REMOTE SENSING AND ARCHAEOLOGICAL RESEARCH IN THESSALY (GREECE)
NEW PROSPECTS IN "ARCHAEOLOGICAL" LANDSCAPE

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ABSTRACT

The use of satellite data in the 1984 campaign of archaeological research in Thessaly (Greece) is in keeping with the general pattern of a methodological study meant to determine the interpretation processes concerning the spatial imagery applied to the archaeological research conducted by the authors within the Centre de recherches archéologiques.

From that study were checked and tested on the site a certain quantity of methodological principles defined by interpreting and analysing satellite images, as part of field archaeological problematics:

- determining the physical factors in order to understand the ancient spatial organisation in the lower Enipeus valley, connected with the distribution and density of identified sites with signs of human occupation.
- formulating an archaeological prospection strategy out of spectral, textural and structural indicators deduced from the satellite data in the eastern plain of Larisa (ancient lake Karla).

Keywords: Archaeology, Prospection, Remote sensing. Satellite.

Let it be stressed that the undertaken work consists in no actual "spatial analysis" of ancient human settlements, but in determining the elements that explain their creation.

2. HYDROLOGY, PAEDOLOGY AND SPATIAL DELIMITATION

Water is actually one of the basic ecological factors in the bio-environmental interdependence cycle: as it is involved on different occasions and at different levels of that cycle, it naturally takes a major part in the analysis of ancient societies, behaviour. It is nevertheless imperative to associate with that major factor the one of soil nature for paedological as well as hydrodynamical qualities, as the latter allow to determine the preexistent local physical realities concerning the development and integration of domestic and/or trade economy. Those types of analysis on the regional level are essential to know the characteristics and resulting socio-economical potentialities that might influence the distribution of ancient human settlements.

In those notions is implied the one of space: the choice of the space to be studied, carried out within a C.N.R.S. team working on archaeological research (R.C.P. 561), had been fixed on the low Enipeus valley and the eastern Larisa plain; both these zones correspond to a limited hence arbitrary space compared to the general physiographical realities, but they nevertheless represent, in consideration of the various facies included, two units considered of sufficiently representative regional characteristics.
3. METHODS AND DATA

3.1. Methodological proceeding

On figures 1 and 2 are illustrated the proceedings used to process, interpret and analyse the satellite image (fig. 3). The study leads to determine an eco-zoning of the main physiographical facies (Cf. Réf. 7, 8, 12). Inside that physiographical zoning are deduced, after setting up of a structural and/or functional relation between the various elements constituting the satellite image, objects or phenomena not directly perceptible in that image.

From that first stage was made up, through sampling, the "ground-truth" at time of the campaign of field observation. That second stage allows to refine the key to determining physiographical factors.

With the help of those methods have been determined the following factors:
- hydrographical: rivers, streams, canals, water stretches, surface humidity.
- orographical: mountain masses, hills, outliers.
- topographical: roads and railways, towns, villages.
- edaphical: forest surface, irrigated and dry cultures, pasturages, bare soils.
- geomorphological: lineaments and tectonic circular structures, river or lake terraces.

Afterwards were discussed the mutual relations of those physiographical factors in order to acquire a general knowledge of the zone under study and especially the proceedings of their creation.

Lastly there was entered into that data system some information of anthropic and especially archaeological character. This operation is the sore point of the study because of the parcellary and/or incomplete archaeological data acquired through prospection. We nevertheless, in the definite case of Thessaly, and especially of the low Enipeus valley, consider that information as the result of a statistically sufficient sampling to allow to discuss about the possible correlations between the physiographical factors and the distribution of archaeological sites.

3.2. Data

The imagery used was that of satellite Landsat 2 of 21st May 1981 (Path 198 and Row 32); images were analogically processed in the coloured composite of belts 4, 5 and 7 on the 1/1,000,000th scale and enlarged on the 1/250,000th scale. The technique employed in such processing is that conceived by E. Barisano and E. Bartholomé (Cf. Réf. 1) within the Laboratoire de télédétection of the Université Catholique de Louvain (Belgium) on behalf of the Centre de recherches archéologiques (Vaibonne).

The basic mapping was that of the second American edition MDR 610/8821 (1943) on the 1/100,000th scale with hectometric grid of the sheets of "Larisa", "Farsala", "Trikkala", "Khardhistsa".

