front of the screen. Maps can be superimposed on screen and new information (the ‘crop mark’ maybe) added via the digitiser (for X and Y values) and mouse (for Z).

We were not sure how easily portable the DPW system was but, if there is sufficient interest (and maybe if we could find out a price) it would certainly seem worth asking for a demonstration of the DVP at AARG – or maybe a select AARG visit to Leica. Any takers?

PC drawing packages – continued

The figure in Books of Interest? was produced using AERIAL 4.2 and Professional Draw (PRODRAW). The original was a plan, but think of it as an aerial photograph as, for this application, there is no difference. Control points were digitised as usual and the site input as a series of sausages (now there’s one for MORPH!) showing ditch widths. Still in AERIAL, the resulting DIG file was converted to a CAD file which was then further rearranged (using CADDXF, part of the AERIAL package) to DXF format. (DXF stands for Data eXchange Format, a code which supposedly allows file exchange...
to and from various software. Unfortunately there are many forms of DXF and they don't all talk to one another.

The DXF file was then imported into PRODRAW and looked like standard AERIAL plotted output, as below.

The shaky digitised lines could then be manually smoothed and otherwise altered using basic PRODRAW tools. Additions could be made at 400% (+) magnification and files combined as in hand-drawn mapping and, for a finished drawing text, key, scale and north point added. Filling in of polygons (sausages) is a press-button operation and colour coding or differential shading of features can be incorporated if this is of any value. I have not yet quite worked out how to output at standard scales, but presumably this is not too impossible.

It's not as difficult as it may appear and is a step towards producing the form of finished mapping that I think ought to be the basis of GIS (etc) files rather than direct AERIAL output as it has been through the final interpretative stages of compilation that completes the process from aerial photograph to plan.

PRODRAW is a graphics package not a fully-fledged CAD program. Costs of the former may range between £100 and £400 while CAD reaches £2000+. PRODRAW had good reviews and we bought it as a £100 promotional offer. Apart from the above games it has been useful for other graphics and for its range of fonts. It is basically similar to other graphics packages and potential buyers are advised to spend a while with a PC magazine to seek bargain prices.

A review of available CAD programs appeared in a recent issue of Archaeological Computing Newsletter (Issue 35, June 1993) as 'CAD without Autocad, is it possible?' by Peter Davenport.
NAPLIB Directory Of Aerial Photographic Collections

In The United Kingdom 1993

A notable advance in the information available to both professionals and public about sources of aerial photographs. Over 200 sources are listed with collections classified by key symbols denoting type of photography, angle of view, coverage and fly cover availability. As well as picture libraries and resource centres, other organizations which include aerial photography collections forming part of larger records holdings are included.

Compiled by NAPLIB the introduction details the history, uses and copyright of aerial photographs, and the main alphabetical list of collections is followed by post code location and geographical indexes for pinpointing requirements.

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REVIEW


Actually, all that English Heritage were prepared to send AARGnews for review was the section on 'The Mucking cropmarks' by D N Riley. This amounts to 3 pages plus one fold-out plan (pp 23-5, with fig 7). (Citations of other publications in Riley's text remain cryptic because the bibliography is in another part of the volume, and they did not send a copy of that.) This review is perforce limited to Riley's contribution, taken out of the context of the volume as a whole.

The context is nevertheless of considerable importance, and I shall accordingly preface the review proper with some comments on the background to this piece of work.

During my time as Chairman of the CBA Aerial Archaeology Committee I tried to push the idea that excavators of crop-mark sites should routinely include in their final reports a section (however small) on how far and how well the crop-mark evidence corresponded to what they found in the ground. Were some features too narrow or too shallow to show up? What were the critical dimensions? Did features of similar dimensions sometimes show and sometimes not? Did this correspond to differences in their respective fillings? And so on. These were observations that must have been made by an intelligent excavation director, but were seldom put on record in the report, because they contributed nothing to understanding the original uses of the excavated remains. But for archaeological photo-interpretation they are important data.

