AARGnews 10

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EDITORIAL

It seems ages since the last issue was put together. Potsdam hadn't happened – or if it had no one who went had time to write about it as AARG 94 was about to descend (or is it us – you – who descend on AARGs..?). Will anyone remember enough about either to put together a summary for this issue? One good thing about the Potsdam meeting was the opportunity to meet archaeologists from the more distant parts of Europe who were new to the aerial game. It was a happy and friendly meeting with no one trying to score points and most people willing to share experiences. Books were exchanged in preference to being sold (except by those of us who ran out of beer money!) and, as usual, we learned as much during the breaks as from the more formal presentations. One result of the meeting is to start the 'Wanted and For Sale' column in this issue and I hope that it gives many of you yet another excuse to scour the second hand book shops. There are some books worth buying on spec (for instance, David Wilson's *Photo Interpretation*, and the two CBA aerial Research Reports) and I'll be pleased to advise of any spare copies that members want to send east. Two further copies of Scollar's *Remote Sensing* appeared in a Cambridge shop, but at £65 they can stay there.

Before that meeting Otto Braasch floated the idea of mating British and European practitioners in a kind of 'uncle' relationship. Nothing formal came of it but contacts were made and I know that some of them have led to correspondence and, in at least two cases, a visit to Britain. The first visitor, back in December, was Michael Doneus from Vienna. Michael came to find out how we did what we do and visited CUCAP and RCHME with a visit to me (initially with my Air Photo Services hat but later as AARGnews editor) in between.

My second visitor, Antje Faustmann, was here for more practical reasons – to try to find work on summer excavations on which she could improve her digging technique and her English. Any offers? Antje, currently studying archaeology in Berlin, is probably the only person who attended *all* the talks at Potsdam where she was working the slide projector. As a newcomer to aerial work she found the meeting interesting and is keen to be further involved. Given her interest in medieval archaeology the combination of period and aerial work in Germany could result in an unusual and valuable viewpoint.

The latest issue of *Archaeological Computing Newsletter* (**41**) included notes on a recent conference, *Imaging the Past*. One paper, frustratingly briefly mentioned, was on work being carried out at Southampton that uses image processing as a means towards classification of artefacts. Shape information is extracted from digital images and thus provides the data on which to apply analytical methods that can lead to a classification [note the use of 'a'!]. The advantages claimed over the 'human method' is that it can be quantified, is repeatable, and can be carried out with large groups of artefacts. The possibilities of using such a system on carefully mapped aerial information is obvious.

This issue includes the continuing series by Anthony Crawshaw – this time on films. Anthony is the only one I know who has made a point of testing films and comparing results – not too easy to do in the air without a cockpit full of cameras. But Cokin filters? How does he get those to stay in their holders? When Chris Cox used a camera with one on it (the filter) vanished as soon as she leaned out of the window. Chris, however, in her efforts to get near-vertical views when flying with timid pilots, manages

to get a gravity-defying proportion of herself out of the window – Cokin filters are not designed to stay in place at 80 knots. There are other problems with this 'dangling out' method. The microphone roars and there is supposed to be a possibility of film flapping about inside the camera – although this has not happened with the Bronica and Pentax LXs that we use. Is it time, perhaps, for a review of current photographic techniques and problems? Regarding techniques, Otto Braasch has been using, or at least testing, a gyro stabilizer this winter and reports that it has been useful with a long lens (180mm) and has enabled shutter speeds to be safely lowered. A written note has been promised....

We also continue the use of satellite imagery following further research by Martin Fowler. In correspondence Martin has sent me a SPOT image of the Avebury area that shows Silbury Hill and the henge monument with great clarity. I spent quite a while comparing the image with a 1:50000 map and almost convinced myself that I could see long barrows (as a highlight and shadow) when the lay at 90° to the angle of the sun. Not much use for prospecting, but excellent for illustration of an area and perhaps to be encouraged as a new form of the traditional 'Figure 1: location map'?

I was interested to read the contribution on inter-tidal work in Essex. This was offered to me soon after I had completed a rapid survey of parts of the Humber estuary using two sorties from CUCAP. One of the questions to occur from that work was to wonder just how effective *old* photographs were in recording a constantly changing zone. The photographs examined were taken in 1978 and 1988 (plus a few of other dates), both at low tide, but there was only one feature – a fairly large (30m) hull – that was identified in both sorties. Possibly the hull is now further silt-covered and not easy to survey on the ground (surely estuary survey is not called *field* work...?). If a 30m hull can vanish in 10 years what chance a fish trap? Does effective survey in inter-tidal zones demand the use of immediately recent photographs? I'd be interested to receive comments on the longevity of features in these areas.

I was just about to bundle off this issue to the printers when a letter and short contribution from Martin Gojda thumped on to the door mat. It has been hinted (C Cox, pers comm) that people are getting fed up with reading (or ignoring) thoughts about what we are doing and why. I think such musings are vital to the discipline – and, indeed, their lack is probably why 'aerial archaeology' in the UK is still over-concerned with discovery and numbers. History, I hope, will show that the development of archaeological field work in Britain was such that it would not allow aerial photography in that country to be anything other than a tool for discovery (?until now). How lucky they are in central and eastern Europe that they have only been allowed to begin reconnaissance at a time when their field work is at a developed stage. Aerial reconnaissance in those parts will, I imagine, become an integral part of routine surveys. Give it another ten years and they may be able to teach us how best to use the technique!

CHAIRMAN'S PIECE

Marilyn Brown

The AARG meeting in St Ives brought together approximately half of the Group's 160 members for a useful and engaging conference. The Research Group acquired a new Honorary Member, when Jim Hancock accepted the invitation of the Committee at the AGM. The pattern of the proceedings followed that of Abergavenny (and Dublin), but with an even stronger emphasis on the application of aerial reconnaissance within a specific locality, in this case that covered by the Cornwall Archaeology Unit, producers and prime consumers of aerial survey.

There were two thematic sessions, one concerned with small enclosures in Western Britain and Ireland, and the other with the recording of small islands. Small enclosures form one of the largest 'classes' of archaeological site, and certainly one that is difficult to handle as a whole. The series of opportunistic excavations in Devon covered a range from Neolithic to high medieval, and had provided clear evidence of long, if not continuous occupation for some of these sites. It was educational to see how various speakers considered the enclosures in the landscape setting, cropmark and upstanding features together, and what emerged in England and Wales (although not in Ireland) was a strong regional variation in morphology. In Ireland, the reason for the variation in size and complexity was identified as social differentiation, linked to the evidence from law tracts. It would be interesting to see how such a landscape approach might be transferred to some regions of eastern England, where the evidence would be almost entirely from cropmark enclosures. The main technical papers on geology, crop recognition and crop trends for aerial archaeologists were extremely entertaining and usefully illustrated, presenting in an orderly manner the kind of information that forms the background, and often the foreground as well, to the discovery of the archaeology in cropmark form. Contributions from Austria and Germany (about a fifth of AARG members are from the European mainland) brought the Group up to date with progress in the east.

The papers given at the Symposium on Aerial Archaeology in Central and Eastern Europe are now being prepared for publication by the Brandenburgisches Landesmuseum für Ur- und Frühgeschichte with the close involvement of Otto Braasch. AARG, one of the sponsors, is proving to be useful body in administering the grant for the volume, which, it is hoped, will appear within the year. The particular interest of the book for British readers will lie in giving a picture of the important developments in countries which were formerly behind the Iron Curtain. There is a proposal to organise a course in aerial reconnaissance for Eastern Europeans, possibly in Hungary.

Following the approval of the AGM, it was decided to present £100 to both the Derrick Riley Fund for Studies in Aerial Archaeology, designed to ‘support the study of aerial archaeology by young scholars’, and to the J K S St Joseph Fund, designed to support a fellowship to further research in *inter alia* European archaeology (especially of the Roman period), ancient or medieval history, and remote sensing.

CONFERENCES

Archaeological Prospection 1995

University of Bradford

12-13 September 1995

Hot on the heels of the new journal comes notice of their annual conference which may include contents of interest to AARG members. Such as: remote sensing, application of relevant software to data derived from archaeological prospection, integrated site evaluations and follow-up excavations. There is an associated field trip on September 14.

Further information from Dr Cathy Batt, Department of Archaeological Sciences, University of Bradford, Bradford, West Yorkshire BD7 1DP, UK

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AARG 1995

Riseholm, Lincoln

20-21 September 1995

It is hoped that sessions will include the following themes:

Recent work in Lincolnshire and the Yorkshire Wolds;

European contributions;

Technical developments;

News and views;

Etc...

Plus field trip on September 22

Offers of contributions for talks and/or posters to Marilyn Brown.

Booking information will be sent to *current* members at a later date.

Other conference-related enquiries to:

Jo Elsworth
CADW
Brunel House
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Cardiff CF2 1UY
UK
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DETECTION OF ARCHAEOLOGICAL FEATURES ON MULTISPECTRAL SATELLITE IMAGERY

Martin J. F. Fowler

Introduction

Over the past 20 years, high resolution satellite imagery of the Earth's surface has become widely available and has led to an interest in its exploitation for archaeological purposes (Ebert & Lyons 1980; Custer *et al.* 1986; Farley *et al.* 1990). While the majority of archaeological studies utilising satellite imagery have been conducted in the USA, the past couple of years have seen satellite imagery being applied to studies in Britain. In one of these, LANDSAT Thematic Mapper (TM) imagery with a ground pixel size of 30m was used in conjunction with conventional aerial photography to define and classify areas of peat in the wetlands of Cumbria in order to identify potential archaeological sites (Cox 1992). In the second, LANDSAT TM and SPOT panchromatic imagery, with a ground pixel size of l0m, were used by Shennan and Donoghue (1992) to detect and map archaeological features in the Fenlands of eastern England.

In an attempt to assess the value of satellite imagery to archaeological studies in Britain, I have been studying satellite imagery covering the environs of Stonehenge and Danebury to identify those types of archaeological features that can be detected on the imagery (Fowler 1993; 1994a). The present note describes a study of SPOT Panchromatic and LANDSAT TM imagery covering the environs of Stonehenge and was presented in poster form to the 1994 AARG meeting in St Ives.

Study area and imagery

The study area covers a 4km by 3km area centred on the Stonehenge monument (Figure 1). It was chosen since it is archaeologically well documented (RCHME 1979) and also represents a relatively 'clinical' area of arable fields and grassland that can be considered to be particularly suited to for the detection of archaeological features on the satellite imagery. The major features present in the area, either as extant monuments or as sites visible on aerial photographs, include: the Stonehenge monument and The Avenue, the Cursus and Lesser Cursus, the Coneybury Henge, 'Celtic' fields and over 120 long and round barrows.

