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TF111054: Helpston, Cambs. Stereo oblique pair taken with near-100% overlap using a motor winder on a Bronica ETRS (which allows a 1.5 to 2 second interval). Apologies for the lack of archaeology (it’s from the edges of the prints) but everything else fuses nicely! Photos, 95.38/1-2 © Rog Palmer, March 1995.
Those of you who are fond of aerial pictures may be pleased to learn that the printers of AARGnews now have the technology to scan in a photograph, play with it, and drop it into the required space on a page, resizing as necessary. The printers were good enough to run a short demonstration of this recently and the results are very good, and can be improved by printing on better quality paper. This system allows reduction and enlargement and can also select a bit of a photo and use just that, or enlarge it to show detail (a bit like a school photo with one head enlarged in the corner!). It can also begin with colour (a print I think – I saw no device for projecting slides) and turn it monochrome. Unfortunately they cannot yet read from disc although demand makes this likely fairly soon. I am not expecting this to change in any major way the number of you who contribute – but please note that there is now the possibility of including good-quality half-tone illustrations with your words. I hope that pictures included in this issue will serve as a demonstration of the type of reproduction that can now be managed. If you can send me the good illustrations the printed copy ought to be a reasonable match. Dotted about in this issue will be some space-filling pictures selected to test the printing of light-toned fields, dark ones, earthworks and so on.... Given that all of you will possess a stereoscope I have included a stereogram so that we can see whether the dots ruin the view.

Robert White sent me a copy of an article from Mapping Awareness (April 1995) which included notes on use of a model aircraft for monitoring environmental change. The model has a wingspan of about 8 feet and has provided a low-cost means of acquiring ‘high-resolution multi-temporal imagery’. ‘The combination of this airborne platform, GPS, digital image processing and file compression technology has demonstrated the potential of 35mm multispectral aerial photography as a data source for GIS analysis...’. No further details were provided in the article although these were offered on contact with the author. One immediate use for such a camera platform could be to add an aerial element to the monitoring of the site at Market Deeping (see AARGnews 7, 20-21). Perhaps a research proposal could be formulated by one of you interested in crop mark development and sent to EH. I’m sure that their inspectors would enjoy flying model aircraft once a month – purely for research purposes, of course. Here’s an opportunity for crop watching, with whatever ground data may be available, for those of you who hope to find out what makes crop marks tick. So much wishful thinking has been uttered as to the need for research of this kind that I’m sure you’ll jump at the opportunity. Won’t you.....

Martin Fowler’s paper on the Stonehenge area effectively demonstrates that the highest resolution satellite imagery now has a place in the already vast heap of photographs that we need to examine to make our interpretations. The quality and resolution even on the copies of copies of copies... that are included in this issue would appear to come close to medium-scale vertical photographs (perhaps as viewed through a dusty stereoscope). His paper also demonstrates to me that this imagery cannot any longer be looked at alone – it must be used in the usual comparative way that we examine a site or area so that dubious features can be eliminated and confidence is given to our choice of archaeological crop- or soil-marked features. The potential of the Russian images is clearly apparent in Martin’s maps of crop marks and soil marks. In this case it doesn’t much matter whether what their origin is, it is sufficient to realise the level of information that can now be recovered from these sources. A second contribution from Martin (who was kind enough to research and write this piece at short notice following a hint from me) outlines the range of Russian imagery that is available. Perhaps the greatest potential for its application may be in those parts of central Europe that are in the early stages of their reconnaissance programmes?

I had a choice of two ‘conversations’ on the books as possible content for this issue – one
that was held back until after RCHME’s strategic review and a last-minute hope for one which could at least begin to air discussion about mapping. Lack of the former means that Bob Bewley and I haven’t met since March (possibly also Bob would rather not say too much about life at Swindon ...?) and that to John Hampton arrived at the same time as a virus infection. John has now recovered from that and we hope to get together with a tape later this year. Meanwhile I have been thinking (which means that I have not been over-busy this year) and have scribbled a few thoughts about mapping that appear somewhere in this issue. The purpose of that is to lay down a few points for future comment which may, but probably may not, spark off a bit of the old-AARG-type discussion and may also have some relevance to the proposed discussion on RCHME’s National Mapping Programme at AARG this September. Although the note began as thoughts on mapping it may have crept a bit over the line with a few political suggestions.

Work on the inter-tidal zones in Essex has produced an interesting analytical note from Davie Strachan on use of verticals. In part this was a response to my query in the last AARGnews but it is much more than just an answer and allows those of us who work only above dry land to appreciate the extensive range of problems to be tackled and overcome in these shifting environments.

Roger Featherstone sent me a piece about regional grants in England. This was received in May very soon after the allocations had been made and is, of course, now out of date. As many of you will know 1995 has been one of those ‘good’ summers with many areas developing exceptional marks in crops and grass.

RCHME themselves clocked up a high hourage (if that’s a word) and also managed to scrounge additional money which, I understand, was put to good use in (at least) Northumberland. Roger is now, or will soon be, chasing around for comments on results so as to write another ‘annual summary’ for Antiquity. Just to save him a bit of work I could note that Chris Cox and I have had a fairly busy time around Cambridge and Hertfordshire with especially interesting results on the clays. As should be expected with continuing ploughing skimming a slice off the medieval fields each year the earlier sites are becoming more capable of affecting crop growth. For those of you interested in crop mark theory these ditched sites usually show late in the season after the cereal has ripened as (usually I think) light marks against a light background.

I took advantage of flights with RCHME to try Kodak’s Technical Pan from the air. Not, unfortunately, over the clay where it may really come into its own on those low-contrast marks. There is a little more that I’d like to do with it before I am convinced that it is better (for the photo interpreter) than the considerably less costly Ilford FP4 but, in general, the contrast is certainly improved and it can be used to produce prints that are startlingly clear. Resolution too is extremely good for 35mm. I have written up the story so far in case it may be useful to genuine aerial photographers. Others of you who carry out your own processing and printing may have additional points to make...

And finally, I needed an index-of sorts for the first ten issues of AARGnews. Just in case anyone else ever refers back to old news I have included the index in this issue on handy tear-out pages.
CHAIRMAN'S PIECE

Marilyn Brown

Autumn has always been a key season for those concerned with aerial reconnaissance and the interpretation of its results; it marks the end of intensive flying, with the cereal crops already cut, while, with the trees still in full leaf and ground cover at its most dense, shadow photography (except under particular circumstances) is at its least productive, and the quest for appropriately revealing winter weather has not yet begun. It is a suitable time for taking stock of the impact of a year's discoveries on the conceptions or preconceptions of the archaeology of an area, or a cultural period, or on a body of work currently seen as complete. More than most other methods of recovering archaeological information, aerial reconnaissance, properly incorporated into the existing body of knowledge, still has the power to change and improve, on large and small scales, our image of former landscapes.

The hot, dry summer (less hot and dry in Scotland) has produced its share of new discoveries. While cropmarking has yielded a useful harvest of material, it has been parchmarking, in particular, that has been revealing new parts of the landscape, with the emergence of previously unrecorded forts and settlements lying in pasture between the upstanding stone and earthwork sites on the higher hills and the cropmark examples in the lower parts of the valleys.

One aspect of aerial recording that is suitable for autumn reconnaissance is the photography (at least in the more exposed parts of Britain) of World War II and earlier coastal defences. Recent work in the Orkney Islands has confirmed the powerful nature of the aerial image in revealing the tactical choices in the planning of defensive structures, the sheer scale of some of the installations and the transformation of remote rural areas into (in terms of number of inhabitants) sizeable towns. Some of the changes, like the building of the Churchill Barriers between the south islands of Orkney, have had permanent and major effects on the topography and subsequent development of an area, while other sites have been deserted without even their earlier inhabitants returning. Modern military defences are a type of monument that are often screened out of the archaeological observer's perception, in the endeavour to reveal the earlier monuments that surround or underlie them, but this is an aspect of recording which should form part, where possible, of each aerial practitioner’s consciousness.