Fig. 1: Process methodology

Fig. 2: Interpretation methodology

Fig. 3: Landsat image of Northern Thessalian plain (coloured original)
We had also the opportunity of observing (for one morning) on the stereoscope the covers of air photographs dated 1974-1976 (N.B.) on the 1/30 000th medium scale. Those air photographs are of limited access and quite restricted distribution. Short stereoscopic observation of those air photos allowed, as regards the low Enipeus valley, to show the possibility to interpret some "structures" as human occupation sites (sorts of archaeological "tells" called magoula in that region) when of a certain size; as for determining physiographical limits they are perceptible only on the "field" level, because of the photographic scale, and cannot give consistent comprehensive information for the valley (except if a very large-size photomosaic is drawn...). For the eastern Larisa plain the conclusions are identical as concerns both the physiographical limits and the circular and linear "structures". Despite such negative preliminary conclusions, it would however be necessary to analyse some areas more thoroughly, in order to locate in particular possible ancient agricultural cadastres.

4. RESULTS AND DISCUSSION

4.1. Low Enipeus valley

The present morphology of the low Enipeus valley typically results from flooding processes; it appears very flat, with monotonous topography and a land use with little space and landscape variation (fig. 4). There were nevertheless observed, in the satellite imagery as well as in the field, sufficiently sensible differences due to different physiographical factors and marked by uneven surfaces (micro-reliefs) and/or changing landscapes (presence of isolated trees and hedges). Moreover, different topographical levels can be measured according to some zones, the zone nearest the river Enipeus being on an average 3 m lower than the one west of the river Farsalitis. Those different morphological characteristics lead us to define more physiographical factors such as pedology, surface hydrology and climatic factors (micro-climates, prevailing winds). We cannot anyhow tackle those characteristics without stressing the influence of the tectonic activity in that region (Cf. Ref. 6, 10). The tectonic activity there is sensible, and it can be considered, not to mention terraces directly, as the reason for the creation of "level stretches" of different heights which affect the phaenological stages of vegetation by their different surface humidity and pedology (Cf. Ref. 9).

It is probable, on the one hand, that the tectonic activity in that sort of lithological material is the reason for variation in the height of the aquifer and hence in the surface humidity and is consequently involved in the determination of the zones liable to flooding; on the other hand, the climatic factors in connection with different humus deposits have affected the pedogenesis of the soils in the plain, which was originally issued from a quite similar parent material.

Before beginning to discuss about the correlations with archaeological data, we have to raise a fundamental question:

Have major changes happened for the last 10 000 years in the phaenology of the low Enipeus valley, as compared with the present situation?

A complete answer to that question can be obtained only through precise analyses, by geological corings, of the lithological, pedological and palynological nature of the whole plain and especially on "sensible" transects. As such an opportunity is not appearing, it is necessary to rely on past studies and our own field observations; despite the tectonic activity, there was no major transformation in the physiographical components of the natural landscape in the low Enipeus valley (Cf. Ref. 9).

On the basis of that conclusion, provisional though it is, we shall extend the discussion to the correlations with archaeological data (Cf. Ref. 13, 14, 15). The latter have been updated out of the various prospection campaigns organised by J.-C. Decourt within the RCP 561 directed by B. Helly. The results of such prospections have been mapped for four archaeological epochs: Neolithic, Mycenaean, Hellenistic and Byzantine.

The correlation between, on the one hand, the distribution map for the archaeological sites and the analysis of the human occupation in the low Enipeus valley from the "new" city of Paliambela-Phyllos (Cf. Ref. 3, 11) and, on the other hand, the thematic map for physico-graphical factors directly shows the connection between the distribution of some site "concentrations" and the corresponding physiographical zones (See maps, fig. 6, 7). Precise limits, of physiographical nature, are here determined in order to differentiate site distribution areas. We find that the greatest densities are located on the best physiographical zones as regards soil qualities and water presence.