SPOT panchromatic and LANDSAT TM satellite imagery (Table 1) were purchased from the National Remote Sensing Centre Ltd, Farnborough. The SPOT image comprised an extract from scene 029/246 acquired on 8 May 1987 provided in the form of a film-written print at a scale of approximately 1:130,000. The print was digitally scanned at a resolution of 300 dots per inch and the resulting 256 greyscale image imported into the PC_IMega package (described in Fowler 1994b) following rectification to orientate with the National Grid. The equivalent ground pixel size of the final image was 12m compared with l0m for the original digital imagery.

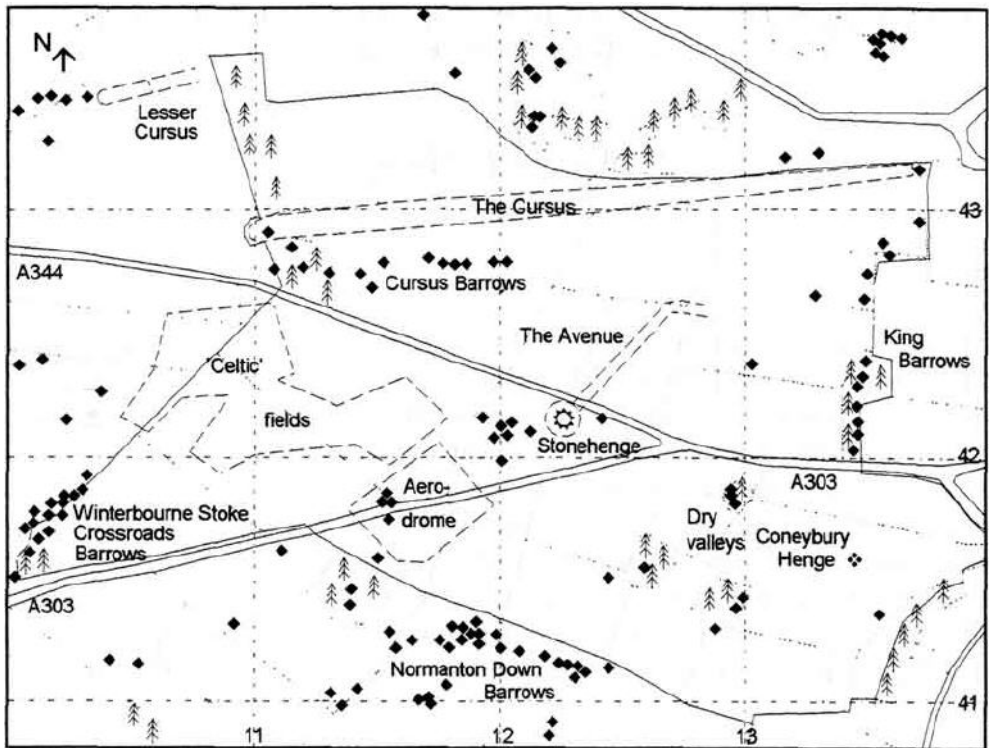

Figure 1. The major monuments within the Stonehenge study area. The Ordnance Survey National Grid (within the SU 100km grid square) is shown at l km intervals.

A 20km by 20km extract from the LANDSAT TM scene 202/24 acquired on 8 May 1985 was provided on floppy disk in the form of 8-bit binary flat files resampled to give an equivalent ground pixel size of 25m. Six files were provided corresponding to the TM spectral bands 1-5 and 7 (Table 1). Imagery from the TM band 6, covering the thermal infra-red region of the spectrum, was not purchased because of its inferior resolution of 120m. Since the TM imagery had been already geocorrected to the National Grid, the data could be readily imported into PC_IMega and geographically referenced without any need for rectification.

Sensor	Band	Wavelengths	
SPOT	Pan	0.51-0.73µm	(panchromatic)
LANDSAT TM	1	0.45-0.52µm	(visible blue)
	2	0.52-0.60µm	(visible green)
	3	0.63-0.69µm	(visible red)
	4	0.76-0.90µm	(near infra-red)
	5	1.55-1.75µm	(near mid infra-red)
	7	2.08-2.35µm	(mid infra-red)

Table 1. Spectral bands of satellite imagery used in the study.

The locations of the major archaeological features in the study area, obtained from the National Monuments Record, were imported into PC_IMega as ASCII text files of grid references. The vector data could then be superimposed on the satellite imagery thereby permitting a direct comparison to be made between known features and the imagery.

SPOT Panchromatic imagery

An extract from the SPOT panchromatic image is shown in Figure 2. The Stonehenge monument can be detected as a prominent oval ring having a lighter tone that the surrounding grassland and with a bright spot offset to the west of its centre. The ring would appear to correspond to the footpath that partially encompasses the monument and which has a higher reflectivity than the surrounding vegetation. Likewise, the bright spot offset from the centre of the oval appears to correspond to the stones of the monument.

To the north of Stonehenge, the western part of The Cursus can be seen on the image as a long rectangular area having a lighter tone than the surrounding fields. Similarly, a number of the Cursus barrows can be identified from their lighter tone. Within the fields to the south of Stonehenge, some members of the Normanton Down barrow group can be identified where they are present as islands of ancient grass within the more recent grassland that surrounds them. No evidence can be found on the imagery of The Avenue leading away from Stonehenge, the Lesser Cursus, the site of the Coneybury henge and the 'Celtic' fields to the west of Stonehenge, all of which have been visible on aerial photographs at one time or another.

To the south of the junction between the A303 and A344, strips of darker tone extending over several hundred metres can be seen on the image. Whilst the nature of these features is unknown, they appear to be associated with the dry valleys of Stonehenge Bottom system. Similar features are found elsewhere on the image, also in association with possible dry valleys.

LANDSAT Thematic Mapper imagery

Of the six LANDSAT TM image bands covering the study area, it is primarily on the near infra-red Band 4 image that archaeological features can be detected (Figure 3). On this band, Stonehenge can be seen as a circular area having a lighter tone than the surrounding area whereas on the other bands the contrast is reversed. These changes appear to reflect the different spectral signatures of the ground cover at the site of the monument compared with the surrounding grassland (Fowler 1994c). It is unlikely that they are due to the presence of 'mixed pixels' containing the signatures of both grass and stone since the stones of the monument occupy only the inner 10% of the circular area seen on the image. Rather, they may be due to a variation in vegetation cover either through the presence of different species of grass or as a result of different management practices.

Figure 2. SPOT Panchromatic image of the Stonehenge study area acquired on 8 May 1987. The National Grid is shown at 1 km intervals. Key to annotated features: S - Stonehenge, C - The Cursus, B - Barrows. *Imagery supplied by NRSC Ltd. © CNES 1987.*

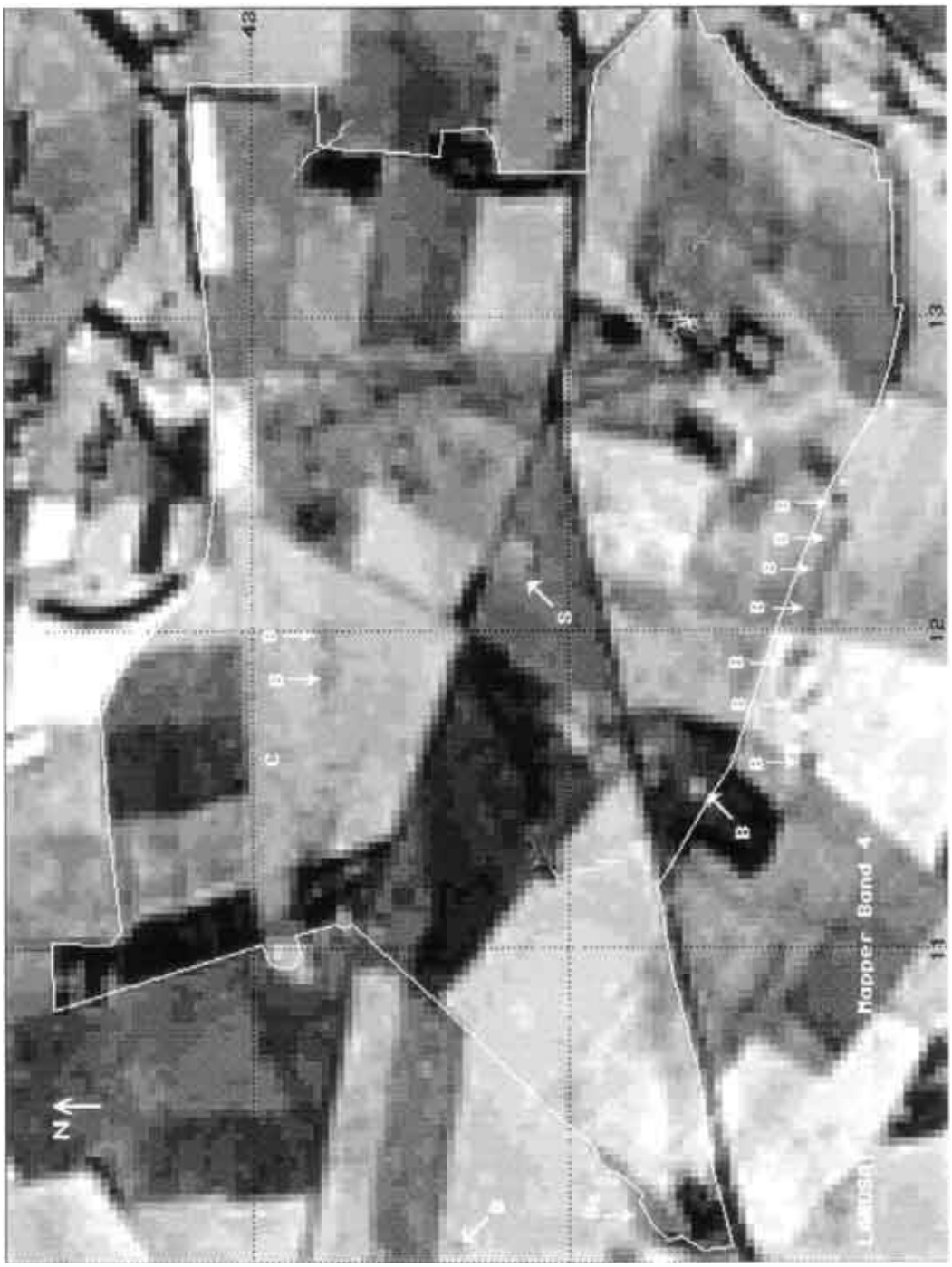

Figure 3. LANDSAT Thematic Mapper Band 4 near infra-red image of the Stonehenge study area acquired on 8 May 1985. The National Grid is shown at 1 km intervals. See Figure 2 for key to annotations. *Imagery supplied by NRSC Ltd. ©1985.*

To the south of Stonehenge, a series of 'splodges' of darker tone can be seen on the Band 4 image which are not apparent on the other five spectral bands. These correspond in location to members of the Normanton Down barrow group that comprise islands of ancient grassland within more recent grassland. They appear to be visible on the image because of the different near infra-red reflectivity of the two grassland types (Fowler 1994c). Similarly, members of the Cursus Barrows can be detected in the grassland to the north of Stonehenge and other isolated barrows can be detected within arable fields. While the different dates of image acquisition preclude a precise comparison between the Band 4 TM and the SPOT Panchromatic images, it is apparent that the various barrow sites that are visible on the two images are not identical, with more sites being apparent on the lower resolution near infra-red TM image.