The 'Defence of Britain' project is one of the topics that will form part of the AARG Conference at Lincoln. Others are the National Mapping Programme, the progress of GIS and role of the Aerial Archaeology Research Group, thus putting the emphasis on current projects and concerns. Is this the kind of programme the AARG conference should have? Should the programme for next year (possibly in Essex/South Suffolk) be more introspective/less introspective? Patrick Nagy from Zurich will be talking at Lincoln about the establishment of AARGE ALPS, a Swiss parallel to AARG, and it should be interesting, and perhaps educational, to see the elements which are judged to be of most value.
Chairman’s photo. Wartime defences at Gullane, East Lothian. Photograph © RCAHMS.
AARG is hoping to establish a database of members by the end of 1995. It will hold the following details: name, title, organisation, address and telephone number of all current members. In order to comply with the Data Protection Act, the information will be used for the following purposes only:

The publication of a list of members of AARG;

Mailing of AARGnews, conference details and other information;

Other disclosures that the AARG committee decides are necessary, or may be useful to AARG members.

If you wish to object to your personal data being held on computer you should write to Jo Elsworth, Cadw, Brunel House, 2 Fitzalan Rd, Cardiff, CF2 1UY before 1 November 1995.
STONEHENGE FROM 230 KILOMETRES

Martin J. F. Fowler and Helen Curtis

Introduction

In the last issue of AARGnews, the identification of archaeological features on SPOT Panchromatic and LANDSAT Thematic Mapper (TM) satellite imagery of Stonehenge and its environs was described (Fowler, 1995). Compared with conventional aerial photographs, the results were disappointing since the low resolution of the imagery (10m ground equivalent pixels for SPOT Panchromatic and 30m for LANDSAT TM) precluded the detection of all but a handful of the archaeological features present in the study area. However, it was considered that such low resolution imagery could be used in archaeological studies through classifying ground cover in prospecting for areas of high archaeological potential and through the exploitation of the multispectral nature of the imagery.

With the end of the Cold War, very high resolution satellite imagery from the Russian space programme has now become available commercially. These products have equivalent ground pixel sizes of between 1.5 and 10m (Baxter 1991) and are primarily film based images that are subsequently digitally scanned. In order to assess the usefulness of such high resolution imagery for archaeological studies, an image extract covering part of the environs of Stonehenge has been acquired.

Image

A Russian KVR-1000 satellite image of an area of 4.7 by 6.3 km to the east of Stonehenge was kindly provided by Nigel Press Associates Ltd for the cost of writing the digital image to film. The panchromatic image, covering the spectral range 0.51 to 0.76 µm, had been acquired in June 1993 from an altitude of between 210 and 235 km and following digitisation had a ground pixel size equivalent to 1.4m.

Processing

An area of the 1:25,000 scale print, covering some 1.7 by 2.4 km to the east of Stonehenge (see Figure 1), was scanned at a resolution of 300 dpi using a flatbed scanner. The resulting 8-bit, 256 grey scale, image with a ground pixel size of roughly 2m was approximately 1 Mbytes in size. The image was edge sharpened using the software provided with the scanner and saved in uncompressed TIFF format for importing into the PC IMega image processing package (described in Fowler 1994).

Vector overlays corresponding to archaeological and other features were transcribed from the image using PC IMega, exported as ASCII text and converted to ATLAS BNA format using a simple reformatting program written in Microsoft QBASIC. The data could then be imported into the Windows-based MapViewer™ package (Golden Software Inc.) for final presentation.
Figure 1. The major monuments within the Stonehenge study area together with the coverage of the KVR-1000 image extract shown in Figure 2. The base map was derived from LANDSAT TM imagery and merged with the major archaeological features derived from the 1979 RCHM(E) survey of the area.

**Analysis**

The image extract is shown in Figure 2 and appears to have been acquired in the early morning with the result that many of the upstanding archaeological features are visible as highlights and shadows. Over 40 upstanding monuments, together with a number of crop and soil mark features that may be of archaeological origin, can be provisionally detected (see Figure 3).
Figure 2. Russian KVR-1000 satellite image of Stonehenge and its environs. Image supplied by Nigel Press Associates Ltd.
Figure 3. Provisional interpretation of the KVR-1000 image shown in Figure 2. The numbering of the various barrows correspond to those given on the barrow distribution map in the 1979 RCHM(E) survey of the area. Crop and soil mark features are shown stippled.
Upstanding monuments

The circular bank and ditch of Stonehenge can be readily traced on the image as highlights and shadows (see Figure 4). Likewise, the circular shape of stone setting at the centre of the monument can be discerned although the individual stones cannot be resolved. Within the henge, the location of the North barrow, and possibly the South barrow, can be seen. Leading away from the monument, the Avenue can be traced as two parallel lines of a dark tone extending over some 500m. Immediately to the south of the A344 and within the Avenue, the Heel Stone can be seen as a highlight. Finally, cutting across the western side of the henge and encompassing the monument to the south and east, the visitor footpath is particularly apparent due to its very light tone. This feature was readily apparent as a prominent oval on the SPOT Panchromatic imagery studied earlier because of its high contrast with the surrounding vegetation.

To the east of Stonehenge, the ditch, berm and mound of an upstanding bell barrow (No. 11 on the RCHM(E) (1979) barrow distribution map) can be readily identified as shadows and highlights (Figure 4). Similarly the majority of the earthworks of the two main barrow groups in the area can be detected and classified on the image. At the Normanton Down group, it is possible to identify the various Disc, Bowl and Bell barrows that make up the group with the disc barrows 3, 4, 14 and 24a being particularly evident (Figure 2). Identification is aided by the somewhat 'clinical' conditions of the earthworks, several of which survive as islands of older grassland within more recent grassland. In contrast, the identification of the members of the New Kings Barrow group, visible from above following the clearance of many of the trees in the area following the gales in January 1990, is less easy although six of them can be seen as highlights and shadows of the upstanding earthworks. Of the 49 upstanding barrows present in the image extract area that are not obscured by trees, some 38 (77%) can be detected on the imagery.

To the east of the Stonehenge Avenue, the earthworks of the unfinished 18th-Century road as it crosses Stonehenge Bottom (RCHM(E) 1979, 31) can be detected extending over some 200m.

Crop and soil marks

To the south of the New King Barrows, the site of the Coneybury Henge, totally flattened by ploughing, can be detected as a circular crop mark feature on the contrast enhanced image shown in Figure 5. Other circular and linear cropmark features can be tentatively detected within the field and it is interesting to note that ridge-and-furrow have been reported to be visible on some aerial photographs of this area (RCHM(E) 1979, 13).

North west of the Normanton Down Barrows, the D-shaped enclosure on Stonehenge Down that has been completely levelled by ploughing (RCHM(E) 1979, 22) appears as a soil mark (Figure 2). Other dark linear marks can be seen elsewhere on the image in particular in the light toned fields to the south of the Normanton Barrows and to the east of Luxenborough Plantation (Figure 3). The significance of these features has yet to be determined and could range from 'celtic' fields, boundary ditches, medieval ridge-and-furrow to other, non-archaeological, features.
Figure 4. The Stonehenge monument from the Russian KVR-1000 sensor. The width of the image is approximately 320m. Image supplied by Nigel Press Associates Ltd.

Figure 5. The Coneybury Henge visible as a cropmark. The width of the image is approximately 640m. Image supplied by Nigel Press Associates Ltd.
It is of interest to note that to the south of the area covered in Figure 2, linear earthworks and 'celtic' fields can be identified on the north and west slopes of Rox Hill. Likewise, two large oval enclosures appear as cropmarks further to the south. Work is in hand to exploit this area of the image and will be reported elsewhere.

Finally, a square of light tone with sides approximately 100m in length is visible to the west of the New King Barrows (Figure 2). A visit to the area in July 1995 failed to produce evidence of any surface features, nor could anything be seen on an aerial photograph of the area dating from 1975. It is possible that this feature may comprise fodder distributed for grazing livestock as the light-toned streaks of varying width that make up the square have the characteristics of such fodder when seen on aerial photographs (see Figure 110 in Wilson 1982).

