Themata 5 E-learning Archaeology, the Heritage Handbook

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E-learning Archaeology

the Heritage Handbook

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Aerial survey in archaeology protection and management system

by Włodzimierz Raczkowski

MSCO Introduction

In archaeology, aerial photos have been used since the beginning of the 20th century, though the technical potential to make them from flying objects had already appeared by the mid-19th century.

> ***Animation***

Antiquity

Dreams about flying – Deadalus & Icarus

Leondardo da Vinci

Francesco Lana de Terzi was an Italian Jesuit and aeronautics pioneer. He sketched a concept for an airship Bartoloneu de Gusmao (Bartolomeu lourenço de Gusmao), was a Portuguese priest and naturalist born in Colonial Brazil, recalled for his early work on lighter-than-air-airship design.

The first manned flight by a hot air balloon took place in the early 18th century. On November 21, 1783, in Paris, France, the first manned flight was made by Jean-François Pilâtre de Rozier and François Laurent d'Arlandes in a hot air balloon created by the Montgolfier brothers.

Wilbur & Orville Wright building the world's first succesful airplane and making the first controlled, powered and sustained heavier-than-air human flight on 17 December 1903.

In 1827, Joseph Nicéphore Niépce produced the world's first permanent photograph (known as a Heliograph).

Louis Daguerre announced the latest perfection of the Daguerreotype, after years of experimentation, in 1839, with the French Academy of Sciences announcing the process on January 7 of that year.

In 1841 William Henry Fox Talbot developed a chemical process which enabled development of photography.

The first (currently known) aerial photos were taken by Gaspard Felix Tournachon, known as Nadar, in October 1858. They were photos of Paris.

SCO History of aerial Photographs

It was at the turn of the 20th century that the first attempts to use aerial photographs in archaeology were undertaken.

> ***Animation***

The first (currently known) aerial photos were taken by Gaspard Felix Tournachon, known as Nadar, in October 1858. They were photos of Paris.

This significant cultural event did not however inspire archaeologists to apply this technological potential to archaeology. Why? It seems that then archaeologists were not fully aware of the potential of aerial photos that could be utilized in their studies of the past. The view prevalent then in archaeology was the theory of cultural evolution; it determined the reflection and perception of the past as well as influenced the fields of interests of archaeologists, research problems and the way of solving them. Evolutionism played a key role in studying the origin of phenomena and cultural forms as well as mechanisms of cultural transformation. Influenced by the premises of evolutionism (e.g. the progressive character of evolution, laws of nature governing cultural development, the accumulation of cultural experiences, the unity of the human psyche or the concept of 'relics'), archaeologists accepted as their main research method the evolution-comparative method, which implied that they compared cultural conditions and forms without paying attention to the context in which they occurred. As a result, the main interest of archaeologists focused on chronology which enabled placing particular phenomena and cultural forms in the evolution cycle (cf. Module 11_1). In this perspective, aerial photos did not appear as the obvious tool to be used in archeological research.

In June1899 the Italian archaeologist Giacomo Boni managed by aerial photographs to obtain a photogrammetric survey of Roman Forum and Palatinate Hill during excavations. They were taken from a changing height between 300 and 500 meters above sea level from a balloon. The result was 'the true portrait of the terrain'.

In 1906 aerial photographs of an archaeological site in Stonehenge (Great Britain) – were taken by P. H. Sharpe during military training. It must be remembered, however, that these photos were made during military training, so they were not inspired by archaeologists.

A Roman villa in Bad Vilbel (germany) was photographed from a balloon.

