

Aerial Archaeology and Remote Sensing

by Paul Goodyear

Introduction

To seek out Trepassey's seventeenth century structures, ideal tools could be the aerial survey or remote sensing techniques. The use of *aerial photography* as an archaeological method sprang into use at the end of the World War II in Europe and the British Isles, indeed, in all former theaters of war. Military pilots had been noting and reporting that at 1000 metres the landscape revealed a different countryside from that their earthbound companions took for granted.

The first aerial photographs of London were taken from a balloon in 1863 and the first aerial photograph of Stonehenge, also taken from a balloon, dates to 1906. There were notable pioneers in the field after World War I, such as O.G.S. Crawford and G.W.G. Allen. Of special interest was the work of Sir Henry Wellcome, whose interests have led to such innovations as infrared photographic surveys using kites.

World War II saw a vast proliferation of technological innovation, especially in the uses of aerial photography and RADAR. As soon as the war ended universities began to reap the harvest of these discoveries for research. In 1945, as civilian life resumed, the geologist J.K. St. Joseph began a multi-disciplinary program at Cambridge University centered on aerial reconnaissance. This became the *Cambridge University Committee for Aerial Photography* and it recorded natural landscapes as well as archaeological and historical sites.

A government sponsored program of the 1980's, the *Royal Commission on the Historical Monuments of England*, underwrote an aerial photographic survey of the Yorkshire Wolds area of Northeast England. The results, from a BBC report;

Today this rolling chalk upland is covered in arable fields, and apart from a few medieval village remains and a scattering of prehistoric earthworks, it is hard to see anything much of archaeological interest.

Only after being mapped from tens of thousands of aerial photographs, by the 1980s, were the incredible extent of the late prehistoric and Roman remains that lay buried beneath all those cereal crops apparent. Thousands of Iron Age square barrows (burial sites), hundreds of farmsteads and settlements, droeways, tracks and field systems were mapped. The worth of this and subsequent mapping projects has been shown many times over, and first-level mapping is now being carried out for all of England, county by county, as part of the *National Mapping Programme of English Heritage*.

Aerial Photography today has evolved in many directions.

The basic tool is a standard camera photo taken from either a vertical position, directly above the desired object, or an oblique shot. Variations are a vertical shot taken in winter, or near dawn or dusk, so that shadows create an oblique effect in the landscape. Vertical shots led to stereoscopic photography which was the standard for most government survey work up through the 1970's. A comprehensive coverage of this technique is found in the work of P.R. Wolf in his *Elements of Photogrammetry*.

Other techniques that have evolved during the past 40 years include *infrared* and *ultraviolet spectroscopy*, which produce images of features invisible on standard photographs. *Ground penetrating radar* (GPR) and *Tomography* (GDT) from satellites have also emerged as useful tools in a field now referred to as *Remote Sensing Archaeology*, no longer requiring aircraft. Tomography began with the firing of an 8 gauge shotgun and recording the resulting terrestrial sound waves, similar to seismic.

The most explosive advancement in remote sensing archaeology appeared thirty years ago with the launching of NASA's SIR-A imaging system on the Space Shuttle. SIR-A sent out its own radar signal and *listened* to the echo. Its first survey, of the eastern Sahara Desert, revealed a landscape under the sand dunes which included long dead lakes, rivers and valleys not unlike those found in Europe, and led to several prehistoric archaeological discoveries along the shores of the hidden ancient waterways.

The basic idea for all uses of these technologies is to reveal the hidden effects of earlier human activity are revealed. As described on the website of the *Aerial Archaeology Research Group*,

Most of what we now record from the air was originally made by digging into the ground – ditches that defined ownership boundaries, pits cut for storage or burial, and post holes that supported uprights for houses and other structures – although foundations and walls are sometimes also visible. These old holes in the ground, now backfilled, levelled, and invisible to the ground observer, comprise a huge percentage of the surviving sample of past communities that is available for aerial study.

The remains of past human activity can be seen from the air in a number of ways. In addition to churches, castles and other old buildings, partly eroded remains of past structures, in the form of earthen mounds and banks, can also be viewed. These sites are known as "earthworks". More elusive, however, are the remains of buried archaeological sites which, in certain conditions, are best viewed from above. When arable fields are ploughed, it is often possible to view the flattened remains of old buildings, roads and field boundaries because of the difference in the soils and materials which make up the remains.

In arable land, the fill of these holes may hold a higher moisture content which

can affect the growth of some crops above them, and this differential growth may be recorded on aerial photographs. On some soils, past features may be seen in winter as different coloured soils. The fill of a ditch, for example, may be a dark organically rich soil that shows against a light-toned natural background. For example, the site of a demolished house might be recognisable from the air due to the concentration of brick, tile and other debris which is visible because of variations of colour and texture. These sites are known as "soilmarks".