Discussion

The earlier study of the Stonehenge area involving the use of Western satellite imagery was limited by the relatively low resolution of the products (10-30m). However, given knowledge of the archaeological features present in the area, it was possible to detect such features as the stone setting and visitor footpath at Stonehenge and several of the round barrows on the SPOT Panchromatic and LANDSAT TM imagery (Fowler 1995). In contrast, the high resolution of the early morning KVR-1000 image used in the present study has meant that for probably the first time it has been truly possible to go from satellite image to archaeology rather than vice versa. The majority of the upstanding archaeological features in the area, discernible as highlights and shadows, could be detected and classified on the image and a number of crop and soil mark features, including the Coneybwy Henge, a probable D-shaped enclosure and other linear features, could also be detected.

It should be recognised that the digital imagery finally analysed in this study is fifth generation having been scanned from the original photographic print to produce a digital image that was then written to film, printed and then re-scanned for analysis. However, the image appears to have retained much of its clarity and the resulting ground pixel size has increased from 1.4 to 2.0m. Original second generation imagery could have been used, however this was constrained by cost (approximately £800) and the relatively large size of the image (approximately 15 Mbytes). The latter is of particular concern when considering the use of very high resolution digital satellite imagery. For example, whereas a typical area of some 20 by 20 km would have a file size of some 0.64 Mbytes at 25m resolution (e.g., resampled LANDSAT TM), this increases to some 4 Mbytes at 10m resolution (e.g., SPOT Panchromatic) and to 177 Mbytes at 1.5m resolution (e.g., KVR-1000). However, this study has shown that by obtaining the original digital imagery as a film-written photographic print at a scale of approximately 1:25,000 and subsequently scanning selected areas for analysis, convenient file sizes can be used with minimal degradation of the image.

Whilst it is recognised that very high resolution Russian satellite imagery is by no means a replacement to conventional aerial photographs and that the present study has concerned a relatively 'clinical' area of chalk downland, such imagery would appear to provide a cost effective means of detecting archaeological features over a large survey area. For example, the whole of Rog Palmer's Danebury survey area (Palmer 1984) of 450 km$^2$ could be covered theoretically by a single KVR-1000 image at a cost of about £2500. The archived databank of
Russian imagery is reported in sales literature as being 'extensive' with products available for all territories of the world with the exception of Russia. For Britain, cloud-free KVR-1000 coverage is not particularly uniform with approximately 50% of the British Isles being covered (see Figure 6). For some areas, in particular Wales, multiple images are available. Several new missions are launched each year and it is possible to request specific areas to be imaged.

Further work is in hand to exploit the remainder of the image acquired for this study, including the investigation of apparent soil and cropmark features, and will be reported elsewhere.

**Figure 6.** Approximate extent of archive cover of cloud-free KVR-1000 satellite imagery of the British Isles. *Based on data supplied by Nigel Press Associates Ltd.*
Acknowledgements

The authors thank Richard Chiles of Nigel Press Associates Ltd, Edenbridge, Kent, for providing the image used in this study for the cost of writing to film and Dr M J Hoey of University College Dublin for kindly providing a copy of PC_IMega.

References


VERTICAL PHOTOGRAPHY AND INTER-TIDAL ARCHAEOLOGY
Davie Strachan

In response to comments from Rog Palmer regarding the usefulness of vertical photography in the inter-tidal zone, the following notes offer the experience of the Essex Mapping Project (National Mapping Programme), which is currently mapping the coastal blocks of the county; and of an assessment made of National Rivers Authority (NRA) photography. Verticals have proved useful because of their early date range (ie pre-erosion/destruction); the scale of photography and their relative lack of distortion; and the fact that in a continually shifting topography, different years of photography are necessary to extract the maximum information. While this situation may appear akin to the use of early verticals in other environments, the nature of the inter-tidal zone presents unique problems in mapping for which vertical photography has special relevance.

Early vertical photography and the Essex Coast
A significant amount of this material, taken in the 1940s by the RAF, often coincides with low tides. None, however, appear to have been taken at the equinoctial low tides required to reveal the largest inter-tidal expanses. The major advantage to the Essex mapping Project has been in the recording of sites on the reclaimed marshes, oyster pits and maritime vessels. The reclaimed marshes were largely converted to arable land, in response to high Government incentives, in the 1950s and 60s. Early photography records, in some detail, upstanding duck-decoy ponds, including features which do not appear on old maps, despite the scale. The courses of former sea-walls can also be mapped, which indicate the sequence of reclamation of an area. In addition, areas where sea-walls have been breached and land within has eroded away can be recorded. Outside the sea-wall, as present salt-marsh erosion is marked, and early photography often records oyster pits and salt-marsh features which have subsequently been lost. Indeed, vertical photography was the main source of the study which highlighted erosion and vegetation change on the salt marshes of Essex and North Kent (Burd, 1992). A good example of an advantage of early photography is at a series of circular tidal-ponds which appear cut into the salt-marsh at Hadleigh Ray, near Southend-on-Sea. While the group appear very similar on RAF verticals from 1953, a sortie from 1947 proved that one nucleated cluster was, in fact, bomb-craters which pierced the estuarine silts. Subsequent silting rendered them virtually indistinguishable from those which have inter-connecting channels, which relate to the natural creek system, and appear to have been deliberately cut for some, as yet unknown, function.

On the large inter-tidal mud-flats, the approximate position of coastal wrecks can be triangulated from verticals because of the amount of coastal control afforded by the scale. While wrecks usually appear in isolation on oblique photography, which although they lack control, do offer detail which verticals cannot supply. Similarly, the position of a large, complex tidal fish weir at Bradwell was obtained because the site appeared through the water of a low tide, which allowed the photograph to be enlarged to fit the base map using a Grant enlarging light table. Again, the scale afforded enough coastal features to act as control. Details of the traps and the rebuilding of the site, which is rectangular and around 350 x 200 m, were then added from low-tide, low-level obliques.
Early photography also offers the opportunity of retrospective monitoring of erosion on features such as wrecks, which can indicate which vessels have been recently deposited, if not give any idea of their date. In addition, due to the continually shifting nature of sand-banks and mudflats, photography from different years offers an excellent opportunity to view varying inter-tidal conditions. A good example of this is the RAF “999 series” sorties which were flown immediately after the flood of 1953. While the aim of the flights was to record damage, especially to sea-walls, the heavy storm conditions also disturbed large areas of the inter-tidal revealing hitherto buried material. The medieval salterns, or Sun-Works, at Sutton-on-Sea (Lincs.) are a notable example.

Regarding the longevity of features in the inter-tidal, it would seem likely that position, in relation to the tidal amplitude and inter-tidal topography, is the main factor. A hull which occurs around LMW is subjected to a high number of wave-bearing tides, while a fish trap which is only exposed twice a year is in a more stable environment. Redhills positioned on the border of the salt-marsh and mud-flat are, because of coastal squeeze, perhaps the most threatened sites on the Essex coast. At Rolls Farm, on the Blackwater, several layers of stratigraphy, including charcoal lenses and briquetage dumps, appear on the eroding cliff of a mature salt-marsh. The site is effectively being excavated, horizontally, by the sea. These factors would appear to emphasise both the importance of continued reconnaissance of the inter-tidal zone, and the consultation of all available sources for any site.

Assessment of National Rivers Authority (NRA) photography

As part of NMP, an assessment was recently made of the potential of NRA vertical photography of the coastal zone, taken at low-tide, for use in the Essex Mapping Project. For the Anglia region the NRA currently have four years of vertical photographic coverage of the majority of the coast at low tide in monochrome, and limited colour vertical coverage concentrating more on tidal rivers such as the Nene and the Ouse. For Essex, the monochrome sorties, dating from 1991 to 1994 and at a scale of 1:5,000, vary in distribution and coverage, although in more recent years, it has included more of the estuaries/inter-tidal zones. Details of the photography are as follows;

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The photography is undertaken in conjunction with the NRA’s twice yearly topographic survey; a ground-based survey to monitor coastal change, and its five year bathymetric
survey. The aerial photographic survey is carried out around mid-July, just before the summer ground survey, to fit into an appropriate low tide window.