Photographs taken from a kite during excavation works in Jebel Moya (Sudan) in 1913 and 1914 by Sir Henry Wellcome. With the passage of time, initiatives to make aerial photos of archaeological sites were more and more

frequent. Some of the initiatives, which often originated outside the circle of archaeologists, nonetheless fulfilled the research objective in archaeology.
The photographs managed by Carl Schuchhardt (Germany) in 1916, which were used to study the Roman Limes in Dobrudga (Romania). With the passage of time, initiatives to make aerial photos of archaeological sites were more and more frequent. Some of the initiatives, which often originated outside the circle of archaeologists, nonetheless fulfilled the research objective in archaeology.
Another example is Leon Rey (France) in 1916, who attempted to identify archaeological sites from Macedonia on the basis of military photos. With the passage of time, initiatives to make aerial photos of archaeological sites were more and more frequent. Some of the initiatives, which often originated outside the circle of archaeologists, nonetheless fulfilled the research objective in archaeology.
Aerial reconnaissance carried out by Theodor Wiegand (Germany) in 1917 in Palestine and on the Sinai.
One of the most spectacular were the experiences and thoughts of George Beazeley (Great Britain), who was involved in 1917 and 1918 in making maps of the area of Mesopotamia on the basis of aerial photographs and who, in consequence, discovered several archaeological sites and subsequently developed a method of handling the photos.
Air reconnaissance photos made by Antoine Poidebard in Syria in 1925.
Other significant achievements of non-archaeologists also contributed to the realization of the potential of such photographs for archaeology (in terms of taking or publishing aerial photographs).
The period after WWI witnessed a gradual increase in interest in aerial photography. In some European countries the first aerial photographs of archeological sites or historical landscapes were made, including those for Poland, Austria, Czechoslovakia, Lithuania, Latvia and Sweden. Most of those initiatives were undertaken to illustrate archaeological sites. But it was essentially the works of O.G.S. Crawford which demonstrated the potential of aerial photos in archaeological studies of the past.

sco O.G.S. Crawford – 'father of aerial archaeology'

In 1921 Crawford published a book, *Man and His Past*, in which he included his reflections on archaeology and methods used in its research. Drawing from his earlier experience (he participated in the research in Jebel Moya and the reconnaissance flights of the Royal Flying Corps at the end of World War I), he voiced an opinion that aerial photographs would play a great role in archaeology in the future. As he saw it, the role would mainly involve discovering archaeological sites and mapping of those sites to understand their spatial structures, environmental settings, contexts, etc. In 1922 Crawford got access to military aerial photographs and he instantly found 'proof' for his assertion. The photographs he got hold of showed a structure of fields represented by lynchets, which were difficult to find (especially concerning their spatial structure), using the field-walking. In his first text devoted to application of aerial photos in archaeology, Air Survey and Archaeology (1923), Crawford proved that aerial photos might be a very effective tool in solving research questions. Another assertion expounded upon in the text was that aerial photographs might serve not only to illustrate archaeological sites, but they could also be used to seek answers to questions concerning past phenomena (in this case the evolution of the system of fields).

> ***Animation***

Having gathered enough experience in applying this method in the years 1922–1928, Crawford prepared another publication titled Air-Photography for Archaeologists, which might be described as a comprehensive approach to the method. In this article Crawford formulated aims and applications of the method, as well as the nature of the phenomena which triggered the emergence of archaeological sites. He also discussed technical problems connected with photography and aerial reconnaissance. Crawford intended it as the first manual for aerial photography to be used in archaeology. Therefore, he indicated which archaeological features/sites might be photographed and when the best time to take photographs was (time of the day and season).
Moreover, Crawford laid out basic categories to determine types of sites, which were soon commonly accepted and which have been used until today. He introduced three basis categories:

> shadow sites, earthworkswhich are detectable based on shadows they cast.
> bare soil, today most frequently referred to as soil marks, which indicate sites on fields devoid of vegetation.
> crop sites, today referred to as cropmarks, sites which emerge because of their diversified coloring and heights of vegetation.

sco How are they visible?

Archaeological features may also be more visible from the air than on the ground.

Look carefully at the aerial photographs and click on archaeological sites visible from the air. To check your answer, click 'Check' button. To Try again click 'Clear' button.