In the case of the zone adjacent to the river Enipeus, the "water" factor appears not only in flood spell but also in dry spell: the fact is that, apart from the water of the river itself and its small affluent, the location and capacity of the aquifer allow economic continuity in agriculture. Such hydrological conditions are necessary to account for occupation perenniality. From the study has been established, out of those physiographical and archaeological observations, the idea - which was not foregone - that those zones actually formed a "region" in the geographical meaning, and thus for a long time. Accounting for the observations carried out, it can indeed be considered that the conditions for human cultivation of that low Enipeus valley, up to the 93m height curve (It seems that below that the occupation conditions are different), have been steady since the average Neolithic (ca. 5 000 B.C.) up to nowadays, for reasons which cannot be specified through analysis, out of remote-sensed information.

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Fig. 4 : Photograph of Enipeus valley landscape
Those comments as a whole allow to clarify the ancient spatial organisation, above all that in the Neolithic and Mycenaean from the knowledge of the physiological factors and their creation. For more recent epochs those physiological factors should be associated with cultural and sociological factors; there can be observed, despite a marked regrouping of human occupation on "major" sites - the poleis of Hellenistic periods - a perdurance of the distribution zones equivalent to that of older periods. But from that epoch those zones have been forming the main part of the "territories", politically meaning, farmed by cities.

Historical analysis applied to the field allows to trace the changeover from a "geographical" situation (the cultivation of a region) to a "political" situation (the distribution of territories between the Greek cities, according to a precise and complete grid, in the considered area). There should also be revealed a phase when such distribution was broken up, in the Byzantine epoch and low Middle Ages (time of the big estates called tchiflik).

To conclude, it would now be necessary to make finer physiological (paedological, palynological) studies in order to better specify the expansion of the different eco-zones. For that purpose a working programation can be contemplated out of the results obtained through satellite data analysis as a first stage. Through that study "limits" have been supplied on the regional level and goals established for those fine analyses. It is no longer necessary to contemplate a large-scale global research aimed at goals supported by regional study.

4.2. Research on eastern plain and Larisa "territory"

In that region we have determined the eco-zones, delimited the different perceptible levels of the ancient lake Karla, which is at present artificially drained and whose surface is used for agricultural purposes, and revealed a series of great-amplitude linear and circular structures. Those various elements have enabled us to confirm the water circulation in that part of the Thessalian plain already described by other authors (cf. ref. 6, 9, 10).

For that zone we have considered two working directions: on the one hand, drawing up a field prospection strategy, making prior the pinpoint observation from the indications of both the results of remote sensing and the archaeological information and, on the other hand, supporting an hypothesis on ancient human establishment in that part of the plain, in accordance with the physiological factors identified by remote sensing.

The fact is that we know nothing accurate, from neither the inscriptions nor the texts, on the Larisa territory. An indirect mention by Polybius about some Etrolian raids suggests that the Larisean possessed the plain called Amyros. But we do not know where that plain lies exactly - no doubt between Pheres and Larisa. Strabo, for his part, refers to some installation works (drainages?) done by the Larisean on lake Nessos, however the existence of a registered choroi as early as the end of 3rd c. B.C. is certified by some inscriptions. In another connection it seems from recording the epigraphical and archaeological findings in the villages of the Thessalian plain around Larisa that there existed scattered establishments meant to cultivate the agricultural landscape (cf. ref. 13, 15, 16). Lastly the presence of lake Karla, which extended in the plain to the Pelion and Ossa piedmonts, where ancient quarries lie, complicates the analysis: did the lake represent a limit to the territory of Larisa, its borders or an integral part of the city's estate?

In order to find answering elements to those questions - which are one of the objects of the research programme undertaken several years ago on Thessaly's ancient cities (RCP 561 then C.R.A.'s URA 15) - we carried out a first campaign in summer 1984 in the region located east and southeast of Larisa.

For such work we had of course to take into consideration not only the information connected to the historic epochs (from the classical period to the end of the Roman imperial period), but also the attainments of prehistorical and geological research, long developed on that region. In that respect we have thus united our works to those of the French team conducted by J. P. Demoule (C.R.A.'s URA 32), who has undertaken a research programme, accepted by the Ephoria of Antiquities in Larisa, on Thessalian Neolithic ceramics.

Moreover the 1984 campaign gave an opportunity of experimenting, for the considered region, the use of remote-sensed data (Landsat satellite images), justified by the scale on which we had to work for a first approach. The recourse to aerial photographs, limited to consultation on the spot, could not be involved in the work preparation.