The NRA hope that one year in five, beginning with 1995 if funds are available, vertical photography at low tide will be in colour. In general, the NRA photographs have been taken under good lighting conditions, in mid-summer, during low, but not the lowest tides, which occur around March and September.

For the assessment, a number of areas were compared with the results from completed NMP plots and/or features recorded by the Archaeology Section’s programme of coastal/inter-tidal aerial reconnaissance.

The most noticeable problem with the sorties was that, because of the very low gradient of the coast, and hence the speed of the tide change, the degree of inter-tidal exposure varies for different areas within an individual run/sortie. This factor was noticeable, not only when a number of runs attempted to record large areas of the coast, but also within the larger individual estuaries. In consequence, according to the arbitrary start position of a run, features may be submerged by the shifting tide by the time that the run reaches a particular site. In this instance, it was decided that the NRA material did not offer any additional advantage over other sources consulted, although the source is recognised as a valuable resource for the study of the coastal region.

Again, this would emphasise the importance of inter-tidal reconnaissance being targeted at a single estuary or stretch of coast when tide shifts too rapidly to allow any extensive degree of prospection. It is possible, in these conditions to “follow” low tides as they occur along a coast. The possible kiddle at Holbrook bay (Suffolk), mentioned in the last AARGnews, was partially visible, although submerged on NRA verticals, which additionally lacked control. The site was subsequently flown by ECC at lowest tide of the year and confirmed as a kiddle and also given a rough position from background detail.

The NRA is also currently investigating the potential of photogrammetric rectification of runs of vertical photography in order to map large inter-tidal zones. The outcome of these developments would certainly be of interest to those involved in aerial archaeology.

**Whitstable Bay: towards integrated survey in the inter-tidal zone**

A large area of the inter-tidal zone of this bay in North Kent is exposed by most low tides. Here, an important horizon is a shingle bank, which represents the area of eroded former salt-marsh, which, as it erodes, reveals previous horizons which contain various palaeontological and archaeological deposits. These include several areas of prehistoric land-surfaces with associated timber remains, and a complex series of kiddles, which, as yet, remain undated.

This area of inter-tidal zone is unique in that it is in the private ownership of Seasalter Shellfish (Whitstable) Ltd. The *Kent Oyster Coast Environmental Survey Project* has been instigated in response to the noticeable erosion in the area, and hopes to include a GPS survey. Permanent GPS positioned markers can then be kept around the bay and used for computer rectification of oblique aerial photographs. Features recorded will include the visible archaeology (notably the kiddles) and the various land surfaces in the bay (especially the eroding shingle bank which reveals the archaeology) which would be too time consuming to do on the ground. The resulting plots of archaeology can then be compared to the more accurate GPS work to assess the feasibility of this technique for use on other sites. The “topography” plots can then form the basis of an erosion monitoring programme involving regular flights which would produce an evolving map to monitor erosion in the bay, and
indicate areas where additional recording might be necessary. In addition, it is hoped that the vertical sources for the area can be assessed in order to reveal previous erosion rates and patterns, resulting in an integration between ground survey, aerial photographic research and aerial reconnaissance for monitoring purposes. It is hoped that details of the aerial photographic aspects of this project will be reproduced in future editions of AARGnews.

Conclusions
1) Verticals should, whenever possible be consulted, as with the general rule that all available photographs should be consulted. High levels of coastal erosion in the south east make the date range of early verticals especially useful. In addition, their use is of special value for the approximate positioning of features in the inter-tidal zone, where no other method is available.

2) It would appear that, in coastal areas with a low, expansive inter-tidal, vertical runs can only assure the optimum low-tide coverage over a small area of the inter-tidal zone.

In Essex, there is a large body of specialist oblique photographs which targets a specific area and records inter-tidal features at the very lowest tides. As result, there are a number of inter-tidal sites with good air photographic coverage. It may well be the case that for other parts of the region the source may be of greater value for the potential discovery of sites. This would reinforce the idea that oblique photography, despite the problems, is the best way.

3) Both discovery and mapping of inter-tidal sites is best achieved by oblique (or vertical) reconnaissance targeting small areas of coast at the lowest possible tides. This should be carried out regularly and can only be done by a number of people on a regional basis in order to record the limited number of very low tides in the year over large areas of coast. Whenever possible, this should be carried out in conjunction with ground survey in order to afford mapping, and integrated with research into early aerial photographic sources.

Reference

Can you imagine some time in the future when we have a world (or at least Britain) devoid of archaeological crop marks and soil marks? When all our sites have been ploughed away or irretrievably ‘saved’ beneath roads or buildings as a result of the current fashion for archaeological non-investigation. Obviously any future archaeologists would have our collections of aerial photographs to ponder over – but would our attempts at mapping be of much use as a principal source of interpreted evidence to future synthesisers of past settlement patterns? My answer to this has to be ‘no’, partly because all examination of aerial photos – now and in the future – begins with a set of questions to answer. To suggest that our mapping will be of primary value is to suggest that future researchers will still be trying to answer our current questions – and I hope we are able to come up with a few answers now and again. I would further suggest that any future use is likely to be hampered by our present-day choice of 1:10000 as a basic mapping scale. It is too small a scale to indicate much other than a location, relationships, and approximate shape and dimensions of those features mapped.

There is also the difference in levels of interpretation. At 1:10000 there may be little point in trying to do much other than make a rapid transference of first impressions because the scale cannot show much in the way of useful detail and ‘micro-relationships’. Interpretative thinking is at a fairly low-level, attempting only to isolate the basic archaeological features. This is perhaps where I went wrong in my Lincolnshire Fenlands work – although mapping was at 1:10560 my thinking, and the level of thinking necessary to dissect and understand the Fenland, was at 1:2500. If the actual mapping had been done at that – 1:2500 – scale I doubt if there would have been much difference in the time taken. All this is my own fault as I find it difficult now to think at 1:10000 level – there is too much to be interested in!

As long ago as 1976 I was outputting my early computer rectifications at 1:5000 to use for measurements because I could not get the degree of repeatable accuracy I required from 1:10560 drawings. This year APS is beginning to consolidate the work we have been doing on the clays west of Cambridge and to ‘have a look’ at the types of feature recorded there. All, or most, have been put through AERIAL and originally mapped at 1:10000 (very conventional!) but as soon as we wanted to begin to examine the sites this scale was far too small. Consequently Alice Deegan spent a few hours shifting the digital records into PRODRAW with the result that we have not only 1:2500 sized (I am not confusing these with accurate 1:2500 plans) paper illustrations of each site but also the facility to shuffle them around on screen to end up with a page of ordered and grouped...
sites. Call it a ‘visual morph’ if you like except that sorting will have been done by eye on 1:2500 originals rather than by pre-defined categorisation and broad-tolerance measurement of 1:10000 tracings (from whichever method has been used to rectify). We are also clear in our reasons for trying to order these sites. Initially we wanted to propose the area as a possible for an AARG research excavation programme [of which more at AARG 95] but, in our sounding out for this, found that it may be possible to undertake the work anyway with the help of the Cambridge Archaeological Unit and their organisation of training digs for the Department of Archaeology. Thus we wanted to clarify for ourselves what we had photographed and how it may be grouped (and possibly what the groups might indicate) in morphological terms. By doing that we could, we hoped, go to CAU with a semblance of archaeological thought to be tested by field survey and small-scale excavation.

So, just what is it that we hope to show at 1:10000 and what are the questions relevant to that level of interpretation? It is perhaps too large a scale to show areas of past landuse – for that we seem to have settled on 1:25000 as did Crawford in 1924 – although obviously features need drawing at larger scales and then reducing. Because any error will have a larger percentage weight the smaller the dimension measured I believe that 1:10000 is too small a scale at which to draw and reliably measure size and area of all but large enclosures. For example, if the map base itself has an RMS error of 3.5m (Harley 1975, 164) does this not mean that any (say) ring ditch that has been drawn as a circle with a scale size between 6.5m and 13.5m could be of 10m diameter? Such tolerance ranges need to be included in any use of measured features as is usual in engineering, etc. Measurements from drawings at larger scale benefit from more accurate base maps which should be matched by greater precision in the archaeological additions. However, 1:10000 would seem adequate to act as a guide for management purposes, allowing the extent of an archaeological site to be indicated in its approximate position against a modern landscape base, as on most SMR maps. Such maps indicate a basic level of knowledge about sites types and distributions and can be used to suggest when further work may be appropriate.