Yes, I know: no amount of excavation feedback will tell us how to interpret a given set of crop-marks on the photographs in front of us. Every site is different, and so is the behaviour of crops in every season. But it is still useful to know when our interpretations have appeared to be successful in the light of excavation and when not. Without some element of ground truth photointerpretation could become a meaningless game with no real archaeological content. Knowledge of some of the meaner tricks played by buried remains and other features on the photointerpreter will instil caution in the way that future interpretations are expressed. And, assuming that excavators read other people's excavation reports, they too would eventually build up a picture of what features they could actually expect to see appearing in terms of crop-marks and what even the finest marks would miss.

Now, Mucking is the largest and most complete crop-mark excavation in the country, if not the world, and publication of its final report is an archaeological event of some magnitude. Here, if anywhere, there should be scope for the kind of commentary I have been suggesting. Margaret Jones herself made a number of pertinent comments at a conference in Colchester in 1979 (Jones 1980). Unfortunately, a paper at the CBA's Nottingham conference in 1980 presented a plan of the Mucking cropmarks that was a travesty of what such a plan should be. The computer plot had been hastily produced by someone with no experience or understanding of archaeological interpretation or of the subtleties that a trained archaeological photo-interpreter is rightly expected to represent.

It was essential that this should not be allowed to stand as the definitive crop-mark
plot for Mucking, so I lobbied the British Museum, where the Mucking archive was then housed; I visited Ann Clark who could not have been more helpful, within the limits of what was genuinely feasible; and I was delighted eventually to learn that Derrick Riley had agreed to take on writing a crop-mark section in the final report. Riley had already produced an excellent study of the crop-marks in and around the North Enclosure (Riley 1987, 96-8) and was clearly the right person to attempt a similar study of the rest of the excavated area.

So what has he been able to achieve?

First of all, the plan, A very satisfactory plan of the crop-marks has been produced which totally supersedes that hitherto current. As expected, there were substantial survey problems. My original suggestion had been that, since the main object was not location, but comparison between the cropmarks and the features excavated, it would be legitimate to use the excavation to locate the crop-marks; but this was to overestimate not merely the accuracy but also the internal consistency of the excavation survey. With the assistance of the Air Photography Unit of RCHME (three of whose members are personally acknowledged) the evidence of 11 selected photographs was combined and related (by means of some 1969 RAF cover) to the surrounding area and so to the National Grid. The final drawing is Riley's and uses the same stippled technique as his earlier Mucking study. Certain and probable archaeological features are plotted with great subtlety. It is high praise when I say that he knows when, and indeed how, to leave crop-marks ambiguous. Riley himself notes that 'no definite gap could be seen in the narrow north-west entrance through the outer ditch of the South Rings'. This is true, but there is a hint of it on his plan, just as there is a hint of it on the photographs. Certain and probable geological marks, like those of frost-cracks, are generally omitted, but in one sample area all the background noise is transcribed, to illustrate the difficulty of separating archaeological marks such as those of graves from geological marks produced by minor periglacial features. (It is nevertheless disconcerting to see this sample area baldly labelled 'area of periglacial features' as if such features were absent elsewhere, whereas in fact they were all over the place, as the accompanying text makes clear.)

