The archaeology of lowlands: a few remarks on the methodology of aerial survey

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Abstract: The paper brings summary of methodological aspects of aerial survey for archaeological purposes and ancient landscape reconstruction. These considerations are based on a 13-year experience in this field. Flights over lowlands in Bohemia aimed at the prospection of cropmarked components of past human activity, especially over the flat Labe (Elbe) basin in central and north-western parts of the country, resulted not only in gathering extensive database but also in collecting much information in terms of methodology. General characteristics of air surveyed data and their comparison with archaeological sources collected during ground-based activities, the relationship between aerial reconnaissance, soil/geology and plant species, and the problem of intensity of air survey in respect to the qualitative and quantitative aspects of data for further analysis and interpretation are the main themes of this contribution.

Key words: aerial survey – cropmarks – landscape – site – settlement

1. Characteristics of data evidenced by aerial reconnaissance

With the majority of archaeological monuments forming the source base in naturally or administratively delimited territories (regions) of various scale, in general terms it is difficult to define the extent of settlement activity, types and quantity of monuments/features distributed in them. This is particularly true of early finds in museum collections because within the scope of traditional archaeology precise localisation os a site was not of primary importance. However, the advantage of these finds (artefacts) dated before the 1970' is the fact that they can be dated - more or less correctly. From the point of view of spatial archaeology this fact is important mainly for the study of settlement (dis)continuity over the whole region and for an understanding of settlement topography (the site setting in respect to natural environment).

By contrast the data obtained by aerial survey has a different character (Gojda ed. 2004). In the first place the location of an identified component is precisely definable within a system of geographical co-ordinates, and these sites and artefact concentrations – mapped as points or polygons - can be used in the analytical processing of spatial data, e.g. in GIS. It is true that components captured during aerial prospection are from the standpoint of the total territory of a relevant settlement area *de facto* a random sample. The factors resulting in making these sites visible (mostly by means of cropmarks) stem from the influence of various conditions. It should be remembered that these conditions change every year - and then there are such factors as terrain slope, ploughing intensity and deforestation, which to a decisive degree influence erosion and, consequently the state and tracebility of sites/features. The total size of the area occupied by components cannot therefore be empirically determined in most cases, even if it is often possible to capture at least the peripheral part of the area. What is important, however, is that cropmarks make available a complete plan of the relevant parts of the area, and that its

qualitative and quantitative composition is known, i.e. the types of features represented, their distribution and mutual spatial relationships or their number. Such an assemblage can be used with success for analysis, the results of which offer a notion of the overall extent of the components and their number.

In the typical environment of a densely settled agricultural (lowland) landscape, the results of aerial survey show that far more often than the terms "locality" or "site" it is necessary to comprehend the prehistoric landscape as a certain continuum of more or less extensive settlement areas, within the space of which there were from time to time changes in functional use (burial, residential, production etc. components). Settlement components show far more diversity in terms of the feature types than was until recently acknowledged. In Bohemia, during the last 13 years of aerial reconnaissance for archaeology many types of areas hitherto unknown have been discovered, in particular extensive areas enclosed by a system of ditches or palisades (Gojda 2004 and 2005). The results of aerial prospection confirm the high density of prehistoric settlement at many locations, documented by earlier finds from excavations and surface artefact collection. The air-born data on prehistoric settlement areas are sufficiently useful in indicating the types (morphology) and numbers of features that occupy such areas.

2. Cropmarks and their relationship to soils and geology

From the viewpoint of the relationship between the occurrence of cropmarks and the subsoil, the aerial survey of the Czech lowland territory in Central Bohemian middle Elbe basin confirmed both theoretical estimates and long-term experience abroad. Approximately 75 % of the sites discovered so far are located on light soils whose subsoil is formed by sands and gravels. Mostly this concerns the pleistocene terraces and the later alluvial level of major river courses. In the case of the broad accumulation basin of the central Labe this concerns a continuous zone along both banks with a variable width of 2 – 10 km. Prehistoric areas are regularly identified also in places where Quartenary alluvial sandy gravels occur as small enclaves and on sites where there is occurrence of airborne sands (dunes). In such sites extensive clusters of residential and other components are often located. Other areas evidenced by means of cropmarks are situated especially on loess and sandy loams. In this regard the experiences gained in our monitored territory are practically identical to the results of systematic investigations in northwest Bohemia.