The point of all this out-loud thinking is to ask again what it is we are trying to show at 1:10000 and, more importantly, why? I will also expand that thought to ask if we have considered using a scale that is not one of the standard OS productions? Do we use 1:10000 and 1:2500 because they are easily available or do we use them because are they right for what we want? I think the former – as we have not yet directed much thought towards what archaeological knowledge we hope to pursue from study and analysis of these mapped features. To some extent we have been conditioned to think in terms only of those common OS scales. This is nowhere more apparent than in most people’s use of AERIAL where, when inputting a scale to display a file on screen, most users opt for 1:2500, 1:10000, or 1:5000. Me? Being lazy I tend to use 1:2222, 1:3333, 1:5555, etc, depending on the size of area I want to see because I can type these numbers without moving my finger sideways! I doubt if the internal calculations cause AERIAL any more stress when using more conventional scales. While I am not advocating a splurge of randomly-scaled work (I do ask for printed output at more conventional scales) I simply use this to demonstrate, perhaps, our general reluctance to think beyond the confines of ‘what is there’ rather than ‘what is right for me’.

Now that digital OS data are more commonly available there would seem to be no excuse or reason why we should not print out maps at a scale to suit our needs either for special cases or for the next instalment, should it really be deemed necessary, of more global cover of a country. Most, if not all, of the current 1:10000 mapping in England comes under the aegis of the National Mapping Programme – so I have to take my examples from that – and one point that has not been made clear is why this mapping is being done. We know what is being done as all project specifications include the quote that the aims and objectives ‘...are to identify and transcribe all probable and possible
archaeological features showing as crop marks and soil marks and previously unsurveyed earthworks...'. To me this is neither an aim nor an objective (a 'why?' question) but a means towards those (a 'what?' question). Further reading suggests that the main purpose of this mapping is to provide fodder for classification. To avoid rocking the NMP boat any further all I will add here is that without knowing the archaeological purpose of this classification how can we know if the mapping scale is right for the job?

So far we have travelled from asking what uses may be made of our mapping by future archaeologists to glancing at scales that may be suitable for some different levels of enquiry. The assumption here is that the mapping will survive and be wanted by our successors – but is this the correct attitude? I think not. Abercrombie and David Clarke drew their beaker pottery very differently – one with great care, the other using a series of rapid sketches that were reckoned to be adequate to provide the information required by that research (David Clarke pers comm when he was trying to convince me that my post-graduate research should begin by mapping England rather than ‘just’ Wessex). So too should we be producing our mapping to meet specific and specified needs. Should this be expected to meet other needs? Only those of ‘lower level’. Thus most SMR and NMP mapping may flag sites or areas that require more detailed interpretation if any research or development is proposed but they ought not be expected to be useful for more detailed analysis – say for study of entrance types or of small-sized enclosures. These maps present little more than an elementary record indicating presence or absence, and within their limitations size, shape and complexity, of archaeological features. It must be assumed that they serve the purpose for which they have been compiled but there should be no expectation that any mapping becomes primary data in its own right, just as those pottery drawings are not. This makes it even more important that the scales we chose to work at are those that suit our immediate needs. And to hell with archival records too, these maps show our interpretations, not reality. Do you want your thinking archived?

The obvious answer to this is to insist that all drawings are on biodegradable material with a life span of maybe ten years. That should be sufficient for most purposes and time enough to get extracts copied for publication – preferably at obscure scales to hinder any further use!

Ok, this may be a bit extreme but it may serve to amplify the point that we really ought to decide why we are mapping before we begin. With developer-funded assessments this is more clear cut. Mapping is either to identify where to avoid and preserve or, more usually, to guide field investigations and help the excavators put their pitifully small sampling holes into some kind of archaeological context. The more information they can be given, the more sense may ultimately come from those evaluations. With smaller-scale mapping the aims are less clear (or maybe more varied?) yet with a major programme of 1:10000 sketching underway in England, plus a certain amount of work going on in (at least) Scotland, could it be made clear what archaeological results it is that these projects hope to achieve and to clarify why the chosen scale is the best one for that purpose? In these days of digital data and the ease of their manipulation, the excuse that SMR and NAR records were originated at that scale is no longer any justification for continuing its use.

Guidance for the ways in which aerial photographs can best serve archaeological management or research is best likely to be made by those involved practically in that speciality. As yet we (at AARG or anywhere else) have not fully discussed the options and possibilities available and seem more prepared to take the money and say ‘yes’ to whatever projects external funding bodies concoct. It is recognised that some of these have been known to make unsuitable use of aerial photographs. Why do we let them? Was there ever any consultation other than at management level?

A year or so ago I aired to a few colleagues the idea of an AARG fringe group, PIG (which, of course, is the Photo Interpreters’ Group), with the hope of re-establishing the discussion element that has been lost from the present annual AARG gatherings. I feel that,
in some respects, we are still groping in the dark – much as we were prepared to admit when AARG began. Now that a fair chunk of public funding is coming our way we seem to have turned a blind eye to any uncertainties – grab it while it’s there! Yet I submit that we, the aerial specialists, have not yet defined our own priorities and practices for use of the material. It is said to be easier to swim with the stream than to go against it. Maybe this explains why I can’t swim.

I suggested that PIG be restricted (?initially) to photo interpreters because that is the area from which the archaeological output from aerial photographs will reach the ‘outside world’. It would seem logical to expect the photo interpreters – not the aerial photographers or managers – to discuss the roles of different mapping scales, their limitations and how use of these will enable archaeological attention and questions to best be focused at macro- and micro-levels. Until a range of such demonstrations is made available there is no reason to expect a change in present technique of choice of scale because it is there or already in use. So if there are any potential PIGgies out there I’d be pleased to hear a small squeak from you.

Reference

[NOTE: Chris Cox was kind enough to point out that if we use maps of unconventional scale we may have to make our own scale rules to measure from them. A good point, but is it a sufficiently good reason to stick to using conventional scales?]
ROYAL COMMISSION ON THE HISTORICAL MONUMENTS OF ENGLAND
AIR PHOTOGRAPHY UNIT

REGIONAL RECONNAISSANCE GRANTS

Roger Featherstone

I would like to begin with a few words about the results achieved in the 1994-95 financial year. As you are aware, we started with a budget (£20,000) that had been substantially reduced compared with the previous year (£25,000). Naturally, the weather then became extremely favourable for crop-mark formation in some parts of the country and RCHME came under pressure from the regional flyers in those areas to provide some additional funding and these included Northumberland, Cheshire & Merseyside, Devon and Teeside. Thus, an additional £6,150 was allocated to the original grants of £18,700 making a total for the year of £24,850 which was dispersed as follows:

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Area</th>
<th>Original Grant</th>
<th>Additional Grant</th>
<th>Total Grant</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tim Gates</td>
<td>Northumb'Ind</td>
<td>£2750</td>
<td>£4000</td>
<td>£6750</td>
</tr>
<tr>
<td>Frances Griffith</td>
<td>Devon/Somerset</td>
<td>£3000</td>
<td>£1000</td>
<td>£4000</td>
</tr>
<tr>
<td>Rob Philpott</td>
<td>Cheshire/Merseyside</td>
<td>£1000</td>
<td>£500</td>
<td>£1500</td>
</tr>
<tr>
<td>Blaise Vyner</td>
<td>Teeside/York Moors</td>
<td>£1000</td>
<td>£400</td>
<td>£1400</td>
</tr>
<tr>
<td>John Hampton</td>
<td>Surrey</td>
<td>£0</td>
<td>£250</td>
<td>£250</td>
</tr>
</tbody>
</table>

Many regional flyers very kindly found the time to collate information and send a summary details of their summer's reconnaissance which, together with details of RCHME's own reconnaissance, was edited and published as a ‘note’ in the December edition of *Antiquity* (Featherstone, R. 1994. Aerial Reconnaissance in England 1994, *Antiquity* 68: 812-815).