None of the other archaeological features in the vicinity of Stonehenge can be detected on the imagery although the location of The Cursus can be discerned given the prior knowledge of Figure 1. However, it is of interest to note that the tone of the field immediately to the west of the monument, and which includes the site of a former First World War aerodrome, is not particularly uniform. Reconstruction of the land cover on the date of image acquisition identifies this as a field of barley (Fowler 1994c). It is possible that the tonal variations may represent differences in the growth of the crop due to either the local topography of the area, which is located on a slight hill, or to the presence of buried features associated with the aerodrome. However, the low resolution of the imagery precludes the identification of any discernible features.

As was the case for the SPOT Panchromatic image, strips of darker tone within the dry valleys of Stonehenge Bottom system can also be seen on all six TM image bands. From the reconstructed ground cover, these features appear to have been located in fields of grass and spring barley at the time of image acquisition.

Discussion

The ground resolutions of LANDSAT TM and SPOT Panchromatic imagery are considerably inferior to conventional air photographs and severely limits their use in the detection of archaeological features. Thus, the features that were initially detected on the high resolution SPOT imagery used in this study were either very large, such as hillforts, or had a strong linear component, such as the course of Roman roads fossilised in the landscape as modern roads and field boundaries (Fowler 1994a). Likewise, Shennan and Donoghue (1992) were able to detect relatively large linear features on SPOT imagery of Morton Fen including a medieval field boundary and part of a probable Romano-British water feature. On lower resolution TM imagery, the circular earthworks of the Figsbury Rings hillfort have been found to be particularly evident on the near infra-red band (Fowler 1984b) demonstrating the usefulness of this spectral band for the detection of archaeological features.

The present study has been shown that under favourable conditions, archaeological features as small as round barrows can be detected on both SPOT Panchromatic and near infra-red LANDSAT TM imagery. These 'small' features appear to correspond to islands of older grassland which have different spectral signatures to the surrounding ground cover of recent grassland or arable fields. Little evidence could be found of levelled sites (such as the area of

'Celtic' fields to the west of Stonehenge) and which are recorded on aerial photographs as either soil marks or through differential crop growth. The failure to detect such features is presumably due to the low resolution of the imagery. Under less 'clinical' conditions to those of the present study area, it is considered that the low resolutions of SPOT and LANDSAT imagery will continue to limit their practical use for the detection of the majority of archaeological features. Such imagery may be better suited to larger scale activities such as providing an overview and mapping of a study area, detecting features having strong linear components or classifying ground cover in prospecting for areas of high archaeological potential.

As a result of the collapse of the Former Soviet Union, imagery with a higher resolution to that of the SPOT Panchromatic sensor is now starting to become available from the Russian space programme (Baxter 1991). Of particular interest is imagery from the MK4 sensor that provides multispectral imagery with a resolution of 5-7m. Since one of the spectral bands covers the near infra-red region of the spectrum, this product may be of potential use in the detection of archaeological features as it would appear to provide a product similar to that of LANDSAT TM Band 4 imagery but at a six-fold higher resolution. Even higher resolution panchromatic imagery, with a ground resolution of 2-Sm, is available from the KFA-3000 sensor. The use of such imagery in archaeological studies, however, is currently constrained by their relatively high cost and the somewhat patchy coverage that is currently available. Further high resolution imagery may become available in the near future as a result of an announcement in April 1994 that the Central Intelligence Agency has decided to give environmental researchers access to its archives of photographs of the Earth taken by US spy satellites (New Scientist, 1994). While there was no indication how or when the data would become available, it was made clear that imagery from current spy satellites would not be available as this would reveal the effectiveness of the technology (speculated in the open press to have a ground resolution of the order of 5-10 centimetres - Dutton *et* al. 1990, 101).

Acknowledgements

The author thanks Rog Palmer for commenting on an early version of this note, Dr M J Hoey of University College Dublin for kindly providing a copy of PC_IMega and NRSC Ltd for permission to reproduce the imagery shown in Figures 2 and 3. The assistance of the RCHM(E) in providing access to the National Monuments Record for the study area is gratefully appreciated.

References

Baxter, J.P., 1991. 'Soviet satellite imagery'. *Mapping Awareness 5(4),* 30-33.

Cox, C., 1992. 'Satellite imagery, aerial photography and wetland archaeology'. World *Archaeology* 24, 249-267.

Custer, J.F., Eveleigh, T., Klemas V. & Wells, L, 1986. 'Application of LANDSAT data and synoptic remote sensing to predictive models for prehistoric archaeological sites: an example from the Delaware Coastal Plain'. *American Antiquity* 51, 572-588.

Dutton, L., de Garis, D., Winterton, R. & Harding, R., 1990. *Military Space.* Brassey's Air Power: Aircraft, weapons systems and technology series. Volume 10. Brassey's (UK).

Ebert, J.I. & Lyons, T.R., 1980. 'Remote sensing in archaeology, cultural resources treatment and anthropology: The United States of America in 1979'. *Aerial Archaeology* 5, 1-19.

Farley, J.A., Limp, W.F. & Lockhart, J., 1990. 'The archaeologist's workbench: integrating GIS, remote sensing, EDA and database management'. In: K.M.S. Allen, S.W. Green & E.B.W. Zubrow (eds), *Interpreting space: GIS and archaeology,* 141-164. Taylor & Francis.

Fowler, M.J.F., 1993. 'Stonehenge from Space'. *Spaceflight* 35, 130-132.

Fowler, M.J.F., 1994a. 'Danebury and its environs from 830 kilometres'. *Hampshire Field Club and Archaeological Society Section Newsletters, New Series* 21, 26-30.

Fowler, M.J.F., 1994b. 'Satellite image processing for the archaeologist'. *Archaeological Computing Newsletter* 39, 2-8.

Fowler, M.J.F., 1994c. 'Ground cover mapping from multispectral satellite imagery'. *AARGnews* 9, 11-19.

New Scientist, 1994. 'In brief. Green espionage'. New Scientist 142 (16 April 1994), 10.

RCHM(E), 1979. *Stonehenge and its environs.* Edinburgh University Press.

Shennan, I. & Donoghue, D.N.M., 1992. 'Remote sensing in archaeological research'. *Proceedings of the British Academy* 77, 223-232.

AARG AND THE FUTURE OF THE CBA AERIAL ARCHAEOLOGY COMMITTEE

Rog Palmer and Marilyn Brown

The Aerial Archaeology Committee (AAC) is one of nine specialist committees that fall under the area of Conservation and Research within the CBA's structure. For some time the CBA has been considering whether any change in this structure is necessary and has recently made the following observation:

'Many of these committees came into being at different times over the last thirty-five years to address particular tasks. If this pioneering spirit is to be retained, it is important that the Council should have the flexibility to refocus on new issues in ways which seize the moment. This may require disengagement from some commitments which have been discharged.'

It has been decided, 'that the specialist committees be wound down in favour of a single Research and Conservation Committee (RCC) which is capable of addressing strategic issues throughout British archaeology.' This Committee should also 'have the capacity to undertake research projects, establishing task-specific working parties as necessary.'

An outline of the AAC was provided by its then chairman in the first *AARGnews* (Wilson 1990, 7) and, other than the frequency of its meeting, this remains little changed. One great advantage of the AAC is that it has greater political freedom than AARG which, through its past and present chairs and officers, is unavoidably linked to the Royal Commissions. This freedom was seen in the issue of a 'Guidance Note' on the use of aerial photographs in archaeological assessments and is again apparent in the committee's proposed research project, to review current practice throughout Britain (see also Richard Morris in *British Archaeol* (1995) **1**, 11).

One of the reasons for adding the AAC to the hit list is the success of AARG as a nationally representative group with specialist aerial interests. Beyond the national interest, AARG's increasing international membership may assist links with Europe that the CBA is also encouraging.

So, as the AAC is to be phased out, we need to establish what its roles were and how AARG needs to restructure itself in order that aerial photography and related matters may retain a level of priority in the organisation of British (?and European) archaeology. Obviously it is important to keep some kind of link with the CBA and this, presumably, would be managed by representation within its new structure. Such representatives would need to be well informed of progress and problems within aerial studies – and this is where AARG can play a key role. It is also essential to remain aware of broader needs of the discipline as a whole and how aerial matters may best be integrated (or separated). Our current thinking is to retain the small but efficient AARG committee and to convene a larger 'forum' which can fairly represent all aerial activities in Britain at institutional, regional and private levels. This forum would necessarily include similar membership that the CBA AAC does at present – representatives from the three Royal Commissions and the heritage bodies of England, Scotland and Wales, plus CUCAP – but with, we would hope, a genuinely regional coverage of non-institutional members. Forum meetings would act as a talking shop – perhaps on an annual basis – in which to air views, problems, and to offer advice. Recommendations would

go to the smaller AARG committee, who would retain the right to form working parties as necessary, and hence to the CBA and back to the institutions.

Until this can be tried and tested it remains the current 'best' solution. As we see it the aim must be to retain the ability to keep a powerful voice in British archaeology that can fairly and appropriately act for the aerial specialists.

Views and comments from AARG members towards a solution would be welcome either in writing (to MB) or for discussion at the AGM (September 20).

References:

Wilson, D R, 1990. 'CBA Aerial Archaeology Committee', *AARGnews* **1**, 7.

All quotes from: R K Morris (Director CBA), 'The Future of CBA Specialist Committees (Summary)', 30 January 1995.

AARG SUBSCRIPTIONS 1995

Many are now (still) due. Please send to:

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SOME FEW REMARKS ON THE BRITISH DIVERSIFIED VIEW OF AERIAL ARCHAEOLOGY

Martin Gojda

During the last few years I had an opportunity to meet a number of British colleagues (archaeologists, air photographers and interpreters, photographs curators, etc.) involved in that most exciting discipline of aerial archaeology and based in different institutes, universities and museums. Apart from a most fruitful personal contacts with them I have read through many articles and books and listened to tens of very interesting lectures, most of which were presented during AARG annual meetings and some in other occassions. Now I feel I should try, as a person whose social and physical geography environments and professional background are different from those of the British, to evaluate recently acquired knowledge and observations and to analyze how consistent or diversified approaches to aerial archaeology in Britain are.