Light soils accompanying this subsoil tended to be settled by prehistoric populations (for example because they were easily cultivated) and at the same time they are a sensitive indicator of buried man-made features. These two facts create a definite methodological problem, that is whether the resulting picture – a dense accumulation of settlement (above all residential) components on the sites with the above type of subsoil - is a reflection of the deliberate preference of light soils by prehistoric populations, or whether it is simply the qualities of these soils that make buried features visible. In other words: does a similarly dense concentration of components exist also on the sites placed out of these light soils? Due to the evaluation of spatial behaviour of prehistoric populations in a given type of environment (and in a specific region) this is obviously a key question, whose answer lies in the connection of other research methods. The

accompanying data shows that especially in the territory with loess soils we can assume analogous density, despite the fact that aerial archaeology in loess landscapes brings very limited results.

3. Cropmarks and their relationship to plant species

Fourteen years of relatively intensive aerial survey in the flat valley and on the terraces in the lowlands of the Bohemian Basin a broad range of experience was gained about processes by which cropmarks are formed in various species of cultivated crops. The main set of information geathered until recently are summarised below.

None of the identified monuments was visible through cropmarks in every year that prospection was conducted. In some locales cropmarks were observed 2-3 years running, and in others only every third to fifth year. It is possible to generalise and state that observations made during annual flights some 50 select locations brought evidence of the revelation of buried features of archaeological origin three or four times over the ten year cycle. The plants best showing sub-surface features were barley and clover/lucerne with wheat showing them less often and corn only rarely - in cases of deep, wide ditches. In contrast to the generally-held view of the weak potential of oil seed rape, it was shown that it is necessary to conduct systematic surveys even over this plant - at the time of this plant's greatest vigour lines and enclosures (including grave pits in the centre) were well preserved, and these could be observed – although with much less distinction - even after blossom fall. The experience of the project is that the frequency of occurrence and the quality of the features rendered visible are most dependent on the thickness of the plough soil, or its decrease due to erosion. Evidence for this comes from the terrestrial measurement of the thickness of the plough soil at several locations where cropmarks appeared more often than every other year during the ten-year cycle, in various kinds of cereal. Less clear are the reasons for the absence of cropmarks during the greater part of the aerial survey cycle (6-10 years) at some localities where the objective conditions for their occurrence were met (dry climate, suitable crops), but where despite this they appeared over such localities on exceptionally (1-2 years, e.g. Ledčice 1, Jiřice 1, Tišice 4).

The onset of the processes making buried features visible takes place over a 1-2 week interval (usually the 2^{nd}-3^{rd} week in May). The annual monitoring of weather developments has shown that higher precipitation in the last winter and first spring month is a cause of the later appearance of cropmarks in winter cereals. At the same time, in the majority of cases cropmarks did appear (albeit not, of course, in such large numbers as usually) according to the precipitation in the spring months and at the beginning of the summer, this process affecting fields sown in the spring. The most successful year of all in the tCentral Bohemia project from the point of view of aerial survey was the year 2000; thanks to an extreme precipitation deficit in the spring months (particularly April and May), a large number of hitherto unrecorded archaeological and settlement historical situations were revealed most conspicuously. Thanks to this experience the number of discovered components (or the surfaces on which they appear) increased in particular in known areas, and several linear objects could be drawn far better than at any time previously. That year also saw hitherto unprecedented numbers of lost tracks and roads

drawn; in several cases their ramifications could also be captured, along with relationships to the ends of current lines of communication within current villages.

4. The question of the intensity of aerial survey

In connection with the inclination in contemporary archaeology for projects with a theoretical basis clearly set out in advance, including the creation and verification of models (a deductive approach, the collection of data by sampling and probability methods) there has in the recent past been intense discussion as to what extent this approach is legitimate, primarily in the investigation of settlement forms and structures at a regional level (in the intention of spatial/landscape archaeology). In Bohemian archaeology in particular - in connection with the evaluation of surface artefact collection strategies - great attention has been paid to these problems. On the one side of the debate are the proponents of an empirical approach, stemming from the notion that repeated research in and of itself leads to greater veracity (the primary aim of this conception thus being to gather source material and only later to set the problems which can be resolved through the medium of the long-term collection of source material). The other side prefers a deductive approach (as brought to archaeology by the New/Processual archaeology, i.e. based on the formulation of hypotheses and their testing on source material obtained by special approaches/methods selected according to the subject of the research). While there can essentially be no doubt that the arguments of the proponents of a deductive approach are at a general level correct, it is perhaps appropriate to make some comments on them here.