When it comes to comparing crop-marks with the results of excavation, there is little that can be added to the comments of Margaret Jones and of Riley himself, as already cited. This is disappointing, though it is useful to have them restated here in the excavation report as opposed to specialist aerial archaeology publications. The conditions in which much of the site was excavated - rapid rescue excavation only weeks before gravel-working - did not allow such detailed recording of archaeological deposits as Riley could use at the North Enclosure. Comparison of the crop-mark plan with the excavation plan (by Riley himself, not by me, as the excavation plan was not sent for review) shows that about 80% of the 213 excavated Grubenhäuser showed up as crop-marks, but only 20% of over 100 excavated round houses. The most important observation for photo-interpretation is that the very clear marks of many Grubenhäuser are not caused by their steep sides or by deep penetration of the subsoil, but by a layer of ash and charcoal on their bottom. When this layer was absent, marks were only faint.
Other conclusions are unsurprising: pits and ditches afford clearer marks when wide, deep or filled with loam, but are less clearly seen when narrow, shallow or filled with gravel. Those less than 0.5m across caused marks only rarely. These results are as we should expect; their significance is that they will be seen by those who use this excavation report. For AARGnews readers the attraction will be to compare the crop-mark plot with the excavation plan for themselves - but whether this is worth £25 I have not had the opportunity to find out.

References


Jones, MU 1980 'Mucking, Essex: the reality beneath the crop marks', Aerial Archaeology, 4 (1979), 65-76.

Riley, DN 1987 Air Photography and Archaeology (London).

David Wilson
BOOKS (AND PAPERS) OF INTEREST?


Of note for two reasons of which the first is the reduction in price. This book has the highly technical content of most of Scollar's work – half relevant to aerial photography, half to geophysical methods – and between the mathematics I found much that was of interest. The book provides a differently slanted introductory section to the usual hows and whys of 'archaeological aerial photography' which contains much of value. In this part lies the second reason for purchase – a comment on 'interpretation' of vertical air photographs and fantasy (p 27). But if I was to quote the three pertinent sentences you wouldn't buy the book!

'South Coast from the Air. By Andrew Bray and Patrick Roach. Self published. 1989. £12.95
Remaindered price (?or misprinted label) £2.95.

Aimed at sailors who may like an aerial view of where they are, or have been, the 'south coast' of this book extends from Swanage to Beachy Head through a series of pictures and accompanying nautical text. Quality of the photographs, and their printing, is hugely variable and tends to mar the appearance of the book. I imagine that its use would be more appropriate as a cabin table conversation piece ('Oh, yo ho ho, do you remember when...') than of much practical application and, indeed, the navigator is advised to use the proper pilot books. For AARG members it may be of interest as a series of seaside photos and for those of you who also take photographs of inter-tidal targets it may be pleasant to read of the difficulties encountered with flight planning for tides during the preparation of this book. I tend to avoid water unless it's been converted to beer and seeing the wash effect of powerboats among small yachts on some of these photographs I wonder how many dedicated sailors think similarly.

A self-explanatory title for work that formed part of Bob's PhD research (Prehistoric and Romano-British Settlement in the Solway Plain, Cumbria – in the press). His excavations were intended to establish dating and function of the sites and also to seek environmental evidence – all good stuff that we need as much of as possible. It is worth dwelling on the question of function (towards which a phosphate survey was undertaken) as the report seems a little cautious, perhaps rightly so, on this aspect. Was the enclosure used for stock? Phosphate suggests it was not as the highest values were outside the ditches – not as daft an answer as it seems as a (possibly) partially recorded ditch could form a field boundary for this purpose. But there are patches of high phosphate within the ditches and these, combined with a subjective view of the track to enclosure junction (see circled area in figure below) suggest to me the possibilities for stock movement control that may have been available using the ditched features plus a couple of hurdles or children. Look at the drawing and think about it – your comments will be welcome!


This Catalogue and its predecessors enable us to appreciate some of the aerial developments that have been going on in Scotland while, perhaps, the rest of us (you!) have been either a little slow to advance or too enmeshed in technological 'solutions'. I have a series of Catalogues dating from 1979 (the fourth year of reconnaissance) to this, the thirteenth. As would be expected over this time, presentation has improved dramatically – from the early typed and tabulated lists, through (I think?) elementary word processed copies with cover illustrations, to this DTP glossily printed and staple-bound version [maybe they'd like to print AARGnews?]. Design apart, the format of all are essentially the same – an introduction commenting on the year's flying conditions, followed by the catalogue divided into archaeological and architectural subjects and listed by Region. This latest issue has the addition of a distribution map (albeit just an outline of Scotland with no clues for we Sassanachs as to where which Regions are) and a number of photographs and rectified plans. The listing by Region and NMRS number (OS sheet number plus a unique site number) makes back checking through earlier Catalogues a relatively swift and easy task. An example: on page 24 there is a rectified plan of a Roman temporary camp at Edenwood and it is possible to trace the history of its photography back through earlier flying seasons by looking under 'Fife', the quarter sheet 'NO 31 SE'; and its number (39) – although the number is of little relevance to the search.