I must confess that there are two separate things that made me to think about this problem a little bit more seriously than I did before. The first one is the volume No. 9 of *AARGnews*, or rather some ideas published in it, and the other the first international symposium on aerial archaeology in central/eastern Europe which took place at Kleinmachnow (Germany) last October and where different attitudes to our discipline were pronounced.

As I see it there are now at least three concepts of what can be termed *aerial archaeology*, but these are not inevitably considered from one perspective. The first two have been expressed by people closely and professionally engaged in archaeology. Many of them have been stressing different applicability of *aerial* (*human landscape*) *studies* (apart from the term *aerial archaeology* this one seems to be another useful denomination as it may integrate various aspects and processes covered by this discipline), that is its potential in the discovering and gathering new data (heuristic in the terms of historiography), its potential as an interpretative tool for archaeological and historical geography (mapping programmes) studies, its importance in managing

archaeological heritage and in educating people, etc. The result is we can read and listen to about *air photo archaeology, aerial reconnaissance, aerial interpretation, air photo documentation.* This is a natural phenomenon in a country like Britain where a high standard of aerial studies has brought the diversification of single processes into existence (how different from Bohemia!).

On the other hand there are people who try to understand and define aerial studies in its whole, in its complexity. When I was writing about my view of aerial archaeology (in this Newsletter's vol. 9) I had in my mind particularly this approach to the definition of the discipline. I also stressed that there must be a person integrating both the application of aerial archaeology data into historical (=archaeological) studies (projects), and its most effective operation within archaeological bodies concerned. My opinion is that this person should be an archaeologist. This attitude was implicitly supported by Bob Bewley's contribution to the same volume (on the contrary to Rog Palmer's view I see in Bob's and mine approach much more similarities than "vast differences") but was sharply contradicted, again in the same volume, by J. Pickering whose opinions attracted my mind also in Kleinmachnow.

There is no doubt that J. Pickering is a personality whose contribution to the development of methods of aerial survey must be appreciated highly. In my mind he is now the only remaining member of the "exlusive club" of the legendary aerial archaeology pioneers (excuse, Mr. Pickering, my audacity to place you into the company of people performing a "peasant work") whose effort to keep in touch with aerial survey, and ability to go on working is admirable. His experiences in flying and practicing air reconnaissance is probably endless and it is a real pleasure to read some of his notes concerning, say, the appearance of historical landscape and its changes in the time course, as he generalized them on the basis of his very long activity. Thanks to R. Palmer we (at least here in my part of Europe) could for the first time realize the potential of persons like J. Pickering for those who are beginners. How attractive it would be for me to share a life-long experiences of him!

For some readers it is now obvious that talking about J. Pickering I am coming straight to the discussion about the third approach to aerial studies in Britain. This could be termed *aerial archaeology without archaeologists.* First of all I have to express my disagreement with at least some points which J. Pickering have recently published and/or pronounced. In his interview with R. Palmer he said: *Aerial archaeology was nothing at all to do with archaeologists - it was invented by aviators. Crawford was an observer in the 14-18 war. He was an experienced aviator and because of his flying experience was able to say that aerial photography would be useful to archaeology. It's now believed that archaeologists invented flying!*

I am afraid this is simply not true. Anyone who has been studying the history of British archaeology and antiquarian studies has to have an idea about those English historians (archaeologists) and amateurs who during the last few centuries established local histories and topographical studies of monuments in landscape and who repeatedly, and in the time course still more urgently, realized the potential of a high viewpoint to the comprehension of the integrity and mutual relations of prehistoric features in landscape. The long list of people (like J. Aubrey and W. Stukeley), who can be considered the pioneers of landscape studies naturally ends (and is crowned) with the personality of Crawford. Only many decades later *landscape archaeology,* whose founder Crawford certainly was, got its name and became seriously involved into the study of our past. Obviously, there were many amateurs without university degrees in archaeology or history whose contribution to the formation of *landscape archaeology* was great (apart from others let me name Williams-Freeman). But most (if not all) of these people were self-educated in history and closely acquainted with their landscapes so that the level of their knowledge in local histories was comparable to the knowledge of professional historians and antiquarians.

The point I want to stress in this context is that in principal it is people basically connected with *ground studies* (archaeology, historical topography), rather than aviators, who not only realized the advantage of looking at both single categories of historical landscape and features buried under the surface (the effects of buried

archaeological features to growing crops were noticed by early post-medieval antiquarians and artists, e.g. J. Leland, and explicitly described by W. Stukeley in the 18th century) but who also *initiated* the inclusion of aearial survey into archaeology. It is well known that Crawford was aware of the potential of aerial photography even before his experience during the First World War. His familiarity with the character of on-site and off-site archaeological structures (in other words, with historical landscape patterns) must have influenced strongly his sensitivity for aerial observation in the war period. To cut this story short, Crawford in my mind was first of all an archaeologist (not in that traditional antiquarian concept which equates archaeologist with an excavator but in the view which sees this discipline as an effort to look for contexts within past human environments) and only in the second instance an aviator. It is obvious that without a trained archaeological eye and knowledge from the ground (and, last but not least, without his professional background and academic education) his achievement in the air would be doubtful.

My private experience with aviators (pilots) without archaeological background is that most of them are ignorant of what I am looking for below the aircraft. There are but few aviators specifically interested in ancient history. What I do not deny is that an aviator who is willing to be trained in distinguishing sites and features in the open landscape has a great advantage.

The idea of aerial archaeology without archaeologists is based on the same understanding of archaeology as the traditional one I write above. I do not share the view that archaeologists have been indoctrinated and, consequently see things like startified layers (I must admit I am not quite certain about whether I properly understand the meaning of the sentence) as this actually is the advantage. There is not only vertical stratigraphy but also horizontal and a good field archaeologist may easily apply his excavation experience and ability in reading archaeological plans and maps to the understanding and decoding buried landscape palimpstests observed from the air. The idea that one can understand archaeology sufficiently during a winter's evening course

is idealistic and just inverse to the idea that one (an archaeologist) can consider oneself a good aviator with no more than few tens of hours spent in the air.

There are many other arguable points in the *JP-RG interview* but I am aware that some of them can be viewed in a different way in a country with a seventy-year aerial archaeology tradition like England on one hand and in a country like Bohemia where this discipline was introduced to archaeological studies only recently. For instance, if I accept the opinion that asking colleagues about whether they want me to photograph sites whose investigation is paid by a (state, private) grant is a nonsense, then our recently founded library of air photographs would now comprise less than half of its actual volume. Many flights here are paid either by money from lesser grants or contracts (pre-building and pre-construction surveys). There are now just two long-term state funded grants for aerial archaeology progressing in Bohemia. The fact they were allocated to this discipline was largely due to the success of initial campaigns and first results achieved by means of grant and contract flights at the beginning of the 1990'. In this context I have to turn to my recently expressed note that the more attractive sites we photograph look, the better chance for aerial archaeology to get money. I am afraid it was not understood properly. The point is that at this pioneering phase of the development of aerial archaeology in every country of my part of Europe people and institutions responsible for archaeological money must be persuaded that aerial archaeology works, that it is something that may help extensively to all of us. From a long perspective there is no point to achieve good results in one year in order to get money for the next but to achieve a permanent inclusion of aerial survey and photographic documentation into the concept of archaeology in the country. Only then we have a chance to gain a permanent and regular income to cover the needs of aerial reconnaissance regardless of results achieved year by year, to put basis for a system common in Britain (allocation of money to government archaeological bodies like RCHME and RCAHMS and its re-distribution to minor institutions practicing aerial studies).

At the end of this review let me express my personal faith that each single opportunity offered to any archaeologist by aviators to spend some time (including just one hour) in the air should be accepted as a useful opportunity to see things from a distance. Everyone who has the aerial experience may know what I am talking about. Believe me that flying over the landscape can be fruitful not only for *aerial* archaeologists but for *every* archaeologist.

OBLIQUE AERIAL PHOTOGRAPHY: FILMS

Anthony Crawshaw

Electronic media or film? So far it's 'no contest' and film has not been overtaken by electronic media for aerial photography. Therefore this article is a roundup of the available film types. As before it will reflect my personal choice, which is for colour print film. This choice is very much a minority view in the UK, where the established usage is black and white negative, supplemented by colour slide. But rumour has it that there is amongst the AARG membership one who still practices the ancient art of the aerial daguerreotype. Please may we have a description of this craft?

Monochrome. The generally preferred black and white film seems to be Ilford FP4, or Kodak Plus-X, used at 200 ASA. This gives a slight underexposure, by comparison with the film's nominal 125 ASA, which is compensated for by over development. This combination, underexposure with over development, tends to increase the contrast of the resulting negatives, which is beneficial for low contrast subjects such as cropmarks. However, one should not automatically use this technique. For example, when photographing buildings a day with high thin cloud but good visibility is sometimes preferred. The idea behind this choice is to enable details on the shadowed faces of the structure to be seen. Clearly it might be counterproductive then deliberately to enhance contrast of the resulting film.

An alternative choice is Kodak Technical Pan 2415 which is a very fine grain film, used to good effect by Otto Braasch; that has to be a recommendation. However, it needs to be processed with a special developer under specific temperature conditions. These conditions are no more onerous than colour development, so if you are used to that then working with 2415 would not be a problem. Our German colleagues suggest trying an ASA setting of 80, with an orange filter, in the first instance.

Recent advances in colour film technology have fed through into black and white films such as Kodak T-Max, which is available in ASA 100 and 400 ratings. These have finer grain than the corresponding 'normal' emulsions; to get the best from the films they need to be developed in the special T-Max developer, although the development process is otherwise standard. If other developers are used the results may lack contrast. I have used T-Max 400 at an ASA of 400, with a reduction of the setting when photographing snow scenes. This lowering of the ASA setting when photographing snowy landscapes is fairly general and is aimed at getting negatives with sufficient density to facilitate printing. The prints may have to be printed darker than normal, in order to accentuate snowy earthworks. The reason for this is that in such cases the important detail may be in the difference between bright and very bright areas.

A further transfer of colour film technology into black and white, is to be found in Ilford XP2 film. In this film the image on the negative is made up of dye particles, like colour films, but unlike all other black and white films in which the image is formed from silver grains. As such XP2 is subject to the same doubts about archival image stability as is colour film.

Colour slides. For colour slides, there is a fundamental difference between Kodachrome films and the rest, in the chemicals used in the film and processing. The Kodachrome process is very specialised but the results have very good archival qualities, which is not necessarily the case for other types. I have personal experience of cataloguing an old collection of aerial colour slides – the Kodachrome images were still entirely acceptable after thirty years or so, whilst some others, in particular Agfa, were not. To be fair, the storage conditions had been far from ideal, with PVC slide cases being used.

As regards usage, the slide films generally seem to be used at their published ASA ratings. For unusual conditions, such as snow scenes, use of a different setting might be needed. I don't have enough experience of slide film to make any useful comments about this. However, it would be a good idea

to bracket exposures in abnormal conditions, since colour slide film is much less forgiving of exposure errors than most negative films.