> ***Animation***

Shadow sites, with their unique landscape forms, are visible in aerial photos thanks to the shadows cast. This means that the most optimum time to photograph them is on a sunny day, either early in the morning or late in the afternoon, when the shadows are the longest. The most optimum season is the turn of autumn and winter, when the sun is low over the horizon and when shadows are visible throughout the whole day.

Shadow sites may also become visible thanks to the presence of snow (snow tends to melt quickly on insulated slopes) or when a site is partly flooded. Such sites are also easy to spot when depressions (e.g. ditches or hollows) are filled with water or the earthwork is partly flooded (surrounded by water).

Soilmarks are usually discernible in winter and early spring. They show up due to the color differentiation of topsoil and fillers that were used to fill in archaeological features (ditches, pits, sunken houses etc.) or ploughed up mounds (barrows, banks). The bigger the contrast in natural color of the soil and the layers of man-disturbed soil, the more discernible the differences of photo tones on the photographs are. Since there is a close dependence of the soilmarks on modern ploughing methods, the soil marks tend to disappear quite often.

The factor that most often leads to identification of an archaeological site is cropmarks. They tend to appear in places with underlying archaeological deposits filled with soil or cultural layers that differ from the surrounding bedrock. These deposits provide better (or worse) growth conditions because they are more (or less) fertile and more (or less) humid.

Depending on the variables, cropmarks are divided into two categories: positive and negative. The positive marks indicate plants whose growth is better thanks to favourable growing conditions, for example, over ditches or pits filled with soil containing a greater amount of humus or more humid filler. The negative marks appear when archaeological features create uncomfortable conditions for vegetation. The difference in a crop's colour might also be emphasised by its shadows due to the difference in the crop's height.

sco Aerial photos as an archaeological source

Crawford claimed that aerial photographs were an objective representation of existing archaeological sites. This means that he believed in what he saw on these photographs and he treated the picture under analysis as real images of the world. He also believed that a photograph recorded everything that archaeologists saw with the naked eye. In one of his works, he compared an aerial photo to a genuine manuscript which might be examined by somebody knowledgeable about hieroglyphs. He assumed that an archaeologist adopted a passive role and a lack of involvement in the analysis and observations made within the framework of the process of reconstructing the past world. For him, observation boiled down to 'pure perception'; an archaeologist was vested with 'an unbiased eye' and 'pure perception' was one of the basic tenets of this empiricism.

Seen from this perspective, information contained in an aerial photograph might be treated in the same way as an archaeological record. To put it more simplistically, an aerial photograph of an archaeological feature became an archaeological record and thus a basis for reconstructing the past. For the aerial photograph to be treated as a source about the past, it was necessary to develop standards for its publication (according to Crawford). Now choose the elements of this standard. You can choose more than one answer.

> Exercise

sco Aerial photographs and maps

From the very beginning, aerial photographs became one of the main methods applied in field archaeology. Their main advantage was that they enabled detection and recognition of spatial structures (cf. Module 2). On the basis of the aerial photographs it was possible to make precise sketches, plans, and maps of individual archaeological sites and whole regions. Try to understand Crawford's way of thinking and notice the potential of aerial photographs.

> ***Animation***

The spatial aspect became important, not only from the view point of making a very detailed documentation about a given site. Crawford was convinced that the analysis of spatial phenomena would enable investigation into the past. The aerial photographs were an effective tool in discovering the past as well as in solving other research questions. Today, the relationship between stray finds and aerial photographs is not seen as very significant, but Crawford saw it differently then. He observed that stray finds were often concentrated in regions where there had been no previous traces of settlements or cemeteries. He believed that aerial photographs would allow detection of archaeological sites in such regions which would further explain the presence of stray finds.

Another aspect that the aerial photographs highlighted, coupled with distribution maps, was connected with roads and

other routes. The relatively prosaic truth, 'roads connect settlements', inspired archaeological searches for roads. It was obvious to Crawford that aerial photographs could become the main tool used to look for networks of roads between settlements.