In essence, there were excellent results in Northumberland, the Cotswolds, the chalk soils of Wessex, Thames Gravels, Northamptonshire, Bedfordshire, Cambridgeshire, Cheshire, Merseyside, Humberside, the eastern part of North Yorkshire and numerous other smaller areas around the country. Less favoured last year were the more westerly areas including Cornwall, the Marches uplands and the north east. A wealth of new material has been recorded including a number of Roman forts, camps and buildings, Iron-age enclosures and Bronze-age and Neolithic ritual and burial sites. I hope that we shall have the opportunity to see some of these results at the AARG meeting in September.

Grants for regional reconnaissance have been allocated by RCHME for the current year (1995/96) in the following way (last year's figures in brackets). Twenty four (24) applications were received for projects with a total estimated cost of £44,695 (£49,975). These were carefully examined by a committee comprising Peter Horne (RCHME), John Hampton and David Wilson representing the CBA and Roger Featherstone (RCHME). As a result of these deliberations and budgetary consideration, allocations were made to 16 organisations (19)
totalling £14,800 (£18,700) out of a budget of £15,000 (£20,000). This allocation represents, in gross terms, approximately 145 hours of flying.

It is hoped that the budget reduction is a temporary measure and will eventually be restored to its former levels.

<table>
<thead>
<tr>
<th>Organisation</th>
<th>Hours bid</th>
<th>Net hours funded</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Photo Services</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To survey the area around Bourn, W Cambs, and the Bedfordshire claylands to record both newly showing sites and monitor destruction of the remainder.</td>
</tr>
<tr>
<td>Cheshire CC and Merseyside Museum</td>
<td>7</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To survey the lowlands of Cheshire and Merseyside and through integrating the evidence with that from other sources to create a fuller picture of the landscape as the basis for further work.</td>
</tr>
<tr>
<td>Cornwall Archaeological Unit</td>
<td>24</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue to prospect for additional crop-mark sites, also augment coverage of the whole range of extant sites and landscape features, including specifically this year, more work on industrial landscapes.</td>
</tr>
<tr>
<td>Devon County Council</td>
<td>38</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue the primary reconnaissance in Devon but undertaken in an increasingly analytical and problem orientated way.</td>
</tr>
<tr>
<td>Devon for Somerset County Council</td>
<td>28</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue the primary reconnaissance in western and southern Somerset.</td>
</tr>
<tr>
<td>Essex County Council</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue the survey of Essex intertidal zone and reconnaissance elsewhere in Essex directed at areas where there are no existing crop-mark sites and at enhancing existing complexes.</td>
</tr>
<tr>
<td>Lake District National Park</td>
<td>7</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Focus on two areas within the LDNP which contain important prehistoric and industrial remains that are inadequately recorded.</td>
</tr>
<tr>
<td>Leicester Museum</td>
<td>8</td>
<td>6</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue reconnaissance for new sites and enhancing existing ones with particular focus on areas threatened by developments.</td>
</tr>
<tr>
<td>Norfolk Archaeology</td>
<td>25</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Problem-orientated reconnaissance and recording status of scheduled monuments. Continued work on Historic gardens and other landscape themes if conditions for crop-marks are unfavourable.</td>
</tr>
<tr>
<td>Northampton</td>
<td>16</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Continued reconnaissance of region for cropmarks following the same strategy as in previous years. Plus approximately five hours for garden survey. Details and timing for this to be arranged with the Gardens Trust.</td>
</tr>
<tr>
<td>Shropshire County Council</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To continue reconnaissance in the western half of the county. (Grant carried over from 1993/94).</td>
</tr>
<tr>
<td>Area</td>
<td>Expected</td>
<td>Achieved</td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>----------</td>
<td>----------</td>
</tr>
<tr>
<td>Suffolk</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>To continue with reconnaissance with particular focus on Brecks Survey Project area and intertidal.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teeside Valley Arch</td>
<td>6</td>
<td>4</td>
</tr>
<tr>
<td>To continue targetted air survey of North York Moors and more detailed scrutiny in 1994.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Teeside Archaeological Society</td>
<td>10</td>
<td>5</td>
</tr>
<tr>
<td>Continued reconnaissance of Cleveland and Lower Tees Valley.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>West Yorkshire Archaeological Service</td>
<td>15</td>
<td>10</td>
</tr>
<tr>
<td>Special focus on areas threatened by development in the eastern part of West Yorkshire and also previously unrecorded earthworks on the Pennine uplands/slopes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yorkshire Dales National Parks</td>
<td>10</td>
<td>9</td>
</tr>
<tr>
<td>Focus on neglected or poorly recorded earthworks sites and industrial remains.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

HIGH RESOLUTION RUSSIAN SATELLITE IMAGERY

Martin J. F. Fowler

Introduction

With the end of the Cold War, the Government of Russia has declassified and made commercially available high resolution satellite imagery from its military and civil space programmes. Elsewhere in this issue, the exploitation of a 1.4m resolution KVR-1000 satellite image covering the environs of Stonehenge is described. The analysis of this image has shown that the majority of the upstanding archaeological features in the area can be discerned as highlights and shadows and that a number of crop and soil mark features, including the Coneybury Henge and a probable D-shaped enclosure, can also be detected.

This note aims to briefly describe the various high resolution Russian satellite imagery products that are commercially available and to give an indication of their cost and the degree of coverage currently available. In the absence of detailed published data, this note has been based on various sales literature provided by Nigel Press Associates Ltd (Tel. 01732 865023), Worldmap International Ltd (Tel. 01970 626236) and the National Remote Sensing Centre Ltd (Tel. 0 1455 844513).

Sensors and Products

Imagery from six high resolution satellite sensors are currently available and are summarised in Table 1. All of the sensors are cameras producing photographic products. In addition to positive and negative contact film prints, images are also available in digital format following the digitisation of the film using high resolution scanners with scanning resolutions down to 8.5 µm.

The State Centre PRIRODA is the primary non-military remote sensing acquisition and processing organisation in Russia. Three satellites are operated by the PRIRODA on a routine basis for the collection of imagery: the RESOURS-Fi carries two KFA-1000 and one KATE-200 cameras, the RESOURS-F2 carries a single MK-4 camera and the RESOURS-F3 a single KFA-3000 camera. Over the last 10 years, there have been an average of 3-4 separate missions per year. Each mission has a total flight time of approximately 30 days and during a mission, each KFA-1000 and KFA-3000 camera takes approximately 1800 scenes and each KATE-200 and MK-4 camera approximately 2500 scenes.

Orbits are quasi-circular and quasi-sun synchronous. A single point on the earth's surface will be overflown 2-3 times during a mission and the altitude of the sun during each pass will be approximately the same. After completing a mission, the payload is returned to earth for a landing in Kazakhstan. Cameras are reconditioned and tested prior to use on subsequent launches.
Table 1. High resolution Russian satellite imagery.

In the following paragraphs, further details are provided on the various products together with comments on their potential usefulness to archaeological studies and an indication of their approximate costs.

**KVR-1000**

A panoramic camera recording on a 180 x 720 mm panchromatic film covering an area of 40 x 300km at a nominal ground resolution of 3-4m or better. Shown elsewhere in this issue to the have potential of detecting archaeological features including upstanding monuments and crop and soil marks. Approximate costs for a 40 x 40km area are £3200 for digital data and £2300 for film.

**KFA-3000**

A camera with a focal length of 3,000mm recording data on a 300 x 300 mm panchromatic film with a ground resolution of 2-3m and a longitudinal overlap of 30% when flown on the RESOURS-F-3 satellite. This product has a similar ground resolution to the KVR-1000 product and is therefore of potential use in archaeological studies. The approximate cost of imagery for 21 x 21km scene in digital format is £3000 and £2300 in film format.
**KFA-1000**

A camera recording data on a 300 x 300 mm two-layer spectrazonal or panchromatic film with a ground resolution of 5m and a longitudinal overlap of 60% (see Baxter 1991 for examples of this product). Of lower resolution than KVR-1000 and KFA-3000 but better than SPOT Panchromatic (10m) and therefore likely to show only large archaeological features. The approximate cost of imagery for an 80 x 80km scene in digital format is £2250 and £1200 in film format.