Prints are obtainable from colour slides, which gets round the objection that colour slides are difficult to work from. However, these prints are expensive and, until recently, suffered from excessive contrast. Recent printing papers are an improvement, albeit still expensive. Like the original slides, there are two different chemical systems available, Cibachrome and the rest. Of the two, Cibachrome is more expensive, but gives excellent results and has good archival qualities.

Colour prints. Turning to colour print films, these have much more tolerance of exposure errors than colour slide film, but have a reputation for low colour saturation when compared with colour slide. To some extent this is true, but there are a variety of contrasts available. In particular, the aerial photographer should avoid the films, such as Vericolor III, advertised as being especially good for portraits, with good flesh tones. Such films have low contrast, designed to prevent the sitter from looking like the drink-sodden wretch she/he undoubtedly is. The print films we need are those aimed at the mass market which likes to have the colours on the TV turned up too much - the usual adjectives used are 'bold', 'rich, bright colours' and 'enhanced colour saturation'. Such films are the Kodak and Fuji "gold" ranges, together with Kodak Ektar 100 and Vericolor HC (120 only), also Agfa Ultra. Use one of these, together with a higher contrast printing paper (same adjectives apply) and the results will have more contrast.

In use, I rate the film at its designated ASA value in sunny conditions. However, I find it best to use half the suggested value in the evening, or at high altitude, or under overcast skies. For snow photographs use half as much again, i.e. 50 ASA for a 200 ASA film in shade, 100 ASA in sunshine. Given the available light in summer, one arrives at 100 ASA print film for normal lenses and 200 ASA for telephoto use. In winter I switch to 200 and 400 ASA, respectively. In general, if you underexpose colour print film the contrast will drop and vice versa, so err on the side of overexposure for aerial work.

Infra-red films. These are not the universal answer to the aerial archaeologist's wish for a technological fix. However these films, which are available in 'false-colour' and black and white do have their uses. I do not number amongst these blanket photography of the countryside, in an attempt to reveal unknown sites. I suspect that the reasoning behind this suggestion, which surfaces from time to time, is confusion with thermal infra-red imagery. This latter is practised to good effect by the military, amongst others, as seen at AARG 93 in Abergavenny and AARG 94 at St. Ives. It is unfortunate that the two techniques have the same name of 'infra-red', when the type of "light" used by both is different and they respond to different things on the target. Thermal infra-red uses a complicated piece of equipment to measure the actual temperature of the subject, be it the ground surface or electrical wiring or whatever. By contrast, infra-red photography uses "light" just beyond the red wavelengths visible to us, which is why we can use normal cameras and film, with slight alterations. Because the "light" used is so close to the visible, it is unlikely that there will be sites which show only by infra-red photography and not in the visible region, hence my doubts about blanket coverage suggestions. By contrast, blanket coverage by thermal infra-red imaging may well be worth while, due to the different phenomena being examined. I am only concerned here with infra-red photography, which measures on film, of suitable sensitivity, the degree to which the rays from the sun are reflected by the subject.

Camera light meters are not sensitive to infra-red rays, so that there will inevitably be errors when using such a meter to control the exposure of an infra-red sensitive film. This is the reason why ASA values are not quoted for infra-red film. Further, the ratio of visible light, to which the camera meter is sensitive, to infra-red rays, which are recorded by the film, varies with weather conditions. As if that isn't enough, the sensitivity of the camera meter to what light gets through the filter may vary from make to make of camera. So, one camera may need an ASA setting of 100 to obtain a correctly

exposed infra-red image, whilst a second make may require to be set at 64 ASA, under identical conditions. As a result, one can only suggest starting points for camera settings, with the firm advice to bracket exposures at first. It is, however, reasonable to offer suggestions for exposure changes due to subject and weather, since these should be similar for different makes of camera.

Enough of the science and on with the art of archaeology. There are three films readily available which are used for infra-red photography, one 'false-colour' and two black and white. All three are sensitive to visible light as well, so filters have to be used if the film is to achieve its desired effect. The 'false-colour' film, Kodak infra-red Ektachrome, is a slide film, sensitive to blue light, as well as the desired wavelengths, so a medium yellow filter has to be used to cut out the effect of the blue light. The resulting images have a spectacular, if somewhat grainy, appearance which is sure to grab the viewers attention. Infra-red rays register as a red colour, red comes out as green, whilst green appears as blue on the developed film. Thus, objects which reflect the sun's infra-red rays strongly, such as growing plants, appear as red or magenta in colour.

This reflection of infra-red rays by plants gives rise to one of the uses of 'false-colour' film in archaeology, namely increasing the contrast of traditional cropmarks. In such cases one has a mark that usually comprises green plants, reflecting strongly in the infra-red, against a ripe cereal background. Depending upon how the ripe cereal background appears to the infra-red film, you may get an enhancement of the desired image.

Soil reflects infra-red rays to a different extent, depending on its dampness. This property gives rise to another use of the film, exploited in Germany, which is soil mark photography. Spring days of showers and sunshine are good for this, as the conditions will accentuate the difference in moisture between adjacent patches of soil.

John Hampton described an interesting series of experiments to compare different film types in *Photogrammetric Record* 8, 37-64 (1974). One type of film used was 'false-colour' infra-red, along with colour and monochrome with two different filters. All four films were exposed simultaneously, in vertical runs over archaeological targets. The targets were showing as cropmarks and although interpretation was helped by the several different images, there was no overall clear winner. On some occasions the 'false-colour' infra-red gave a benefit, particularly early on in the season, whilst on others it didn't. The results appeared to vary with the type of geology and crop.

I have found little or no benefit from using 'false-colour' infra-red film on strong green-on-green cropmarks (weak ones may benefit), root crops, peas or parch-marks. However, these comments are open to correction, as I have not used the film a lot.

Atmospheric haze arises from light being scattered by minute particles in the air; such scattering is generally worse for blue light, whilst red light is scattered less. As a result the sun's rays often have a red tinge at sunset, when the light has to come further through the atmosphere. Infra-red rays are scattered even less than red ones, which has two useful effects for us. Firstly, an infra-red photograph will usually be less hazy than one in visible light. Secondly, the shadows in said photograph will usually be deeper than the same scene in visible light. This is because the shadows are illuminated only by scattered light, not by direct sunlight (statements of the obvious come free with AARG news). The scattered light is usually blue (it's the colour of the sky, you see...) which is filtered out from the infra-red film, *ergo* deeper shadows. This is a long-winded way of saying that a third type of scene that may benefit from infra-red photography is earthworks.

Don't forget that one doesn't have to be looking at actual shadowed earthworks to benefit from this effect; a cropmark may owe part of its tone to differences in leaf cover allowing one to see a greater proportion of the shaded area below the 'canopy'. These considerations apply to both 'false-colour' and black and white infra-red photography.

A major disadvantage of 'false-colour' infra-red is that it uses an obsolete development process, E4. In the UK there is only one commercial processor offering to process the film, Argentum of 1 Wimpole St., London W1M 8AE, telephone 071 495 6051. The price of processing, only, is £11.75

(August 1994). Kits are available for processing the film oneself but the process is complicated and I have never felt it worth learning, for the limited use I make of the film.

Turning to usage, the film does not tolerate underexposure or overexposure well, i.e. it has poor latitude. One stop either side of the correct exposure will give a poor quality result. A consequence of this poor latitude is that when sunshine and shadow areas appear in the same frame, one of them will be so badly exposed as to be virtually useless. Subject to the caveats noted above, my camera gives acceptable results, using an orange B+W 099 filter, at the following ASA settings:-

Sunshine	125-150 ASA
Shade	50-75 ASA

In sunshine there sometimes seems to be a difference in the ASA setting required, according to the sun angle; increase the setting for shots into sun, by comparison with views down sun. As a general point, it may be possible to salvage something from an underexposed slide film by printing it in the darkroom. An overexposed slide film is lost forever.

Black and white infra-red films. There are two types of such film available, Kodak High Speed Infra-red 2481 (35mm.) and Konica Infra-red 750 (35mm. and 120). The films have different properties, in that the Kodak is grainy and of lower contrast, by comparison with the fine-grained Konica. Further, the Kodak emulsion tends to scatter the light hitting it ('halation'), sometimes giving rise to a soft 'glow' round objects. This is prized by some photographers interested in special effects, but is not an improvement to the archaeological landscape. The Kodak film is sensitive to "light" further from the visible region than is that from Konica. This may give more pronounced infra-red effects, but could also be the reason why the Kodak film needs more careful handling than does the Konica. Thus, Kodak say that the camera should only be loaded in total darkness. Although it is possible to use a film changing bag when airborne, speaking as a pilot I would not recommend this! The Konica film, at £7.50 for 24 frames, is more expensive than the Kodak is for 36 frames. A disadvantage of the Konica film is that only one batch is made per year. If stocks are out when you order it, you just have to wait until next year!

Development of both films is normal, using D-76, although the Kodak data suggests a longer development time. For the Konica film I used neat D-76 at 25° Centigrade, for 4 minutes in a small tank. In future I might give the film slightly longer development, to give somewhat denser negatives.

Both films are sensitive to visible light, as well as infra-red, so need filtration if they are to show their infra-red capability. For maximum effect one can use a Wratten 87 filter, but this passes so little visible light that apparently you cannot frame the subject in the viewfinder and the cameras meter will be ineffective. These difficulties rule that filter out, as far as I'm concerned, so I have tried the nearest thing I could devise, which passed just enough deep red light to enable the viewfinder and meter to work. This filter was a combination of a Cokin red (A003) and green (A004), used together. Although just usable, this combination does not pass sufficient light to illuminate the cameras viewfinder scale, if it relies on light from the scene being photographed to show up the numbers.

So for the Konica film, only, I have also tried a Cokin red on its own and the B+W 099 (orange). The reason that Konica suggest an orange filter, as an alternative to the red, is that the Konica film, unlike the Kodak, is not sensitive to colours near the green region. Thus there is said to be no disadvantage in letting these colours through to the Konica film. I have only tried the Konica film on one site with different filters, due to the nuisance value of changing the filters in the air, so these comments must be treated with caution. That said, the orange filter did not give such good crop differentiation as the red one, so I will stick to the red in future, as being a reasonable compromise between user friendliness and the loss of the infra-red effects we are seeking.

Eventually we get to using the films. For the Konica film in sunshine I would suggest starting with an ASA setting of 20-32, using a red filter and the camera on an automatic setting. For photographs in shade I would start with an increase of half a stop in

the exposure. Given the reduction in light levels in the shade anyway, the film may not be sensibly usable without direct sunshine. As this is based on very limited experience, these remarks are open to modification. All the caveats noted earlier apply, so bracket the exposures initially. Like the 'false-colour' film the Konica has poor latitude and so sunshine and shadow do not mix in the same frame.