> SCO Exercises

→ **LU** Flight reconnaissance *by Włodzimierz Raczkowski*

SCO From kite to satellite

From the very beginning, interest in aerial photography brought about interest in the search for a potential platform which would enable the enhancement and establishment of a tool for recording the surface of the Earth (a camera, a detector, a scanner, etc.). The first aerial photographs were taken from balloons. Quite early on in the process, kites were also applied. But airplanes invariably took over. Today we have at our disposal also motogliders, or paragliders as well as a few models of remote control devices: airplanes, helicopters. Photos of the surface of the Earth can also be made by different scanners placed on satellites.

One should not be too judgmental when considering which platform is best: each of them may be used effectively. Platforms such as kites, balloons, or remote control models are suitable when documenting single sites or very small regions. Airplanes or motogliders, on the other hand, are better suited to surveying much bigger areas. Satellite images offer the possibility to view and record a picture of a given terrain as a whole (as e.g. vertical aerial photos used to make maps). Currently, the biggest problem associated with satellite images (freely available) is their ground resolution.

The choice of an appropriate platform for recording equipment therefore depends on research objectives and funds available.

SCO Image recorders (cameras, scanners, detectors)

A decision concerning which equipment should be used to record the surface of the Earth is determined by financial needs and the possibilities archaeologists have. Due to technological progress and archaeology's open, interdisciplinary access to the achievements in other fields of research, the opportunities in choosing appropriate recording equipment appear to be unlimited. So, depending on the wavelengths to be recorded, various equipment can be used.

> ***Animation***
>
> The most commonly used recording equipment is cameras, which may work with the light of the visible spectrum from ultraviolet to infrared. As to which camera to choose from, this depends on the preferences and experiences of the photographer. Furthermore, a crucial and key criterion to take into account is the lens used. In the past, cameras for taking analogue photos dominated, so the quality of the image was also determined by the emulsion parameters and types of reels, etc. Today, digital cameras dominate, so, besides the parameters of the lens, what also counts equally are the characteristics of the matrix.
> Filters placed on the lens play a significant role in selecting a wavelength from the range of ultraviolet to near infrared, which can be recorded by cameras. There is a wide selection of filters and myriad ways to set them up. Achieving the expected result depends on the objects photographed, the external conditions photographs are taken in, and the lighting conditions.
> To record wavelengths outside the visible spectrum, different types of detectors, scanners and radiometers can be applied. They can record relatively narrow ranges of electromagnetic radiation outside the visible spectrum. Multispectral scanners are also being used. Multispectral remote sensors (scanners) produce images with a few relatively broad wavelengths bands. Thanks to these properties, they can identify objects of different spectral characteristics with high precision.
> Yet another instrument more and more often used in archaeological image resonance is LIDAR (acronym from Light Detection and Ranging), a laser scanning of a surface area. This instrument, carried on a plane, produces stunning three-dimensional photos of a surface area to the accuracy of 1-5 cm. An important advantage of LIDAR is that it can even record a surface of area covered by a forest.

SCO Photo types

Different recoding instruments produce different images, whether they are analogue, digital, or infrared. However, from the point of view of the application of aerial photographs in archaeology, another area of imaging is important: vertical and oblique photos. The division into vertical and oblique photos is important when considering interpretation and mapping.

> ***Animation***
>
> Vertical photos are obtained when the lens axis is targeted perpendicularly to the surface of the Earth. Such photos are used primarily to make maps. From this point of view, vertical photographs should logically not pose such problems with mapping; however, this is not always true. In reality, when taking vertical photos, the camera's lens axis is always tilted by 1° to 3°. Hence, vertical photos

(depending on the needs of documentation) need rectification as well.
Oblique photos, on the other hand, are made when the camera lens is tilted from an angle that is not perpendicular. The proportions of objects on oblique photos are always distorted; therefore, rectification is necessary.

> SCO Exercise

→ LU Aerial photographs as resources

by Włodzimierz Raczkowski

SCO The usefulness of archival photos

Aerial reconnaissance is one of the main forms of activity of aerial archaeologists. However, it is often forgotten that there are many photographs that can be used in myriad projects, from land management to the protection of archaeological heritage.