**MK-4**

A multispectral camera recording data on to four separate 180 x 180 mm films with a ground resolution of 6-8m and a longitudinal overlap of 60%. Each film covers a pre-selected spectral band. In the case of RESOURCES-F2 missions, three lenses acquire the pre-selected bands while the fourth acquires colour spectrazonal data on a two-layer film. Imagery from this sensor is of potential archaeological interest since it can acquire data covering the near infra-red part of the spectrum (0.81-0.90µm). Previous studies using lower resolution (30m) LANDSAT Thematic Mapper Band 4 data covering the near infra-red (0.76-0.90µm) showed that some archaeological features, such as the ditches of the Figsbury Rings hillfort and several barrows in the vicinity of Stonehenge, could be detected on this spectral band through differences in vegetation cover (Fowler 1994; 1995). Compared with LANDSAT, the MK-4 imagery has a 4 to 5 fold improvement in resolution and may therefore be of use in archaeological studies. The approximate cost of a 170 x 170km scene in digital format is £2250 for one band and £3400 for three bands. In film format, a similar area costs approximately £850 for one band and £2000 for a three band composite.

**KATE-200**

A three band multispectral sensor with a ground resolution of 15 to 30m recording on 180 x 180mm film. Three separate cameras acquire the different bands of data with a longitudinal overlap of 60%. Like the MK-4, this sensor also covers part of the near-infra red band of the spectrum but at a lower resolution. May have some potential in detecting archaeological features. Approximate costs of digital data for a 225 x 225km scene are £1250 for one band and £1875 for three bands of digital data. In film format, a similar area costs approximately £200 for one band and £450 for a three band composite.

**TK-350**

A single band topographic camera recording on a 300 x 450mm panchromatic film with a ground resolution of 10m and a longitudinal overlap of 20-80%. Resolution comparable with SPOT Panchromatic and therefore likely to show only large archaeological features. The approximate cost for a single image covering 200 x 300km in film format is £3500.
Other products

A product termed DD-5 is available from Nigel Press Associates Ltd. This appears to be a collection of digital images scanned from the products of several satellites with ground resolutions of 2-5m. Approximate cost is £8 per km² with a 10 x 10km minimum area.

Coverage

The archived databank of Russian high resolution imagery is described in the sales literature as being 'extensive' with products being available covering territories from all parts of the world with the exception of Russia. Three to four new missions are launched each year and it is possible to request specific areas to be imaged.

For the British Isles, the most extensive high resolution cover is currently provided by imagery from the KVR-1000 (3-4m resolution) and KFA-1000 (5m resolution) sensors. Over 50% of the land masses of Great Britain and Eire are currently covered by these products (Figure 1 a and b) with multiple images being available for some areas. For the nominally higher resolution KFA-3000 sensor (2-3m resolution), there is currently no cover available. Coverage by the multispectral MK-4 sensor (6-8m resolution) is currently confined to North East Scotland and a part of Southern England (Figure lc). Likewise, the coverage by the lower resolution KATE-200 sensor (15-30m resolution) is restricted to the Eastern Britain (Figure ld). Whilst the current cover can be best summarised as being somewhat 'patchy', the datasets are expected to be enlarged over the coming years as new missions are flown.

Acknowledgements

The author thanks Nigel Press Associates Ltd, Worldmap International Ltd and the National Remote Sensing Centre Ltd for providing information for use in the compilation of this note.

References


Figure 1. Approximate extent of archive cover for high resolution Russian satellite imagery of the British Isles. The extent of cloud free coverage is shown for KVR-1000 imagery. The coverage of scenes containing <30% cloud are shown for the other imagery. Based on data supplied by Nigel Press Associates Ltd (KVR-1000) and Worldmap International Ltd (KFA-1000, MK-4 and KATE-200).
Two flights made this summer with RCHME gave me the opportunity to try Technical Pan. The film was used in a 35mm camera with 50mm lens and no filter. For comparison targets were also photographed on 120 FP4 – my usual monochrome film and format. FP4 was exposed through a 2x yellow filter. Technical Pan is an extremely fine-grained film which can be exposed at a choice of speeds (between 16 and 250 ISO) and contrast levels depending upon the application (Kodak publication No P-255(H)). The film also has extended red sensitivity which, for the aerial photographer, means that it should penetrate haze and will also have the effect of lightening red areas. This latter factor suggests that a ripe barley field, for example, will be lightened in tone thus increasing the contrast between the field and a green crop mark. Unless haze is very visible a filter (a yellow filter helps eliminate haze) would not seem necessary.

I had obtained the technical blurb from Kodak about the film and could see why some people may be worried about using it – the choice of contrasts and developers is huge. I wanted to rate the film at 100 ISO which, conveniently, meant I could use my normal film developer for processing although other, specialist developers could also be used. However, the Kodak blurb gave an exposure index range from 50-125 and development times of 6 to 12 minutes. Logically, using the film at 100 ISO would need a development time in the region of 10 minutes ... or would it..? So I rang one of the technical staff at Kodak who was encouraging, if slightly vague, and suggested giving it six minutes of full-strength development.

One film of Technical Pan from the first flight on 22 June was processed in ID11 (the Ilford equivalent of D-76) at full strength for 6 minutes at 20°C. I made no change to my usual small tank shake-it-about method, giving ten inversions when the developer first goes in followed by 5 inversions at 30 second intervals. I did not follow the suggested method of dunking the film in a tank of developer in total darkness but poured the developer into a closed loaded tank. This can be accomplished in about 10 seconds (as can pouring it out after development) which, even with a total development time of six minutes, makes only a few percent difference. Past experience shows that at least ±10% is needed to make a humanly-visible difference and considerably more over- or under-development to affect print quality. However, with the much shorter development times given for other developers this additional 10 or so seconds is likely to be more critical.

First comparison came when the film was hanging up to dry next to the FP4s. It was like comparing my drawings of ridge and furrow to the APU’s – one full of detail and meaningful, the other hazy and unappealing. I’ve never seen such a range of contrast from aerial negs. On printing the contrast became a bit of a problem – there was too much – and it was extremely difficult to get a full range of tones without a lot of messing about, shading, and using different filters (which, on Multigrade paper changes the paper grade). Dark area and shadows were fine but highlights lacked detail unless burnt in. This does not matter for most archaeological aerial photography – but I wanted to try and improve things a bit on a second flight. Resolution was superb and good enough to see tiles on a roof (from about 2500 feet) and most of the archaeological features seemed to print up as well as the medium format equivalents. There is the difference in enlargement to consider too – 35mm needs about 7x enlargement to fill the width of 8 x 10 inch paper, the 60 x 45mm only 4½x. The film enlarges extremely well on to 8 x 10 so there is no excuse for interpreters to have to use those silly little-sized prints that are usual for printing from 35mm negs.

Having decided that the film was workable I exposed a couple more films during a second

TRYING KODAK TECHNICAL PAN FILM

Rog Palmer
flight on 7 July. Still at 100 ISO and still without a filter (I’d hate to imagine what a filter would have done to the contrast of the first film) but this time developed in ID11 at 1+1 in an attempt to reduce the contrast. Diluting the developer requires an increase in developing time so, basing the fiddle factor on the assumption that the previous time of six minutes was correct, I calculated that 8½ minutes should do. Much better! The negs no longer had that extreme contrasty look and the printing was easier although the film is still a bit more finicky to print than FP4. A few percent difference in exposure time has a much greater effect when printing Technical Pan than with FP4 or other less contrasty negatives. A next stage will be to try to lower the contrast slightly during development by using ID11 at 1+3 as increased dilution of the developer will result in less contrasty films.

I know that Otto Braasch has been using Technical Pan – he told me at 80 ISO (which would lower the contrast) and through an orange filter (which would increase the contrast as well as needing an increased exposure time). Otto’s processing was done using another of the Kodak recommended developers of which I have no further information – although I believe that Otto has circulated an information sheet on his use of Technical Pan.