The results were as follow. The archaeological data as well as those supplied by satellite imagery have led to work on a rectilinear axis approximately oriented west-east, from Larisa to Kastrion (ancient and modern quarries) through the villages of Platytambo, Glavki and a little south of Niamata. On that axis were discovered, between Glavki and Kastrion, hence on the shore of lake Karla and in the very so-called flooded zone, a few traces of human occupation concentrating on four points: two up to now unknown sites, revealed in the field by deep ploughings and not to be confused with the more important establishment called Magoula Arapi. The ceramics collected on the spot are classical, Hellenistic, Roman and Byzantine. More to the east, 2 km of the village of Kastri, and also in the supposed lake zone, a less important establishment was revealed by Roman and Byzantine ceramics. In the same direction and on the same axis, 1 km of the village of Kastri, a stone layer visible on the verge of a drain is accompanied by big roughened ancient blocks scattered on about 300 m (fig. 9). That layer of average-module (about 30 cm) coarse stones is covered with earth mixed with pebbles: no doubt a broken piece of roadway.
advisable to refine the distribution for historic epochs, going back in time as much as possible, including the Byzantine and post-Byzantine periods.

Geomorphologists and palaeontologists will also contribute to the study. The first discussions started during the campaign with Mme Dimitraki, from Stanford University, allowed profitable exchanges of information. In the same way the contribution of remote sensing will allow, as shown by the 1986 campaign, to prepare and refine the prospection strategy, on the one hand, and to specify and enrich the interpretations, on the other hand.

Figures 6 and 7 are the thematic mapping of photomorphoscopic areas and main hydrogeological features deduced from Landsat image interpretation on which have been based the archaeological analysis and the ground survey strategy (see next page).

Out of the remote-sensed data alone a second axis, which overlaps the first one at the village of Glavki, has been studied. Being parallel to the road Larisa-Volos described by 19th c. travellers and now replaced for interregional traffic by the Ethniki-Odos - that axis lies more to the northwest, and it is therefore close to the supposed limit of lake Karla. It is marked out by the villages of the plain. Out of short observations was located on that axis the site of Petra, already known, but also discovered a new ancient site, 1 km northwest of the village of Lophiskos. On more than one hectare, perhaps of circular structure (in correlation with those of the satellite image) we found on the surface ceramics of all epochs, blades of “chocolate flint” and obsidian chips.

Such results lead to two important conclusions. First of all it seems clear that the road Larisa-Volos, such as we know it, cannot be considered as the ancient road. It actually side-steps all the villages, all the points where archaeological remains and inscribed monuments were discovered. The ancient road, for reasons revealed by E. Barisano’s study, and according to the most credible anthropological behaviour, should be located on the alignment materialised by the villages and sites. An experimental proof of it is given by the discovery of several ancient sites so far not identified, on both axes Larisa-Glavki-Kastrion and Larisa-Glavki-Stefanovilikon. The consequence is that the road Larisa-Volos cannot be held, as was the trend, to be a constant limit corresponding, for a long time, to the shoreline of lake Karla: northeast of that road the flooded or submerged zones, southeast the cultivated and inhabited zones.

Secondly, it appears that the density of human occupation in that zone may be greater than supposed. In order to make sure of it, we have to programme systematic prospection campaigns, such as conducted by C. Gallis for the southwestern part of the plain. For all that the chronology will have to be considered imperatively. It seems possible to find Neolithic occupation sites in the presumed zone of the lake beyond the limit fixed since K. Grundmann at isohypse 64 m (Cf. Ref. 10, 16). But the chronology will have to be refined for confirmation. For that purpose collaboration with prehistorians is necessary. It will also be

The results obtained, as concerns handling of satellite images and aerial photos as well as archaeology, are still incomplete but full of promise.

The fact is that the remote-sensed images have been only analogically handled and have supplied results fit for direct use in the field. Their numerical handling should make more accurate the determination of limits, the definition of physiographical sub-zones, etc.; the same for aerial photos. From the archaeological point of view, it is now mainly a question of time and means: that campaign did allow to check a certain number of hypotheses, contributed by remote sensing, but above all to raise new archaeological questions on the history of ancient human occupation in that region.

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