> ***Animation***

World War I was a time since when most of Europe was consumed in warfare and when many aerial photos were taken. Many collections of photographs from this period have been destroyed, yet those that remain have not been sufficiently utilised. Recently, an increase in interest in such photographs in Europe has been observed, leading to the publication of more than a few photo collections. A good example is the study of aerial photos taken in Belgium during World War I. On the basis of these photos, it is possible to document many activities and undertakings related to military actions as well as to identify archaeological sites.
Since 1933 in Germany, photomaps have been made at a scale of 1:25,000. As a whole, these photomaps constitute are a great resource of the cultural landscape from the time before and during World War II. A large collection of German, British, and American photographs taken during WWII throughout Europe is found in the The Aerial Reconnaissance Archives (first housed in Keel, it has been moved to Edinburgh).
After World War II, vertical photographs for cartographic purposes have regularly been taken in all European countries. Usually, every few years, coverage of a whole country is made. Such photographs are available in appropriate cultural and research institutions (organized differently from country to country).
It should be remembered, however, that both the scale and the time the photographs are made are not always suitable to the needs of archaeology. Nonetheless, such photographs as a resource should be taken advantage of by archaeologists since the photographs can provide information about now non-existent archaeological sites.
Since the 1960s, satellites have been used to record the images of the Earth. Satellite images can play a great role in studying archaeological heritage, especially in regions that are hard to access. As with any other method, it also has its shortcomings. These include the period during which images were taken (as in the case of photographs made for cartographic purposes) and image resolution. When the resolution is too low, it is difficult to identify small archaeological features.
In countries which have not imposed any limitations on amateur aerial sports and photo taking, many people have been recording the images of the Earth for reasons of self-interest. Their photographs offer a great potential to study archeological heritage; therefore, cooperation with amateur photographers can be very fruitful. Some countries remain closed in their policy towards amateur researchers of the past (perhaps a consequence of bad experiences concerning the amateur use of metal detectors), but in conjunction with archaeological research, this approach remains unjustified. Amateurs can be very helpful in documenting, sometimes unwittingly, archaeological heritage. A good example of cooperation with amateurs of aerial archeology was a system of support for air reconnaissance whose policy functioned in Great Britain between 1960 and 1980. It should be remembered that amateur pilots and conservation services active in archaeology can only benefit being open to mutual cooperation.

SCO Mapping

Crawford said early on that aerial photographs should be closely connected with maps, and that archaeological data encapsulated in the photo became meaningful only when translated onto a map.

The value of the data and problems related to their mapping depend on the scale of a map. For small scales (1:50,000 or 1:100,000), archaeological data observed in a photo may only be equivalent to a point on a map which indicates the localization of a site. For big scales (1:10,000 or 1:5,000), such aerial data may reveal information about the shape or spatial relation among particular features. In archaeology, the need to create maps using aerial photographs has changed during different periods (cf. Module II_1). For cultural-historical archaeology characterized by a diffusion approach, small-scale maps were sufficient. Field archaeology imposed the need to

make precise plans of particular sites. Processual archaeology created the need to take precise measurements of spatial phenomena, which implied precise mapping. Such a need raised the problem of what method to use for mapping, especially oblique photographs.

Drag the scrap of the aerial photograph and place it properly on the map. If needed, you can rotate the fragment moving your mouse up and down.

SCO Methods of mapping

Place all the draggable elements in the right place on the map and on the photograph. Then check your answer. If it's correct, go to the next slide and match the points from the map with proper points on the aerial photograph. Check your answer. Good luck!

> ***Animation***

Manual methods

In archaeological practice, two primary methods of mapping have been used for a sustained period of time: the paper strip method and the Möbius network method. In both methods translation of the data is based on control points. A control point is an element (feature) which can be identified both in an aerial photograph and on a map. The paper strip method requires at least four control points, while the Möbius network method requires at least five visible points. The points should form a traverse surrounding the archaeological site, since only within such a traverse can a correct rectification be carried out. Hence, when conducting aerial reconnaissance and taking photographs, it is important to take shots which enable identification of control points. In some countries where plots of land have been integrated, this causes a problem.

