



NEW ZEALAND
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NEW ZEALAND ARCHAEOLOGICAL ASSOCIATION NEWSLETTER



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AERIAL PHOTOGRAPHY IN NEW ZEALAND ARCHAEOLOGY

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PART I:

It is not the aim of this paper to present an exhaustive analysis of aerial photography in its application to archaeology. Rather one aspect of this study, the elements of light, soils, vegetation, and moisture that mark sites, will be discussed and related to New Zealand conditions, especially those of the North Island. It is hoped in this way to draw some positive conclusions as to the methods by which hidden site features and perhaps even hidden sites can be discovered in these conditions.

Since the Second World War the attention of New Zealand archaeologists has been drawn to the possibilities inherent in aerial photography (Blake-Palmer 1947, Golson 1957: 66-67) but few serious attempts have been made to apply the technique. True, some field archaeologists have viewed their sites from the air, but this has tended to be the exception and not the rule. The failure to use this most important tool has been caused by the acceptance, without modification, of techniques successful in one region on the understanding that they would work in another area no matter how the conditions differed. So the high hopes held by Blake-Palmer (1947: 239) have come to nothing. It is possible that the study of successful techniques in terms of these different conditions could prove worthwhile.

In many ways it is incorrect to talk of "techniques" in this paper. These relate more to ways of pointing a camera and taking a photograph. Here the concern is rather with the markings that show on the photographs, why they show, and how they can be made to reveal more than they do at present. Some of the earliest, and certainly most successful work in recording these markings has been done in England and it is the English terminology that is used the world over.

The following is a summary of Bradford (1957: 11-44). Sites located and mapped from the air in England are usually termed by the type of phenomenon that show up their form.

Shadow Sites:

The basic method for photographing above ground sites is to use light and shade contrast caused by a low early morning or late evening sun. These are the "shadow sites" of English terminology. Shadow does not have to exist however as contrast between different intensities of reflected light is sufficient to point up features.

Crop Sites:

Many sites no longer show features above ground, these having been ploughed or levelled out. In this case their form can still be seen from the air by differential vegetation growth, usually crops, caused by different depths of soil supplying different amounts of water and nutrients to the plants. Several factors limit the use of this method spatially. First a crop coverage is required. In England some 40% of the land area is under crop so that this limitation is not as great there as it is in other less arable lands. The second factor is the type of crop required. Barley, wheat, oats, and rye are ideal but tree crops, vines, and root crops are of little use. Thirdly the soil parent material should be consistent and well drained. Chalks and gravels fit these requirements perfectly but clays and deep alluviums have not the necessary drainage qualities. Fourthly, to show up the features of a site with crop growth, a period of dry weather is needed to accentuate the lack of moisture in shallow soils and the persistence of moisture in deep soils. Thus differential growth is developed fully. When these necessary factors are present in varying degrees hidden sites will show in vegetation patterns. These are the crop sites of which there are two kinds. In the first, features of a site are shown by well developed growth. That is, pits and ditches, and perhaps even large post-holes will, because of their depth of fill, be marked by excessive crop growth. In the second type this process is reversed. Site features, such as roads and walls, close to the surface limit the depth of soil and so the moisture available to vegetation. In this way feature will be marked by lack of crop growth or parch marks.

Grass and Weed Marks:

Finding sites by differential grass growth is not common in England. However, weeds with their longer roots can withstand drought better than other plants and can therefore be important in site definition.

Soil Marks:

Occasionally ploughing or the stripping of top-soil will reveal differences in soil colour caused by the buried features of a site.

Damp Marks:

Soil saturated with excessive moisture shows as dark markings on monochrome film and as such can be important in revealing low-lying features.

Such are the methods by which sites have been found in the English countryside. The results have been spectacular. Site distribution maps, previously showing a bias to upland areas where above ground sites had tended to remain undisturbed, can now be corrected by the addition of ploughed out lowland sites revealed by aerial photography. Excavations, such as that at Little Woodbury, have been successfully based on one photograph. However, the application of successful English method to other parts of the world has been restricted to either areas with a similar physiographical makeup or to arid regions.

It is therefore proposed to rework the English data, drawing from it those basic elements that are actually marking the site features. The suggested terminology will not differ greatly but will, it is hoped, be less restrictive. Take for example the term "crop sites". These "sites", so common in England, will be exceedingly difficult to find in New Zealand where under 1% of the land is similarly planted. So "crop" will be almost useless in a New Zealand terminology. Another point is that the crop, whether it be wheat, barley, rye, or hops, has nothing to do with the category of site it shows; it merely marks the site. So both terms, crop and site, can be criticised. The essential elements are two. First, the site is being marked and secondly, this is due to vegetational contrast. Therefore "vegetational contrast markings" is suggested as a better descriptive term for those phenomena of differential growth of all types of vegetation that mark hidden sites and hidden features within known sites.