Now that I have examined number of targets on 35mm Technical Pan and 120 FP4 some initial comments can be made. Resolution, as expected by the specification of the film, is extremely good. However, there are some frames that retain a certain 35mm fuzziness which can presumably be put down to movement (all exposures were 1/500s or shorter) or the fact that I am using Pentax lenses rather than Leica. The Technical Pan prints do not easily show the complete tonal range of FP4 and this is especially noticeable in dark crops from which tram lines tend to vanish and the slight texture caused by changes in reflectance can be lost. This may be remedied by printing specifically for that crop – but I haven’t tried that yet. On any crop with typical dark-on-light crop marks it produces extremely clear results which sometimes appear to have slight contrast enhancement. It will be interesting to fly with the film late in the summer season to see if any enhancement is noticeable in those poor-contrast crop marks that develop above sites in clay.

A late-season flight (22 August) with RCHME saw us in search of marks in beet and grass fields. The beet was easy to see – green boxes in an otherwise brown world – and Technical Pan photographed it satisfactorily. Grass (you know, that brown stuff covered in hungry animals) that we saw was good for earthworks – with a certain amount of very light, almost white, parching above ‘humps’ and tinges of green in the damper of the hollows. Technical Pan appears to have enhanced the contrast of these features, which were showing by virtue of their colours rather then the usual shadows. I have printed only a small number of samples from the films exposed that day and again note the extremes of contrast which have resulted in visually unappealing prints which tend to ‘black out’ in shadows. Most of the target fields on the August flight were light in tone and prints made for these areas are fine – it is the surroundings (usually urban areas or woodland) that require a shorter exposure in the enlarger if they are not to end up too densely black.

That last flight also showed an unexpected versatility to Technical Pan. Given all the warnings about spot-on processing, etc it was pleasing to find that the one roll film I used, although under developed (roll film seems to need a different development time to 35mm), produced better prints than I could have made from similarly thin FP4. The one problem with enlarging from the roll film negs was, as boasted in Kodak’s blurbs, the problem of seeing the grain when focusing! However, I’ll put a few more rolls through when next airborne and see if I can get the development right and then learn to print the stuff.

Comments from any other users will be of interest. Watch this series....
TL150992: Milton Park, Peterborough, Cambs. Dark(ish) field with ‘conventional’ crop-marked features – some good, some becoming weak. Photo 95.114/26 (35mm Technical Pan), © Rog Palmer, July 1995
AARGMART

Your chance to own a piece of history.....

I still have one of Derrick Riley’s cameras for sale, on behalf of Mrs. Riley. The details are as follows:-

Olympus OM2n, Chrome, with Olympus Zuiko
50mm., f1.8, lens £160
Olympus Zuiko 135mm., f3.5, lens for above £40
Olympus OM Winder 2, for above £40

This comes with spare batteries, shoulder and wrist straps and four 49mm.
filters, two yellow and two Skylight 1B.

There is also a Yashica gadget bag, £12, and a Sunpak GX14 flash unit (boxed),
which has a guide number for 50 ASA, 10m., 33ft., £25, and various small accessories.

The camera shows evidence of normal wear, whilst the winder has some cosmetic
damage, in the form of missing paint. However, all functions appear to work. If any of the
equipment is faulty on purchase I would get it repaired, but that is the limit of any guarantee.

I will bring the equipment to AARG at Lincoln, so people are welcome to look at it, if
they wish.

Anthony Crawshaw, 15 Kings Staith, YORK, YO1 1SN. 01904 635965.
BOOKS OF INTEREST?


There are so many people mentioned in the acknowledgements that my mental short-list of reviewers was demolished as soon as I opened the book. John Samuels came to the rescue and, perhaps appropriately, was involved with Derrick Riley in work on some of the Nottinghamshire area sites. However, John has been busy finishing a book on archaeology and the law and it has not been possible for him to complete his review in time for this issue. RCHME, therefore, will benefit(?) from two rounds of publicity. What follows results from little more than a rapid scan of my own copy of the book.

The aerial photos were interpreted and mapped at 1:2500 and then published on a base enlarged from OS 1:10000. This works well although, having chosen to use that scale instead of the (assumed) 1:2500 maps that were the basis of the rectified AP interpretations, I wondered why they didn’t include the contour information from that scale which may have helped show situation. Some plans have indicated elements of topographical information by hachures added to the OS base maps. It is hoped that informative topography will be included in the similarly overlaid plan-on-OS map in Cathy Stoertz’s forthcoming Yorkshire Wolds volume. RCHME please take note! Reproduction at 1:5000 is good and shows that a lot more use could be made of that ‘intermediate’ scale which can show most of the detail that can be defined at 1:2500 but doesn’t result in unwieldy drawings. The level of photo interpretation is fairly abysmal – or perhaps I should say that the lack of conventions to identify ditch, bank, natural and recent makes the finished drawings confusing. Perhaps the APU is playing cautious (or objective) and only mapping ‘cropmarks’ – but it does result in some fairly uninformative illustrations and is publication of fairly low-level photo interpretation rather than archaeological interpretation. This may make the case for insisting that the photo interpreter is responsible for the finished drawings, either by producing them or by having the final say in their content. However, it is good to see that overlying and adjacent ridge and furrow has been drawn in an informative way rather than as boxed directional arrows.

I was somewhat upset to read in the caption of Figure 105 that it was a vertical photograph ‘... taken in October 1930 by OGS Crawford.’, and again in Figure 116, only this time in 1925. Taken from the RAF maybe. It is a pity to see RCHME (holders of the Crawford collection) perpetuating the myth that all of those photos were taken by OGS. As AARG members know – or ought to – Crawford took very few aerial photos himself. His part in the Wessex from the Air campaign in 1924 and flights in Scotland in 1939 (Antiquity 13, 280-292) seem to be the total in Britain. Both campaigns are mentioned in his Said and Done.

One final comment must raise objection to the fact that although work for this volume has meant that: ‘Not all sites previously regarded as camps have been included because in some cases re-examination of the evidence has failed to confirm their identification.’ (xi), nowhere are we provided with the expected list of which ones these are. Surely in the interests of sound scholarship, further research, and maintenance of local records it is essential that readers are informed of these?


Surprise surprise, another moan! But only to say how poorly printed the plates are. It may be a function of industrial landscapes to be printed badly (I remember the dark gloominess of the Cambridge Industrial History from the Air) but Chris Cox photographed much of the content of the EH book and I developed all the films and printed
a number of sample prints so I know that it could have been done better. The small number of good illustrations in the book show the level of quality that is achievable – so what went wrong?

To produce a picture book it would seem wise to start with exhibition-quality prints. You give the negatives to a caring photographic printer who can squeeze the utmost from them and produce a print with good blacks, true whites and a good range of grey tones in between. Was this done by RCHME (holders of the material) or were EH given a heap of library copies to chose from and then use? In these times of digital imaging and precise control of book production processes there is little excuse for publishing such grottily printed aerial photographs. As it stands the book is unlikely to enhance the use of aerial photographs or to arouse much interest in industrial archaeology. Should we suggest pulping and starting again?

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TL474952: Upwell, Cambs. Space filler. Turbaries, water course, etc. Intersections with modern boundaries show relief. From colour print, slide original, 93.27/10, © Rog Palmer, March 1993.
AUTHOR INDEX TO AARGnews 1-10

During some recent writing I became sufficiently annoyed with having to flick through past issues of AARGnews to find various wise words that I spent a couple of hours compiling what follows. All it contains are the contents pages rearranged in (a kind of) alphabetical order. I have omitted most of the adverts and anything un-named has been credited to AARG member Anon. Jointly written pieces appear under the name of the first author only. Once in alphabetic listing entries are, or ought to be, in date order. Page numbering follows the original Contents and shows only the first page. Dates will have to be calculated.

It works for those of us who can remember who wrote what – but to do any proper subject index is well beyond me especially as the contributions are a mixture of disc and paper. I have included it in this issue in the hope that it may be useful to some of you. If anyone wants to do it properly or differently I can supply a copy on disc.

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