Computer methods

Manual methods are quite time-consuming and are characterized by their relatively low precision. It is not surprising then that in the 1970s an attempt was made to create computer methods of aerial photo rectification. Today archaeologists use two specialized software programs for rectification: AERIAL and Air Photo. Both programs also require control points. Depending on the number of points available (four or more) we can also obtain information about the precision of rectification. Both programs also enable the opening of files which can be read in GIS (Geographic Information System) programmes. Through the programmes, it is possible to obtain a rectified photograph or its interpretation and place it in an appropriate place in a given space.

Photo interpretation

The process of interpreting aerial photographs is complex and therefore requires knowledge from different disciplines and fields of study. Hence, one should have some knowledge of lithology, agriculture, biology and, certainly, archaeology. Regarding the last point, knowledge should concern the specific character of archaeological sites in particular regions. In theory, before setting about interpreting aerial photographs, an interpreter should learn about the results of previous excavations carried out in this region, as the basis of these results can create accurate parameters as to what can be found in an analysed aerial photographs. On the other hand, it is purely prudent for the interpreter to limit the investigation only to features already known since this may inadvertently lead to passing over or missing what is not known.

An important element of the interpretation process is also reflecting on the reasons why some zones are devoid of archaeological sites. A lack of soil or cropmarks does not have to imply an absence of archaeological sites or features (cf. Module II_1) as such absence can be brought about by many factors.

Standardisation

Archaeological features are first interpreted and then graphically presented in the form of maps or plans. In this form they are published, but to be accessible to readers they have to employ some standards which allow for a 'reading' of the maps. To this effect, there is a need to agree on particular graphic forms representing particular types of archaeological features or geomorphological structures, which may be important in the interpretation of spatial structures and the function of features. Good examples of standardisation of data presentation are projects done within the National Mapping Programme in England (cf. Module II_1) or in the Royal Commission on the Ancient and Historical Monuments of Scotland.

If you want to learn more about computer-aided methods of the rectification of aerial photographs, do the exercises described in the pdf document below. To complete the tasks you will need to download additional material (photo and map).

> SCO Exercise

→ LU Aerial photographs and Archaeological Heritage Management (AHM) *by Włodzimierz Raczkowski*

SCO Aerial photographs and Archaeological Heritage Management (AHM)

Until 1960, archaeological conservation (culture-historical archaeology) was based on the collection of information about archaeological sites and features. This archaeological theory was therefore grounded in an empiricist view stressing the need of a detailed description of data without any reference to theoretical constructions. Processual archaeology, on the other hand, rejected inductive explanations of phenomena from the past. Therefore, the practice of collecting a maximum amount of data which would allow glimpsing into the past could not be fully accepted by processual archaeologists. This does not imply, however, that data ceased to hold any meaning in archaeology. On the contrary, the data collected by archaeologists became essential in testing and confirming hypotheses or refuting other models (cf. Module II_1).

Ways of treating aerial photographs in the practice of conservation have not undergone significant changes compared to previous periods, yet processual inspirations have impinged on ways of solving many previous conservation problems. At least to a certain degree, the changes have involved the application of aerial photographs (especially in Great Britain). The first aerial photos were connected with aerial reconnaissance carried out in order to build up a comprehensive database about archaeological sites. Under the influence of processual reflection, the data base was completed with spatial information and with time the data were transformed into a spatial database created within GIS. The conservation services are, as a result, in possession of a great amount of material records, which is a very effective tool in archaeological heritage management and protection. Access to such data bases is very easy, thus already at the initial stage of designing different projects or investments, it is possible to envisage and thus avoid potential conflicts between the needs of socio-economic development and the need to protect archaeological landscapes. In either case, the dominant view about the objective character of the data is contained in the database.