The same can be said for the term "shadow sites". Once again "markings" must be substituted for "site". "Shadow" is not complete enough for reflected light variation on its own can show features. Therefore "light contrast markings" is suggested as a fuller term.

Two other English terms, "soil markings" and "damp markings" will be changed only by the inclusion of "contrast".

The definition of any one site cannot be thought of in terms of just one of these phenomena. They could all contribute to the marking of that site. Light contrast markings might show terraces, ditches and banks, while vegetational contrasts might expose pits and perhaps post-holes.

Then again, one feature will also tend to be contrasted by more than one marking. Vegetational and light contrasts could work together to show pits as could damp and soil markings.

The English terms have now been reduced to their basic essentials and on these the terms suggested above have been built. They are:

- (i) vegetational contrast markings
- (ii) light contrast markings
- (iii) soil contrast markings
- (iv) damp contrast markings

These somewhat cumbersome terms cannot be expected to replace their English equivalents in New Zealand but it is most necessary that the basic element definitions be understood. It is only then that workers in different geographical fields can set about analysing these elements in relation to the conditions found in their areas to find ways of spotting contrast and thereby obtaining the most comprehensive understanding of the site photographed.

The conditions governing the contrast markings that expose sites and site features in New Zealand are very different from those in England. Perhaps the most limiting factor is the scale of vertical photograph available at present. These have been taken for topographical mapping where only small scales are necessary. The two basic scales are 1:15,840 and 1:44,000 (Exley 1961). When it is considered that Bradford (1957: 67) considers between 1:3000 for small sites and 1:12,000 for an all-over view of the country, to be best, the difficulty of using the very small New Zealand scales becomes apparent. The 1:15,840 series of photographs is not totally useless however for with it large sites can be picked up by light contrast markings.

A ground condition that must be taken into account is the soil types found in New Zealand, and particularly in the North Island, which are basically of two types - clays and deep alluviums. It is these two soils that Bradford (1957: 15) records as being the least likely to accentuate vegetation growth differences as, under nearly all conditions, moisture is available to the plants. However in dry periods hidden features could be expected to give differential growth, but whether this would be enough to record on the usual black and white film is doubtful. Certainly soils other than these two could give better contrast marking.

A further ground condition is that of vegetational cover. This varies greatly from that of England. The lack of cropland in New Zealand has already been noted. Grass does not contrast as well as some crops. Similarly the great areas under forest and scrub will also limit the area to which aerial photography can be applied.

The problem is then twofold. First, photograph scales, at the present time far too small, must be made larger. It would appear that the only way this can be accomplished is by archaeologists hiring small planes and taking the photographs themselves from a low altitude. Shawcross (pers. com.) has had some success here for over Ongari Point he was able to photograph middens inland from the main site showing as white patches in ploughed land. Secondly, some way must be found of increasing vegetational contrasts that are not great enough to show with present methods. Large scale will accomplish this to a certain extent but something more is needed. This "something more" could well be infra-red colour film sometimes known as "false colour" or "camouflage detection" film. This was introduced during the Second World War to detect differences between the reflective power of living foliage and green paint. Since then its ability to contrast has led to its application in such fields as forestry, geology, water pollution, and drainage work. In archaeology few attempts have been made to use such film and the one traced published report on such an attempt with black and white infra-red film (Edienne 1956) is not available in New Zealand. In principle the film has the capability of over-contrasting vegetation and moisture contrast markings (Anson 1966) that New Zealand conditions demand.

To test these possibilities an experiment is in progress in the Auckland area. With Aero Ektachrome Infra-red film large scale photographs are being taken of sites in the area. Results will be published as they are available.

Up to the time of writing virtually no hidden sites have been found in New Zealand by aerial photography, a direct reflection on the scale of photographs available and the vegetation cover. Yet at least one such site exists. Groube (1966: 111, 112) has recorded the difficulty of locating Te Kuri's Village on a ten to eleven acre ridge. In England a great deal of success has been had in finding such sites from the air. If New Zealand archaeologists are to have anything like this success the groundwork done in England forty years ago will have to be repeated in New Zealand with this country's conditions in mind. The borrowing of unmodified English technique will not be good enough.