Perhaps the most remarkable type of site, however, are those known as "cropmarks". In this instance, variations in the sub-soil caused by buried archaeological features results in differential crop growth.

Potential

There is little available evidence of the use of these methodologies; either for preliminary archeological research, or as a follow up exploration of established sites, such as L'anse aux Meadows or Ferryland, in Newfoundland. The Newfoundland and Labrador Government stereoscope photographs of the Trepassey area taken in the 1940's, 1950's, and 1960's would be an excellent free resource to submit to the practiced eye of a trained aerial photograph interpreter.

The US Government, under President Clinton, declassified much of the reconnaissance satellite photography acquired during the 1960's and 1970's. An excellent example of these resources is listed at <http://www.csr.utexas.edu>. A possibly apocryphal story tells of photos once posted on the walls of MUN's Engineering Building in the early 1970's, purportedly shot from near space, showing someone standing on a lakeshore structure in Happy Valley/Goose Bay. A study of what is now available through this declassification program may well turn up pictures and other images of Newfoundland and Labrador that could well be of use to the SWVP.



Image 1 is an extracted section view of the Lower Coast and the southern portion of Trepassey taken from photograph 13526-89 (1954) in the collection of the Government of Newfoundland and Labrador. The original plate is a high resolution stereoscope.

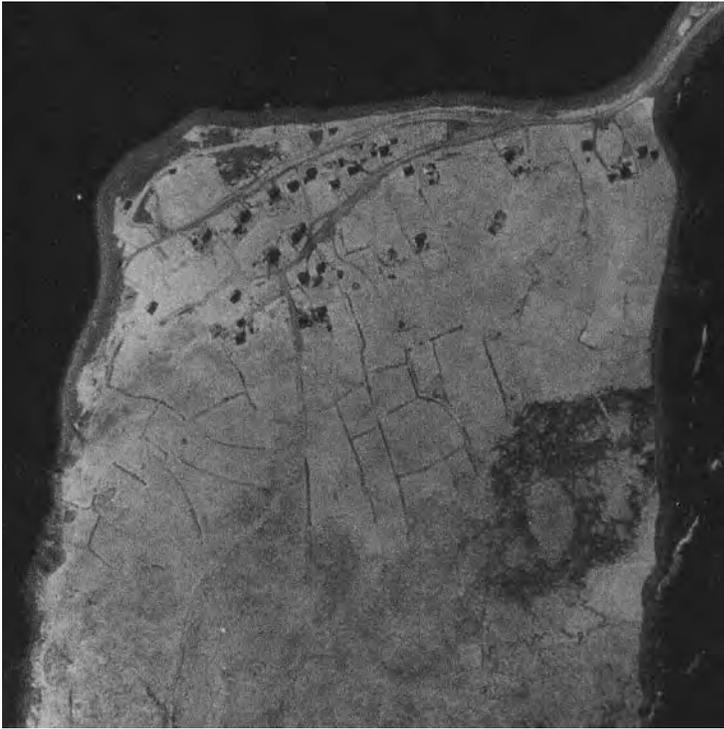


Image 2 is an extracted section of 20056-14 (1968, Government of Newfoundland and Labrador) clearly showing the stone fences of the Lower Coast. Speculation would have Vaughan possibly using this area as it was close to the fishing grounds and has lots of space for pastures and flakes.

The fences are of great interest to SWVP and the organization's research plan includes conducting an archaeological interpretation of the fences in 2013.



Image 3 is an extracted section of a 1919 aerial photograph of Trepassey Harbour taken by the United States Navy's first trans-Atlantic flight showing a Navy support vessel at anchor off the Lower Coast and an oblique view of the Lower Coast fences.

Even a quick assessment shows these fences virtually unchanged 50 years later. Nor is it a stretch to imagine some may have 17th century origins. Skilled archaeological interpretation is required to pursue this idea.

Reference and various sources on the field of aerial photography and remote sensing

Wolf, P. R. 1974. *Elements of Photogrammetry*. McGraw-Hill, Inc.

Wikipedia article on Aerial Archaeology with excellent reference links

http://en.wikipedia.org/wiki/Aerial_archaeology

Website dedicated to the use of aerial cameras mounted on kites

<http://www.armadale.org.uk/kite03.htm#add>

BBC program relating to the extensive use of aerial archaeology in Great Britain

http://www.bbc.co.uk/history/ancient/archaeology/time_flyers_01.shtml

Site of the Wellcome Trust

<http://www.wellcome.ac.uk/About-us/History/>

Website of the Aerial Archaeology Research Group (AARG)

<http://www.univie.ac.at/aarg/php/cms/>

Declassified US recon satellite images of a 600 BC Greek colony site in the Black Sea

<http://www.csr.utexas.edu/rs/research/arch/>

Remote sensing (Ground Penetrating radar) at the Etowah mound site in Georgia

<http://www.archaeology.org/0811/abstracts/etowah.html>