Following the divisions of field research in archaeology it is possible to speak of two approaches. The evaluatory or synthetic one consists in that archaeologist in the field conducts a synthesis of his/her observations; the analytical one in that space is divided into component parts – geodetic network, polygons etc. – in which data is then collected. Both approaches may, for example, be applied during a ploughwalking survey: while traditionally this method of field investigation was used to seek out concentrations of archaeological components or to verify the results obtained by other means, in contemporary landscape projects priority is given to the analytical approach. That aside, aerial survey remains a research method that – if it is to be effective – must be applied to the study area systematically i.e. repeatedly. Aerial prospection is a typical cumulative method of obtaining data. This is because the interactions of the conditions causing the effect of increasing the visibility of buried features do not, in most instances, reach optimal levels. Such a situation occurs only rarely, and at relatively long intervals. The belief of many archaeologists that a single aerial survey may reveal the situation beneath the terrain surfaces in their regions *in toto* is naive. There is therefore no alternative than to aim for a long-term, systematic survey, with the ideal being the decentralisation of such activity (smaller regions regularly monitored by regional archaeologists, who know the landscape and the topography of prehistoric monuments therein well; the only country in which this model works to a greater or lesser extent is the United Kingdom). It is of course necessary, meanwhile, to set aerial survey within the framework of a clearly-defined regional project aimed at an understanding of the history and/or structure of settlement, or at the recording and protection of archaeological monuments.

One of the fundamental reasons supporting the conducting of aerial survey in the long term is its potential in the field of the identification of new, in the study region previously unrecorded, components of the prehistoric cultural landscape. These are in particular enclosures varying in size and plan, which are difficult to identify by means other than remote sensing. The discovery of every feature of this kind - especially ditches enclosing large areas and special features of the henge or rondel type - brings to the modelling of settlement structures in specific regions qualitatively new facts. It is clear that any conclusions regarding settlement structure in the study area will be influenced to a fundamental degree by the absence or presence of this kind of monument in the source material with which it works.

Survey undertaken with a project framework is tasked with revealing the distribution of settlement components in selected areas of the “old settled land” and through repeated overflights gaining the most complete impression possible of the size of settlement areas (or of their residential cores and funeral areas), and with ascertaining whether and to what extent ditched enclosures appeared in the settled parts of the fertile lowlands, and whether there were strategically-situated sites fortified by ditches unknown prior to the project. It is necessary to bear in mind that a certain basis for the formulation of these problem areas consists of the results of earliest aerial surveys. It has been shown that 10-15 years of repeated aerial survey is a period long enough to provide a more or less qualified answer to the questions set down. Further aerial surveys in the same area undeniably bring new discoveries that, however, - in the author’s view - do not alter in any fundamental respect the present evaluations of prehistoric and Early Medieval settlement dynamics in the investigated landscape types. Should this happen, nevertheless, it will further strengthen the importance of aerial archaeology in coming to an understanding of past settlement systems. In this connection it is necessary to present one of the experiences gained over the course of the ten years of prospection - that despite the experience of the observer it is evident that every year a certain number of monuments made visible by cropmarks escape detection. In addition to the mere overlooking of monuments lying at greater distances from the aircraft at moments of concentration on other activities (map reading, note writing, film changing etc.) evidence for this comes from the occasional supplementary identification of features during study of the photographs documenting the discovery of conspicuous linear features. A typical example (far from being the only one) is a site, where during careful analysis of an enlargement of a photograph of the Neolithic rondel several ground plans of Neolithic longhouses were recognised along with several smaller enclosures. These features were clearly not recognised during the actual flight because the attention of the flight crew was entirely occupied by the unusual, large, and highly visible enclosure, and missed the less conspicuous features, because of the implicit expectation that if they were hidden below the surface they would be equally visible. Moreover, the fact that these plans of residential structures were not recognised at the locality over which the flight team was conducting the survey shows that the number of similar features, represented only by poorly visible groundplans, which fail to be recorded, may annually be higher than one would guess.

It must not be forgotten that in countries like the Czech Republic aerial prospection has a very short history. Experience from abroad is instructive, showing how research conducted systematically and over a long period has brought such a volume of data on

the quality of settlement forms, and on the density, variability and dynamics of prehistoric settlement areas, that it has markedly altered that overall approach to the archaeological resource and the understanding of its spatial properties. This is why aerial archaeology must continue to be practi in this country, too, in future, to the most intensive degree possible. Its non-destructive character is another argument in favour of the fulfilment of this hope.

Bibliography

Gojda, M. (ed.) 2004: Ancient Landscape, Settlement Dynamics and Non-Destructive Archaeology. Prague: Academia.

Gojda, M. 2004: Prehistoric Bohemia: Landscapes and Settlement in the Heart of Europe, *Landscapes* Vol. 5/1, 35-54.

Gojda, M. 2005: Features, Sites and Settlement Areas in the View of Air survey (Bohemia, 1992 – 2003). In: Air Photography and Archaeology 2003. A Century of Information (J. Burgeois – M. Meganck eds), 101-111. Gent.

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