The Catalogue also shows the level of indexing which RCAHMS has achieved and I am impressed by the present design and its ease of use. All of the entries have a short description and it is hugely satisfying to see that so few of these are just 'cropmarks' (nor are there any 'building' entries in the architectural section!). Clearly the catalogue has been compiled after examination of the photographs has allowed an elementary archaeological classification to be ascribed, the basis, I assume, of RCAHMS's in-house
index and therefore of work which would be done whether published or not. It's a system which obviously works in, and for, Scotland where, presumably, an in-house index makes correlation of photographs even easier than looking through thirteen volumes.

From the point of view of my own research and commercial interests I could wish there was a similar series for England (and I remember that in early years of CUCAP St Joseph used to circulate an annual list – albeit in photograph order and thus extremely tedious to use on a topographical basis). Like the NLAP 'express service' I'd be prepared to pay for it as paper copy or on-line. Or maybe I should try and develop a Scottish aerial interest...?


I'd welcome comment from anyone who is more affected by this than I am (you who are SMR AARG members maybe). I have scanned the volume and read specifically the parts relevant to the aerial record and find a superbly constructed circular argument. We are told that the National Mapping Programme is designed to bring SMR aerial mapping to 'necessary standards of accuracy and consistency' (p 37): it is recommended that SMRs are responsible for primary recording from local sources while RCHME do the same from national sources (p viii): it is recognised that many SMRs employ staff on temporary contracts and that it is difficult to ensure 'continuity of expertise' (p 15): despite this, it is intended to develop arrangements for SMR secondment to RCHME for training (p 41): it is then again recommended that SMRs are responsible for primary recording (to nationally agreed standards) of information derived from air photographs – but now the 'local sources' no longer appears (p49). Unless I've got it wrong, and unless permanent SMR staff could be taught sensible air photo interpretation (and this would be a wonderful thing to happen), then doesn't it mean that any information added from AP sources after completion of NMP has the possibility of being of questionable standard (again)? Despite any comments to the contrary, I know that I am not the only person capable of interpreting air photos. I also know that some SMRs contain absolute archaeological rubbish under the guise of 'cropmarks' – although these, fortunately, are decreasing with time. So I have to ask whether the proposals for dealing with the aerial record have made any advance? Please SMR people, let me know!


Derrick's contribution is one of several in this first volume of the Mucking saga. Are we to take it as an example of the kind of report which should be included in all publications of excavated 'cropmarks'? If so it ought to be read by us all (and it is only 2½ pages) – or should it? I have read it several times, each time thinking I must be missing the point somewhere, but after each reading all I could think was, 'Why?'. We know of Derrick's interest in 'cropmarkology' and presumably this is part of the overall study as were the extracts in Air Photography and Archaeology. But I just can't see what the Mucking piece is actually saying (other than that different features produce different crop responses – not exactly new news!). Was there the hope to deduce an element of predictability beyond 'crop marks appear in the summer months'? And if so, how can it be applied?

[Derrick replied (from hospital) to these queries. His main point was that if, or when, excavations take place on crop marked sites then the excavation report ought to include 'something factual' about them and this ought to be an expected specialist contribution in all such reports. We know that the only way this is likely to happen is if we, as aerial photographers or photo interpreters, make the effort to do the necessary work and encourage its inclusion in relevant publications.]
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