My experience of using the Kodak film is limited to one film, used in overcast conditions. I used the combination of Cokin red and green filters and it seemed that an ASA setting of 200-400 would have given the best results. Despite this very considerable improvement in speed, by comparison with the Konica product, I would prefer to use the latter. This is because of the Kodak films disadvantages of grain, halation and lower contrast, together with the handling difficulties.

I found two circumstances where the Konica film improved on the normal colour prints taken at the same time. The first was faint green-on-green crop marks and the second was marks in fully ripe cereal crops. As both of these are situations where I have sometimes been disappointed in the normal colour photographs, as not doing justice to the features I remembered seeing, I feel that the Konica film is worth an extended trial. By contrast, results are worse than normal colour when the subject is a pronounced green-on-green cropmark or a germination mark against a light soil. The reason is that the strong plant growth reflects much infra-red and registers lighter on the film than the adjacent weaker plants or bare soil. These latter do not appear so bright – result a reduction in contrast, not the increase we hoped for. Soil marks did not seem to benefit from the film, although the weather was not unduly damp, so this may not have been a good test.

Focus adjustment when using infra-red films. Camera lenses are designed to bring visible light to a sharp focus, but infra-red rays generally come to a slightly different focus. The lens will normally have a small red mark adjacent to the usual focusing mark. This is the infra-red focus, so place the infinity mark against the red mark when taking photographs solely by infra-red rays. When using 'false-colour' infra-red there is a problem, in that the film uses both visible and infra-red rays. As two of the three bands that the film uses are in the visible region, leave the focus in its normal position and accept the fact that the infra-red portion of the image will be slightly out of focus. There are two exceptions to this. The first are autofocus lenses or compact cameras and the second are some, but not all, apochromatic lenses. In these last the infra-red rays come to the same focus as the visible light. In neither case need you worry about the focus problem – either you can't do anything about it or you don't need to.

PROBLEMS AND POTENTIALS OF COASTAL RECONNAISSANCE IN ESSEX

D Strachan

1) The nature and importance of the Essex coast

While the three hundred or so miles of low-lying Essex coast appear to make up around one-third of the county's border, its uneven and indented nature make it more likely to constitute well over half. Its real importance, however, is reflected both by its variety of ecological environments and, due to its gently sloping, horizontal nature, its scale. The former primarily consist of large areas of inter-tidal mud flats and sand banks; salt marshes; sea walls and grassland (often on reclaimed marsh). In some areas, such as the Dengie flats, the distance from Low Mean Water to the modern sea wall is over three kilometres. Figure 1 shows a hypothetical section of coast, showing the types of site in their context.

In addition to the fertile reclaimed arable lands in the coastal areas, these diverse environments have been utilised as a resource for industries such as salt-production, fishing, and oyster cultivation. The various physical remains of these past activities represent a concentrated source of extant archaeology in the county. By comparison, the vast majority of inland land-use has for long been dedicated to arable farming. This has resulted in very little upstanding archaeology, placing great importance on the recording of crop marks to understand past activities. In addition, the geological nature of the county results in very few stone-built remains. Despite this, however, the coastal zone has, for long, been recognised as an under-represented area within the county Sites and Monuments Record (SMR).

2) Previous work

In the 1980s, the Archaeology Section instigated a ground survey, funded by English Heritage, which produced a number of important new inter-tidal sites and high-lighted the archaeological resource of the coast (Wilkinson and Murphy, forthcoming). In addition, in 1994, a coastal assessment was carried out on behalf of the NRA, although this was largely based on information then on the SMR. Aerial interest in the inter-tidal zone resulted from reports, from a local boat-owner in 1991, of complex wooden structures appearing on the mud-flats of the Blackwater estuary. These proved to be *kiddles*, or tidal fish-traps, as described below. Reconnaissance, in 1992-3, revealed a number of similar structures around the Blackwater estuary and Mersea Island (Wallis, 1993 and 1994), revealing the potential for archaeological discovery in the inter-tidal zone. In 1994, further flights were dedicated to the coastal region generally, with the primary aim of evaluating the potential for SMR enhancement of the whole coastal zone from the air. The area of interest was defined as from Mean Low Tide to around 0.5 km inland of the modern sea-wall. The flights recorded a large number of sites new to the SMR, making it clear that while there are considerable problems associated with coastal reconnaissance, the potentials and benefits are equally considerable.

3) Photographic problems

One of the major problems with coastal aerial photography in the region is obtaining the coincidence between low tides and good photographic conditions which enable recording. While high tides occur twice approximately every 24 hours, Spring tides (extreme) occur approximately every 14 days, around full and new moons, with neap (less extreme) in-between. The lowest of the low tides occur a day or so after the day of the full or new moon. Of these, the lowest occur at the equinoxes, around 21st March and 21 September (this is when the sun and moon are in alignment). The low-lying nature of the coast in Essex means that the extremes in HHMW and LLMW (Highest High and Lowest Low Mean Water) expose a large extent of inter-tidal zone.

Unfortunately, the vast majority of very low tides in a year occur very early in the mornings, or in the evenings, when light conditions prevent photography. This problem is increased because the lowest tides occur at a time of year when the sun rises late in the morning. Haze, from very oblique angles of sunlight, and an overall low-level of light restricts shutter-speeds, making fast films a necessity. This problem is exaggerated in that with around only five very low tides at suitable times of day in a year, weather conditions on those days, can easily limit the potential of a seasons flying.

The second main logistical problem concerns the recording of control features around the archaeology for use in the location of sites and the production of accurate plots. In the expansive inter-tidal mud-flats, detailed photographic recording generally means that no mapped features appear in the frame, while recording a site in its context generally means that all detail is lost and the feature becomes difficult to see. This problem is amplified by the fact that coastal sites are rarely “surrounded” by mapped features. Although location of sites is generally possible with general views, obtaining rectified plots with any degree of accuracy from oblique photography is, in most cases, impossible on the mud-flats, and, at best, difficult on the salt-marshes.

4) Implications of coastal change

The dynamic nature of the coast is evident, in many areas, from a comparison of the Ordinance Survey first edition, and modern maps. These changes are the result of both natural processes and human intervention. While natural forces result in both the creation and destruction of mud-flats and salt-marshes, human intervention, in the form of land-reclamation has also greatly altered the face of the coast.

Mud-flats form, and naturally increase in size, as tides deposit suspended particles of mud which sink at high tide. In other areas, however, changes in currents can result in the depletion of mud-flats. Evidence also suggests that off-shore dredging results in changes in marine topography which are, as yet, unpredictable and not fully understood. Shifting mud-flats may, in one area, reveal previously buried sites, while in another, bury (and therefore protect) sites previously visible. This is certainly the situation in the Blackwater estuary, and it would imply the need for continuous reconnaissance in the inter-tidal zone.

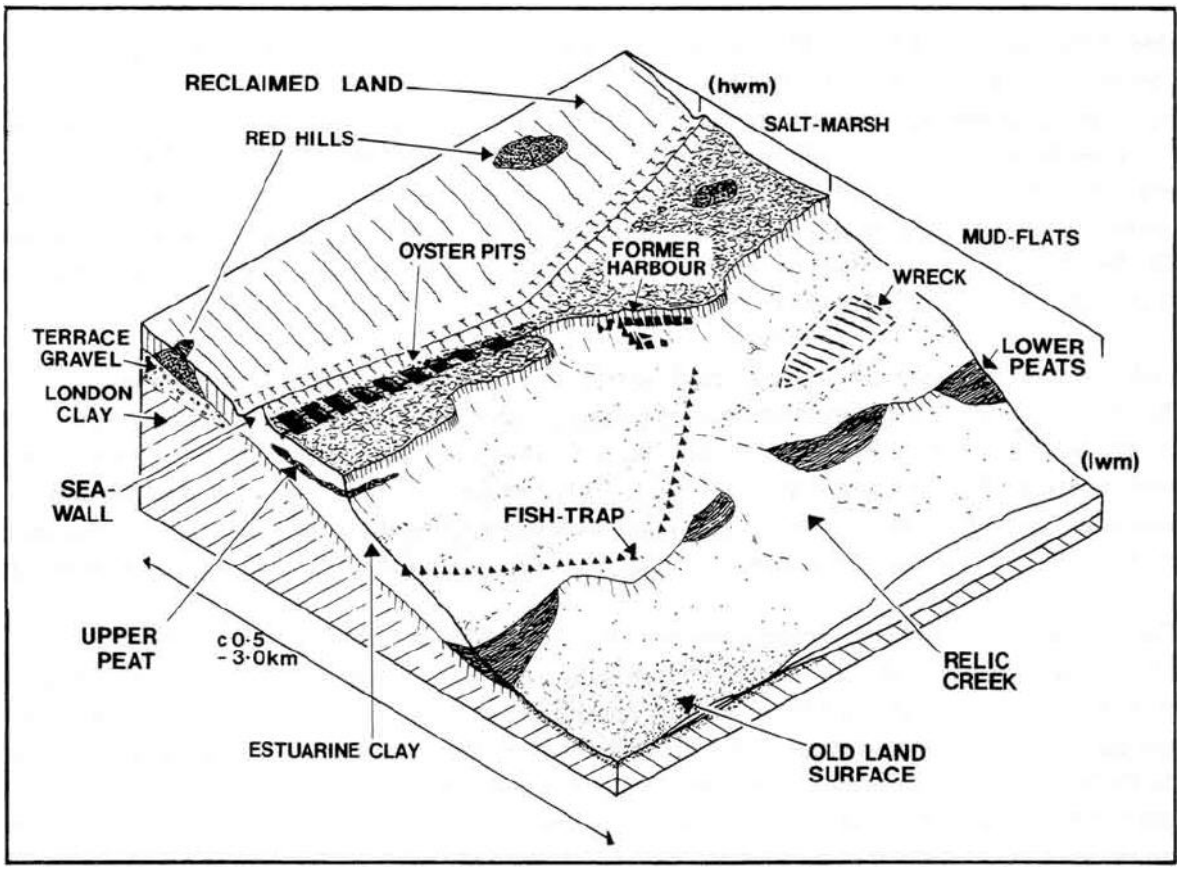

Fig. 1 *A typical section of Essex coast, showing types of environment and the associated archaeology (after Wilkinson and Murphy, forthcoming).*

Salt-marsh forms as salt-tolerant vegetation takes root in the areas of newly formed mud-flats which are only covered by spring high tides. The establishment of plants then results in greater mud deposits, so creating a tendency towards expansion. Salt-marsh erosion, at an alarming rate, however, has been noted as a major feature of coastal change in south east England. Between 1973 and 1988, the Orwell, Stour and Crouch lost over 25% of salt-marsh, while the Blackwater estuary and Canvey Island lost between 20-24% (Burd, 1992).