SCO Aerial photos and post-processual reflections

Processual archaeology can be credited with turning archeologists' attention to the role of theory. But this was a double-edged paradox and became a source of criticism of the fundamental assumptions of processual archaeology. By turning to different philosophical theories created within a wide philosophical trend defined as postmodernism, archaeologists noticed the inherent limitations of the processual archaeology they turned to. Undoubtedly, the search for inspiration in diverse philosophical theories at the second half of the 1980s was a very significant factor in shaping the perception of archaeologists concerning the objects of their research. The diversity of philosophical tenets has led to many diversified ways of approaching fundamental problems in contemporary archaeology. Postmodernism has taken very different forms in the works of many philosophers, and it encompasses, among others, the following elements.

> Exercise: answer with yes or no
> These three very general features of postmodernism, which certainly do not exhaust the description of such a complex phenomenon as that of postmodernism, are indicative of the thorough re-evaluation of thinking in the humanities. In archaeology, the critical reflection stemming from postmodernism has also led to significant changes in approaching archaeology as a science, pondering the relation between the past and present, and considering the concept of archaeological sources. Recently, it has brought about a change in the approach to aerial photographs too.

SCO Aerial reconnaissance and distribution maps

Up until recently, distribution maps were treated as the primary source for drawing conclusions about diffusion processes, migrations, communication routes or mutual cultural relations. A map with marked points was treated as an objective reflection of the real past. The same applied to distribution maps created on the basis of information obtained from aerial photographs. This especially concerned the identification of zones and contexts (mainly environmental) of the presence of particular categories of sites.

Post-processual reflection introduced a number of themes which questioned all previous assumptions adopted on the basis of previous approaches. So, first a question was posed about the reasons for the concentration of certain categories of monuments or sites in some places and for their absence in other regions. The answer was not searched in cultural processes that took place in the past but in contemporary activities undertaken by archaeologists (such as aerial reconnaissance). On the basis of the analysis of the decisions made by archaeologists about the itinerary of the flights and the places where aerial photographs had been taken, a conclusion was reached that these very decisions had a major impact on the picture emerging on the distribution maps.

In consequence, a new practice of recording itinerary of

reconnaissance flights developed (using GPS), since such an itinerary may significantly effect interpretation of the distribution of the sites in space. On the other hand, it follows from what we know about reconnaissance flights so far, about the regions of their concentration, that there is a need to fill the 'spatial' gap and conduct some reconnaissance on areas so far ignored. A question arises, namely, why some areas have not been covered by reconnaissance flights. It is reasonable to assume that archaeologists were convinced that there was nothing to be found there (as an effect of geographic determinism). Hence, self-reflection on the previous practice of aerial reconnaissance flights may lead to development of new strategies of planning and carrying out such reconnaissance. Once a new strategy is implemented, the maps of site distributions may change dramatically.

SCO Interpretation process

The conviction that photography was objective and neutral became an integral part of our thinking (at least in Europe and America) begun in the late 19th century. In science (including aerial archaeology) this conviction received the status of unquestioned truth. This is the reason why the information about archaeological sites visible in aerial photographs was treated as the truth about the past (see above). Contemporary philosophical reflection, unlike the positivists' ideas, posits that what we see, and that the way we perceive something is not a part of our natural, inborn human capabilities, but rather a consequence of the ways particular societies develop knowledge, systems of needs, and a hierarchy of values.

> ***Animation***

A culturally determined meaning of a photo may be revealed in certain phenomena on the level of producing information (taking a photo, choice of a photo, composition, and construction of photo, compliance with rules of professionalism, aesthetic or ideological norms, etc.) and the way it is received by a recipient (the way things are perceived or read) using, more or less consciously, the reservoir of available cultural codes. Signifying codes are historical and cultural. It is no more reasonable to say that in photo reading a man uses 'an immemorial' sense or values than to say that meaning is always a result of historical development of a given society. In this sense reading a photo is always historical, depending on the knowledge of a recipient, its language, and the ability of deciphering codes.