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PART II:

To test the possibilities expressed in Part I of this paper a flight of one hour's duration was taken in the Auckland area on June 11th. The crew consisted of a pilot, a recorder and a photographer. With each of the twenty 35 mm exposures the recorder noted altitude, the location and a general description of the shot, the f stop and the shutter speed. These last two were very important for ordinary light meters cannot be used as they will not record variations in infra-red light rays. The f stop was therefore varied between f16, f11, and f8 with a constant shutter speed of 1/125th of a second. It was most unfortunate that due to lack of time comparable monochrome shots could not be taken. This will have to be held over to another flight. The flight lasted from 8.30 to 9.25 a.m. meaning that shadows were low and long. Conditions were generally sunny but heavy single clouds put some sites in shade. Ground conditions were moist.

Preliminary results are promising if not spectacular. The first was entirely unexpected. Infra-red film exaggerates shadow, recording it as close to black. In this way minute shadows showed up. Low banks and terraces stood out clearly on One Tree Hill even though the photographs were taken from 1700 ft and some considerable distance from the site. The most spectacular shot in this respect was, however, one of Brown's Island, where four low (agricultural?) banks were found running down the seaward side of the east tuff ring.

Vegetational contrasts were excellent. In the case of terraces, the luxuriant growth on the flats appeared as bright to dark red contrasting with the light green to white of the near-dead vegetation on the slopes. However, in all cases monochrome film would have recorded a similar, if less colourful, contrast. One shot has shown that the film has possibilities in a swampy environment. At Waitawa Bay (grid ref. 655497) several drains of filled channels were marked by swamp vegetation, presumably rushes, showing as a dark brown-red against the light green of the paddocks. Whether these be European or Maori is not important. The main point is that vegetational contrasts in this swampy environment exposed a system of man-made drains.

Several problems have presented themselves. The most immediate one to a student is cost. The film cost £1.8.0, a Wratten 12 filter 3/4d, the developing chemicals for one film 16/6d though this could be reduced by processing more than one film at a time, and the plane hire was £5.10.0. for 55 minutes - in all £7.17.10. for twenty exposures. However the results have justified this expenditure. The developing of the film presents further difficulties as the manufacturers will not do this. A skilled technician is needed as the process involved is long and complex.

This one film has then shown some results and defined problems that will point the way to future work. On the technical side much information has been gathered. The optimum exposure for Aero Ektachrome Infra-red film using a Wratten 12 filter appears to be between f11 and f8 at 1/125 of a second in bright sunlight, but this is something that will have to be tested in all seasons and all types of light. Unless light contrast is wanted, flying should be limited to several hours either side of noon to eliminate shadow. The planning of the course is very important. The pilot should know what is expected of every photograph so that he can "set the plane up" over each site. To take photographs of small sites at low altitudes, long low flat runs over the "target" appear to be best but at a higher altitude steep banks allow the camera to be pointed down almost vertically. Further, a small area covered well is better than patchy coverage of a large area.

The next planned flight will be over a swamp area, that of the Hamilton Basin, where the aim will be to study contrast in these water-logged conditions. It is hoped here to isolate the distinctive vegetation associated with swamp pa and perhaps to find previously unrecorded sites. The main point that has come out of this first flight is that infra-red colour film has too many possibilities to be abandoned at this early stage. All seasons and as many different types of environmental conditions as possible will have to be studied before any positive conclusions can be drawn.

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PART III:

The testing of Aero Ektachrome Infra-red film in a swamp environment was carried out on June 24th in the Hamilton Basin. Conditions were cloudy and hazy but the light was sufficient for the successful exposure of the film. The exposure used was f8 at 1/60th of a second with the Wratten 12 (haze penetration) filter. Monochrome photographs were also taken for comparison. The altitude of the plane was a constant 1,000 feet.

In the Ngaroto district four unrecorded swamp pa were found though these will have to be checked with a ground survey. All were visible from the air. The infra-red contrast was very good, the bright red of the growing vegetation on the sites contrasting with the dull red or light green of the surrounding swamp growth. However all these sites

were visible on the monochrome photographs. It would appear that what this film lacks in contrasting ability it makes up for in grain size, thereby showing the detail of the different swamp and higher ground species.

North of Hamilton no swamp pa were found but whether this is because of environmental or cultural factors cannot be said without further investigation. It was therefore decided to test the banks of the Waikato River about Taupiri where Kelly (1940) had plotted the existence of two flat-land settlements. Nothing definite has come from these photographs except for some confused markings in one of the localities.

Parts II and III have summarised the results of the tests carried out in the winter months. It is obvious that from low altitudes much detail can be photographed using fine grain black and white film. Areas can also be covered intensively in a very short amount of time. In the plane one lake could be circled twice, once for colour and once for black and white shots, in as little as five minutes. However it has become obvious in these two flights that the best results will not be had until summer drought conditions, with the resulting exaggeration of vegetational contrast, prevail. So further work has been postponed to this coming summer, be it dry.

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