Naturally, salt-marsh erosion occurs because of the isostatic readjustment of this part of the continental shelf following the end of the last ice age. In Essex and north Kent, the isostatic uplift is currently estimated at -1.5 mm per year (the west coast of Scotland being +1), although this figure is likely to be higher in low-lying areas such as the Dengie peninsula. A good example of this is Othona Roman fort, at Bradwell on the Blackwater, where around two thirds of the site has been lost to the sea. Human activities, such as land reclamation and pollution, also play an important role in marsh depletion. Sea-walls, the result of land-

reclamation and coastal defence, dislocate the marsh from its natural setting, which results in erosion. Groynes, while often effective at localised protection, often increase erosion further along the coast. The breaching of old sea-walls also results in the degeneration of former salt-marsh. Salt-marsh also acts as a "sponge" for pollution, which is deposited at high tide. These processes erode archaeology which is harboured by, or is an integral part of the salt-marsh complex (i.e. wrecks, oyster-beds and former harbours). This relatively slow, though continual process, often occurs in inaccessible parts of the landscape, where development rarely poses a threat, and has gone unnoticed. In this way, sites are lost, or heavily eroded, without recording. Coastal erosion, however, also reveals new archaeology which has, until now been buried and protected. Indeed, the horizontal nature of the salt-marsh and mud-flats results in the appearance of new sites both in plan and in section, unlike a cliff scenario where they will only be revealed in section. Again, the continually changing nature of this landscape requires both immediate and continued reconnaissance.

5) Types of sites

i) **Weirs and Kiddles***:* These features appear on the inter-tidal mud-flats of estuaries, and are the remains of tidal fish-traps. As result, the problem of control for mapping these features is of special relevance. Binoculars are useful to search large expanses of mud-flat in order to locate sites. Often non-archaeological linear features appear (usually objects dragged around by tides, or natural streams) which can cause distraction. Weirs are substantial and permanent wooden structures consisting of upright timbers with wattle thatch between. They are usually V-shaped. Kiddles are basically timber and net variations on weirs, often being square as well as V-shaped. There exists fairly extensive documentary evidence for fish-traps in Essex dating back to the 15th and 16th centuries. The tradition continued, occasionally, into the early 20th century. The sites survive as stumps of the upright timbers, and appear, from the air, as long, post-defined linear features in the mud-flat.

In 1993, two permanent control stations, tied into the National Grid, were positioned, using GPS, in the vicinity of Collins Creek. CUCAP was commissioned to produce vertical photographs (at a scale of 1:4000) for photogrammetric use; this involved the use of several additional, temporary control points for Aero-triangulation purposes. This produced a small scale map showing the position of timber structures in the estuary.

In addition, a stop-and-go GPS ground survey was carried out by the University of East London Land Survey Dept. This produced more detailed information, on 20 metre sample stretches of the post alignments. Auger survey was conducted to assess estuarine stratigraphy, and, although samples proved to be too small for dendrochronology, two C14 dates, of the 7th and 10th centuries were obtained. Stretches of wattle panelling were recorded and sampled, as was a sample of basketry, which may have collected fish in the V of the trap. The fish-trap complex at Collins Creek is the most complex so far known in Essex, and involves several phases of construction and use. The entire complex covers around 2,000 x 700 m. Initial ground survey suggests that much further work is required to map more of the structures and obtain further samples for dating and phasing.

ii) **Red Hills***:* Red Hills consist of low mounds of partly fired clay (briquettage) and earth representing debris from the salt extraction industry of the Iron Age, Roman, and occasionally, the medieval period (Fawn *et al*, 1990). From the air they appear as soil marks (in various shades of reds and purples) both in the inter-tidal salt-marsh and inland of the modern sea-wall on reclaimed marsh. These are referred to as wet and dry sites. Wet sites are often slightly less obvious because of the colourful nature of the salt-marsh (green/purple vegetation and grey/brown clays and alluvium/estuarine silts). Dry sites show best as the contrast of red earth against the dark soil of a ploughed field, although they should, in theory, produce differential crop growth. Colour photography is, therefore, essential in recording. Although often surviving as low mounds, the potential for shadow marks is limited because of the three dimensional nature of the creeks within the marsh which produce complex and confusing shadow patterns.

The accurate mapping of Red Hills in salt marsh depends greatly on the natural features of the salt-marsh. 1:2,500 sheets show the outline of the main channels and creeks allowing effective control and centred plotting to within a couple of metres. Dry sites, on reclaimed land used for arable farming, have the normal rectification requirements.

Interest in Red Hills began in the late 19th century, and was greatly accelerated in 1906 with the establishment of the Red Hills Exploration Committee. The Colchester Archaeological Group has published a list of three hundred and forty one known, or suggested sites. Despite this, only around thirty have been investigated and recorded in any detail, and only two are scheduled. The vast majority of sites were discovered by field-walking, and the distribution of these often reflects the course of previous coasts. An excellent example of this occurs along the Dengie, where over twenty sites appear in a line over twelve km long, and which runs parallel to the modern coast, though inland by three to five km. Reconnaissance offers a vast potential for the discovery of these important sites by targeting such areas when fields are under plough.

iii) **Oyster Beds***:* Cultivation of oysters has a long and fairly well recorded history in Essex (Benham, 1993). Indeed, previous work on the industry has generally concentrated on the documentary and cartographic evidence for production and social history from the 18th – 20th centuries. Although production reached it maximum in the mid-nineteenth century, organised cultivation is known to have been well established in the middle ages, and the first reference to Essex oysters occurs in the Roman period.

Oyster pits are recognisable as anomalies to the natural creek pattern of the salt-marsh. They usually appear as an inter-connected linear series of roughly rectangular pits running parallel to the existing, or a previous, sea-wall. It is often possible, however, to confuse them with natural pools. While large, regular types are obvious from the air, small irregular scatters are not. The pits are filled with estuarine silts, and appear well both at low-tide, often when additional internal features are visible, and at high-tide, when the pits are full of water. In the latter situation, however, there is a tendency for pits on the edge of the marsh to disappear

altogether. Good results can be obtained by photographing, at high tide, the water-filled pits reflecting sunlight in contrast to the surrounding dark vegetation.

As with Red Hills, sufficient control for sketch-, or computer-plotting is often available as mapped salt-marsh and sea-wall. It is evident on the ground, however, that the subtlety of internal variation, often comprising inturns after sluice gates, and the overall hydrology of a site, cannot be appreciated from APs. Ideally, therefore, the location of the pits is mapped from APs and then detail added to these plots on the ground.

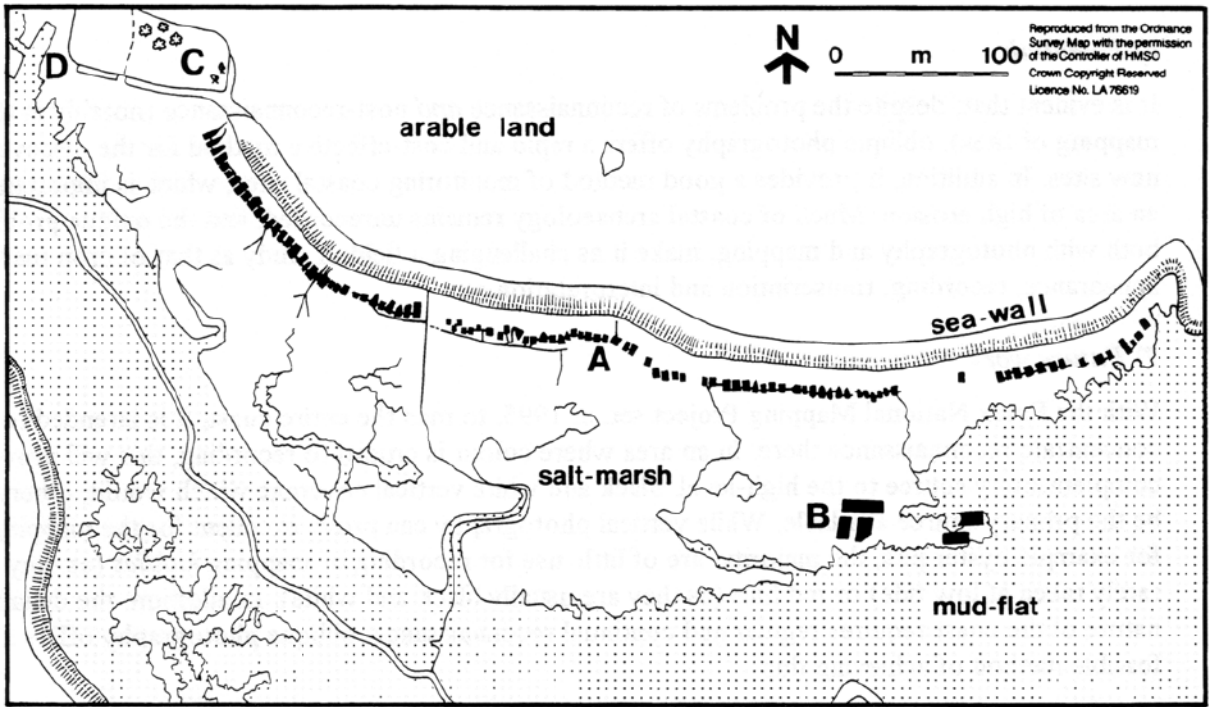

Fig. 2 *Bartonhall Creek, R. Roach: A) small, irregular pits, B) large, regular pits on 1st ed., C) site of unidentified buildings, D) former harbour.*

A variety of sizes, morphological types and spatial relationships have been recognised in Essex. Two distinct groups have been recognised. The first are large regular rectangular pits (*c.*10 x 5m) usually appearing in single lines parallel to sea-walls; in orderly parallel lines on offshore islands; or in either orderly or irregular distribution along the entire salt-marsh zone. The second group are small, less regular groups generally in single lines along sea-walls. Field work has revealed that the former group contain the remains of wooden sluice gates and other internal features, while the latter group are on the whole more eroded, contain more vegetation, but contain no internal features. In addition, while around 80% of the large type appear on the OS 1st edition, none of the small type do. Figure 2 shows the important site at Bartonhall Creek, on the River Roach, which contains both types. Both the position of pits, and the overall shape, can be easily mapped from verticals, and with the Essex NMP mapping the coast this year, the broad morphological information will exist as a good basis for further ground research in the future.

iv) **Wrecks***:* Remains of vessels occur in the salt-marsh creeks, in the inter-tidal mud-flats and in the eroded remains of former harbours. With a 200 mm lens it is possible to fill a negative with a boat from the air, offering the potential for identification of a wreck without a site visit. This is of importance to sites on the mud-flats which are often difficult to visit. While interpretation of boat type depends heavily on the condition of the remains, there is potential for identification based on size and morphology (the majority in Essex are barges). A very low percentage of wrecks were found to be recorded on the SMR.