Such a view significantly challenges the way aerial photographs have so far been interpreted. It is important to realise that there is not one correct and finished interpretation of a photograph. Any interpretation is entangled in a concrete historical situation. This is the example of a hermeneutic spiral – each time we look at an aerial photograph we get different information resulting from our previous experiences or changing needs.

An interpretation process takes place at all stages of work with aerial photographs: planning reconnaissance, flight, taking photographs (what to photograph and how to do it), photo interpretation and translating this information into maps when using these data in creating images of the past. For each of these stages, it is possible to define a hermeneutic perspective (formation of content) and a phenomenological perspective (constructing mutual relations between an archaeologist, a photo and the past).

An aerial photo is not a tool which enables us to recover the past. Both the photograph and the meanings we can extract from it are entangled in a cultural reality; they are an effect of complex processes of social formed images of the world. This social context imbued in our interpretation of aerial photos refers to 1) the stage of taking the photo (this particularly applies to oblique photos, but not only); 2) interpretation of the content included in the photo (both oblique and vertical); 3) application of the photo (or rather the content of the photo) to solve research problems; 4) realization of the conservation policy and the protection of archaeological heritage; and 5) dissemination of knowledge of the past.

A photograph is essentially treated as a system of visual manipulation. We therefore cannot talk about the existence of independent data (cf. the conception of database in culture-historical and processual archaeology) but rather about the production of data concerning the past. The data become the object of reading, interpreting, and arguing in archaeological discourse in constructing images of the past.

SCO A photo as an element of persuasion (education and popularization)

An important element of contemporary discourse created from different perspectives about the past is the common belief about the objectivity of a photograph. Because of this belief, aerial photographs are a very persuasive part of narration about the past and the possibility of studying it. The aesthetics of photographs, their mysteries, and elements of romanticism or realism appeal to viewers. A photograph creates the impression that its message is neutral and objective. Additionally, it represents reality, and for the viewers this is the past reality (not the reality of making the photograph). As an archaeological record, it creates a metaphorical contact with the past. By employing the so-called effect of reality

(exemplification), when a detail (a photograph of a given object) is introduced into a more general text, the photographs create the impression of 'touching' past reality. This is why photographs are an excellent tool in popularizing archaeology and are widely employed in education.

sco The potential of aerial photos in conservation practice

Because of their features, understood in a traditional way or from a post-modern reflection, aerial photographs may fulfill different functions in the protection and management of archaeological heritage. Such examples are:

> ***Animation***

1 Documenting the progress of excavation works,
2 Documenting well-known archaeological sites,
3 Discovering new archaeological sites,
4 Discovering new types of archaeological sites,
5 Judging investment projects by indicating the potential threats posed by them to archaeological heritage resources,
6 Evaluating the condition of the preservation of archaeological sites,
7 Determining the range of sites (this is significant in adding sites to the register of monuments or investment projects),
8 Correcting the localization of sites known from other data,
9 Evaluating the value of sites,
10 Monitoring sites included in the register of monuments,
11 Illustrating sites,
12 Developing social knowledge about the history of archaeological heritage.

This rather extensive list is still, by no means, a complete list of the potential ways of using aerial photographs in archaeology. However, both present and future practices depend on the needs and imagination of the future users of aerial photographs.

sco Integration of methods

The effectiveness of aerial photographs depends on the integration of this method with other methods used in archaeology. Nowadays, this mostly implies compounding aerial photographs with field-walking and various geophysical methods. In the process of integrating different methods in studies of archaeological sites, all the methods should be treated as complementary to each other, not as competing ones. In the former case, any differences in the results obtained via different methods provide a stimulus for reflection on the reasons for differences, on the 'condition' of a site, the condition of its preservation and stratification processes. Integration of the methods could and should trigger deeper reflection on the essence of formation processes in order to obtain a fuller understanding of the phenomena. Different methods afford different information about a site.

> sco Exercise

msco References

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