6) Potentials

It is evident that, despite the problems of reconnaissance *and* post-reconnaissance (notably in the mapping of sites), oblique photography offers a rapid and cost-effective method for the discovery of new sites. In addition, it provides a good method of monitoring coastal sites, which is important in an area of high erosion. Much of coastal archaeology remains unrecorded, and the unique problems, both with photography and mapping, make it as challenging a field of study as that of crop mark appearance, recording, transcription and interpretation.

7) Future work

With the Essex National Mapping Project set, in 1995, to map the entire coast, it is intended to concentrate reconnaissance there. In an area where colour is crucial to recording, this will provide a complementary source to the high-level, black and white vertical coverage which would, otherwise, be the primary source available. While vertical photography can prove excellent for the mapping of, for example oyster pits, the majority are of little use for recording or mapping *kiddles* (as they are rarely taken at low tide) or red hills (as they are usually black and white). In addition, the dynamic nature of the coast requires regular and continual reconnaissance; oblique photography offers a feasible method of achieving this.

The Air Photography Unit (APU) of RCHME has recently carried out a country-wide assessment of air photo surveys in the inter-tidal zone. This has been a part of the joint RCHME/EH project “England’s Coastal Heritage” (ECH), which has sought to evaluate the archaeological resource of the coastal zone. The APU examined the various sources of photography available and how they have been utilised in different projects. The findings, which will be published in ECH early next year, are very much in line with those of Essex. They emphasise the importance of the continued use of reconnaissance, but also highlight the potential of photography commissioned by specialist bodies such as the National Rivers Authority and the Hydrographic Department, who fly at low tide.

Discovery and recording from the air must be seen as a primary stage of survey on the coast. It is vital that sites are recorded on the ground, and that the relevant excavation or documentary and cartographic research takes place where appropriate.

It would seem likely that the results from Essex have implications for the rest of south-east England, if not for all coastal areas. Similar coastal landscapes, such as south Suffolk and the

Medway in Kent will surely contain similar remains. Reports have recently been received of potential kiddles in Kent and the Suffolk side of the Stour (described by a local resident). There has been no study of the inter-tidal zone of Suffolk, and it therefore does not appear on the Suffolk SMR and awaits recording at the next Spring tide. It would also seem likely, however, that if the archaeology of the coastal zone is under represented throughout the country, then the potential for discovery and recording is vast on a nation-wide scale.

8) Bibliography

Benham, H., 1993. *Essex Gold, The Fortunes of the Essex Oysterman*. E.R.O. Chelmsford

Burd, F.H., 1992. *Erosion and vegetation change on the salt-marshes of Essex and North Kent between 1973 and 1988.* Nature Conservancy Council. Research and Survey in Nature Conservation, No **42**

Fawn, A., Evans, K., McMaster, I., and Davies, G., 1990. *The Red Hills of Essex, Salt-making in Antiquity.* Colchester Archaeological Group

Wallis, S., 1993. Aerial Survey in 1992, *Essex Archaeology and History* **24**, 193-194

Wallis, S., 1994. Aerial Survey in 1993, *Essex Archaeology and History* **25**, 233-234

Wilkinson, T.J. & Murphy, P., forthcoming. Archaeology of the Essex Coast: Volumes I & II. *East Anglian Archaeology*

AERIAL PHOTOGRAPHY IN SCANDINAVIA

It is one of life's coincidences that some two months after asking Jan Norrman if he knew of any aerial work in Norway I was sent a copy of *Magasinet SAS Norge* – the local version of Scandinavian Air Service's flight magazine – which included an article headed 'Her ligger et Vikingskip'. It included the following:

> In Norway the attitude was for a long time that the topography was not good for aerial archaeology. The first real aerial-archaeological investigation was done in 1976-1977 by the then PhD student Per Haavaldsen in southern Vestfold. His aerial photographs show clearly that aerial archaeology is a useful method for at least parts of Norway. Later aerial photos have been taken of Ringerike over a ten-year period with good results. Aerial archaeology is today a natural part of conservation projects where large areas cultivated land are affected. Of larger projects can be mentioned Gassør prosjektet [gas pipe project], the Gardermoen project and Norway State Railways double track in Vestfold. But it is first and foremost the personal initiative which has been typical for Scandinavian aerial archaeology up to the 1990s.
>
> Per Haavaldsen was the foremost pioneer in aerial archaeology in Norway. He completed his investigations over southern Vestfold in the years 1976/1977, but was soon forbidden to do aerial photography by the Department of Defence. This ostensibly because he was supposed to be a security risk because of his left-wing views!
>
> A result of the flying ban is that Haavaldsen's photos and register have never been published until this edition of *Magasinet SAS Norge*. His black and white photos have for almost 20 years languished in the archives of Oldsakssamlingens [collection of ancient remains], but the colour photos have during this time been in Haavaldsen's private archives.
>
> Similar photography has been done by archaeologist Terje Gansum over the Slagen Valley just outside Tønsberg during the last three summers. This is where the Osberg mound lies. Until now archaeologists and historians have regarded the Osberg mound as a relatively isolated phenomenon, without other important prehistoric remains in the vicinity. But Gansum's photography reveals a literally completely different picture. On several sites in the Slagen Valley the marks in the vegetation show remains of burial mounds which have later been ploughed away or perhaps used as sand pits. Only 400m away from the Osberg mound there was, in 1990, found such a mark, the size of the Osberg mound. These remains of an unknown large mound have so far not been investigated more closely. Especially the first summer, in 1992, the conditions for archaeological investigations from the air were particularly good. The summer was very dry, therefore the marks in the vegetation were all the clearer.
>
> The next two summers have revealed new and unknown ancient remains in the same area. What can be observed from the air will vary from year to year, that's

> why it is important to do investigations over several years and several times per season. Among Gansum's other finds are hitherto unknown large mounds on the Rom farms in the north of the valley. Also in the Basberg area the aerial photos show that there have been large burial mounds, the same is true for Horgen near the Osberg mound.
>
> Altogether these finds form a new picture of the history of the Slagen Valley. The Osberg mound has not been an isolated large mound. Instead it is one of a collection of mounds, from the iron age/Viking age, which are not much different in size from the famous area Borrehaugene [Borre mounds] outside Horten. The finds are thus not only exciting in themselves, but the relationship between the Slagen Valley and the Borre mounds must be seen in a new perspective.

(From *Magasinet SAS Norge* November/December 1994: translated by Ellen Wang)

I sent the translation to Jan Norrman and asked if, with his 'local' knowledge of universities, etc, he could track down any of the names. Jan's reply was even more promising – he found the person, Dagfinn Skre, who does most of the aerial work (rather than write for the popular press!) and who ought to be in contact with other active Norwegians. As yet there has been no reply from him to my hopefully persuasive letter.

Jan Norrman also passed on the good news that he will be gaining an assistant(?), Kjell Edvinger, who used to work for him (and was then an AARG member) and is returning to the regional office in Western Sweden. The additional pair of eyes in that part of the country seems especially welcome.

AARGMART

An opportunity for exchange or barter

WANTED

· CBA Research Report 12 (1975), *Aerial Reconnaissance in Archaeology*. Michael Doneus, Institut für Ur- und Frühgeschichte, der Universität Wien, Franz-Klein-Gasse 1, A-1190 Wien, Austria.

· Rog Palmer (1984), *Danebury*... Tomasz Herbich, Instytut Archeologii I Etnologii PAN, Al. Solidarnosci 105, P-00-140 Warszawa, Poland.

· David Wilson (1982), *Air Photo Interpretation for Archaeologists*. Michael Doneus, Institut für Ur- und Frühgeschichte, der Universität Wien, Franz-Klein-Gasse 1, A-1190 Wien, Austria.

> Copies of this book are always in demand and any second hand copies should perhaps be bought in anticipation of this.

FOR SALE

· Derrick Riley's cameras. Olympus OM2 with 50mm and 135mm lenses;

Nikon F601M with Nikkor 35-105mm lens.

We have only these bare details at the time of printing. Further information and offers to Anthony Crawshaw (who is handling the sale on behalf of Marjorie Riley), 15 King's Staith, York YO1 1SN

· *Into the Sun* ed David Kennedy (Sixteen essays on aerial photography in honour of Derrick Riley). Several copies at £9.95 at Oxbow Books, Park End Place, Oxford OX1 1HN

BOOKS OF INTEREST?

Archaeological Prospection. Vol 1(1) (November 1994). Wiley. Annual personal subscription - four issues - $(sic)120.00.

As expected, the first issue of this new journal is heavily biased towards ground-based prospection. The Editorial summarises the intended scope of the journal and expresses the hope that future contents will be broader in outook and include results of integrated surveys. Aerial matters are allowed for through the inclusion of Bob Bewley as an associate editor although I am uncertain quite how aerial survey, as usually published, is likely to fit into the journal's scope. One paper in the first issue, by Jorg Fassbinder and W E Irlinger combines aerial and magnetic prospection in a way in which we are becoming so used to in Britain. To quote their summary: 'Although the aerial photography gives the location, the details of the plan derive from high-resolution magnetic prospection...'. And so much for the role of aerial reconnaissance!

The cost is likely to keep *Archaeological Prospection* firmly in the libraries only category (it must work out at about 50p per page) but it will be worth keeping an eye on future issues in case any aerial-relevant papers are included. Any hopeful contributor is advised to read the Editorial in issue 1, as well as 'notes for contributors', as a guide towards expected content.

Wales from the Air: patterns of past and present. Chris Musson. Royal Commission on the Ancient and Historical Monuments of Wales. undated (?1994), unknown price.

Seen while in the process of reviewing for another journal. No comment other than to say that I like it and think that it shows considerable initiative on the part of RCAHMW to publish such a book. Might the profit pay for another assistant for Musson...?

La Prospection Aérienne en Bretagne. L Langouet and M Gautier. Centre Régional de Documentation Pédagogique de Rennes. ?1994. 100F.

A one-page blurb for this book was collected from a heap at Potsdam. It claims to include maps, colour photos, notes on methods of prospection and 'd'approche des sites' (zzzz) and an essay on the archaeological interpretation of the results. Otherwise I have no information.

Prehistoric Settlements. Robert Bewley. English Heritage/Batsford. 1994. £25/ £14.99.

Young Bewley (according to the author's photo) is at it again. AARG's review copy was sent to Chris Evans who has not yet responded. I've read it (the good thing about these Batsford books is that they can be read during a couple of meal-times) and thought it a good introduction to the range and types of settlement – in its broadest sense – in Britain. Very well illustrated with maps and photos (mostly aerial – surprise!) although with a couple of the verticals 'upside down' (with north to the top) and therefore, for me, with negative up. Perhaps there is also a little too much content (repeated content) about the problems of aerial reconnaissance...?

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