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An international journal devoted to
environmental change, and its effects
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1st Symposium on
Living with Landscapes

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INTRODUCTION

Environmental change

The environment of the Earth is for ever changing. Changes occur at a whole array of time scales and, for example, over geological time, the Earth has witnessed both greenhouse and icehouse conditions. Even over the last few millions of years, we have experienced repeated lurches from glacial to interglacial conditions, while over the last ten thousand or so years of the Holocene we have had neoglaciations (such as the Little Ice Age), pluvials in the Sahara, and several phases when conditions have been warmer than today (as in early Medieval times). At a shorter time scale there have been fluctuations at the decadal scale, including ENSO, the Pacific Decadal Oscillation, and the North Atlantic Oscillation. In addition to appreciating that there have been changes at a whole range of scales, it is important to recognize that some changes have been abrupt and also that the degree of change has sometimes been very substantial. For example, around 9000 years ago, much of the currently hyperarid Sahara was a savanna landscape with large lakes and some major rivers. Conversely, at the maximum of the last glacial, around 20, 000 years ago, many parts of the currently humid tropics were probably much drier. The climatic changes also have had an impact on world sea levels, and during glacial and interglacials the world's continental shelves were alternately exposed and flooded.

All these natural changes have had a major impact on the fortunes of human societies and have played a role in such matters as migrations, the collapse of civilizations, and the origins of agriculture.

Now, however, humans are having an increasingly important role in promoting environmental change. On the one hand, changes in land cover are modifying rates of erosion and runoff , while on the other the emission of a cocktail of greenhouse gases into the atmosphere is starting to cause global climate change. In coming decades it is likely that, for example, many glaciers will melt, permafrost will decay, sea levels will rise, rainfall regimes may become more extreme, and desert dunes may become more active. Hazards such as droughts and floods may change in intensity.

Environmental changes, both natural and anthropogenic, and in the past and in the future, are now a major concern for many academic disciplines, and so the appearance of this new journal is extremely timely and significant.

Andrew Goudie, University of Oxford, UK.

ARCHAEOLOGY OF A ROMAN LANDSCAPE IN CENTRAL PORTUGAL

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Since 2001 an interdisciplinary team of archaeologists and geographers from the universities of Gent (Belgium), Evora (Portugal) and Cassino (Italy) has organized several campaigns of geo-archaeological fieldwork in and around the Roman town site of Ammaia in Northern Alentejo (Portugal, figure 1). These investigations aimed at achieving a better understanding of the town/countryside nexus in Antiquity as well as of Man's effects on the landscape during the ancient Roman times. Particular geo-archaeological questions that were dealt with include; the topographic setting and site location choices by the Romans, water provisioning and exploitation of important natural resources such as building stone (granite, marble), metal ore and rock crystal. [1-2]

The ruins of the Roman town of Ammaia are located in the municipality of Marvão, in the heart of the Natural Park of the Serra de São Mamede, which is a mountainous area of East central Portugal extending into Spanish territory. Apart from the preserved woodland, this area of the region Alentejo is still very rural. The population is low in number. Several smaller towns are present there, but no big cities. Farms with large estates are also dispersed throughout the landscape. A great part of the sparse population still makes a living of agriculture dominated by cork and olive plantations and pastureland. These activities are hindered by many outcrops of granite, indicating that the resulting soils are very shallow, evidently making them very poor, and mostly suitable for stock grazing (mainly cows) and cork and olive production. The now-abandoned Roman town site lays in a mostly hilly landscape, near the river Sever, geologically dominated by quartzites and schists surrounded by an undulating, sometimes nearly flat, landscape of granites. The abundance of natural water springing in the area clearly attracted Roman settlements,

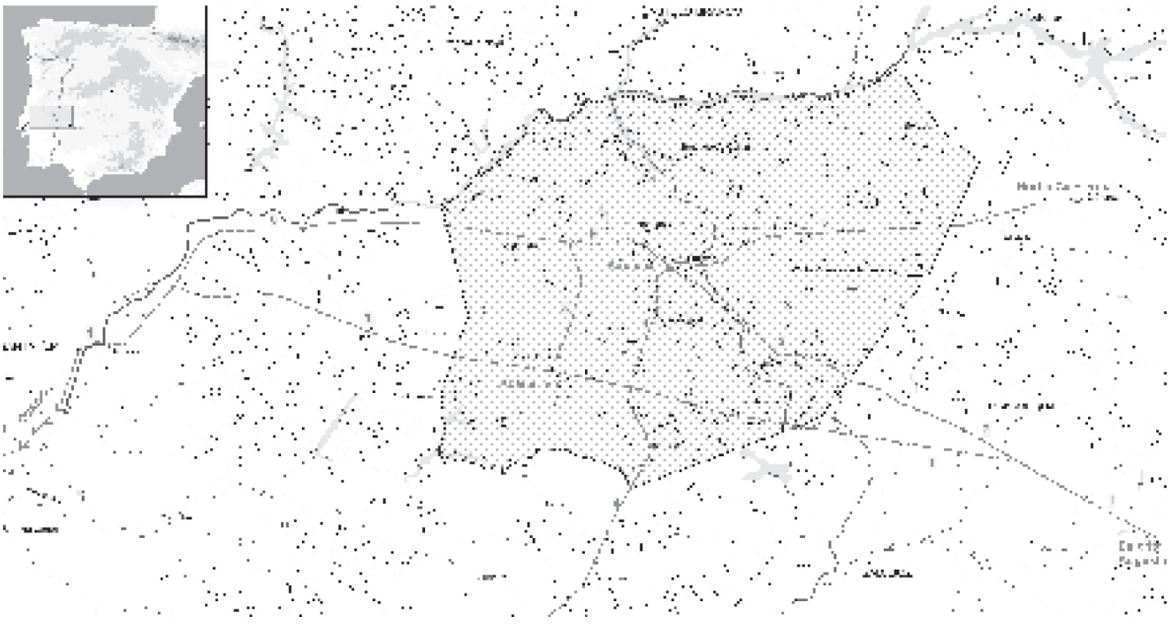

Fig. 1 The Tejo Valley. The grey area includes the hypothetical extension of the territory of the ancient town of Ammaia inserted in the schematic Roman road network

and assured and prolonged the life of the Roman town from the 1st to the 9th centuries AD.

Several typical geo-archaeological themes have been approached in the field project so far. Some of these are shortly described below [3].

Mapping the city wall

Detailed observations of a topographic, geomorphologic and archaeological nature in the part of the landscape around which most archaeological findings have been located so far, made us propose a new working hypothesis for an intensive study of the urbanisation of Ammaia. This geoarchaeological fieldwork comprised:

- a full assessment of present-day terracing and field limits,
- an evaluation of the dispersion of archaeological debris (building materials, pottery,etc...) in the fields
- a careful mapping of the still visible positive or negative remains of the circuit wall itself, some of which was discovered during the excavation work.

According to these field observations, and the careful examination of existing aerial photographs of the area, the superficies of the walled Roman town structure of Ammaia would approach some 22 ha (figure 2). The ancient urban area appears to be quite regular, almost rectangular walled zone near the Sever river, only somewhat elongated in a South-Westerly direction with a small hilltop extension. This relatively small urban area was certainly well chosen. Apart from its general situation in a suitable agricultural area with good provision of water and other natural resources, the Roman topographers chose to develop their city in between two narrow paleo-valleys, connected with the existing stream. Apart from the elongated Western segment of the city the area knew no steep slopes and was well connected by land routes.

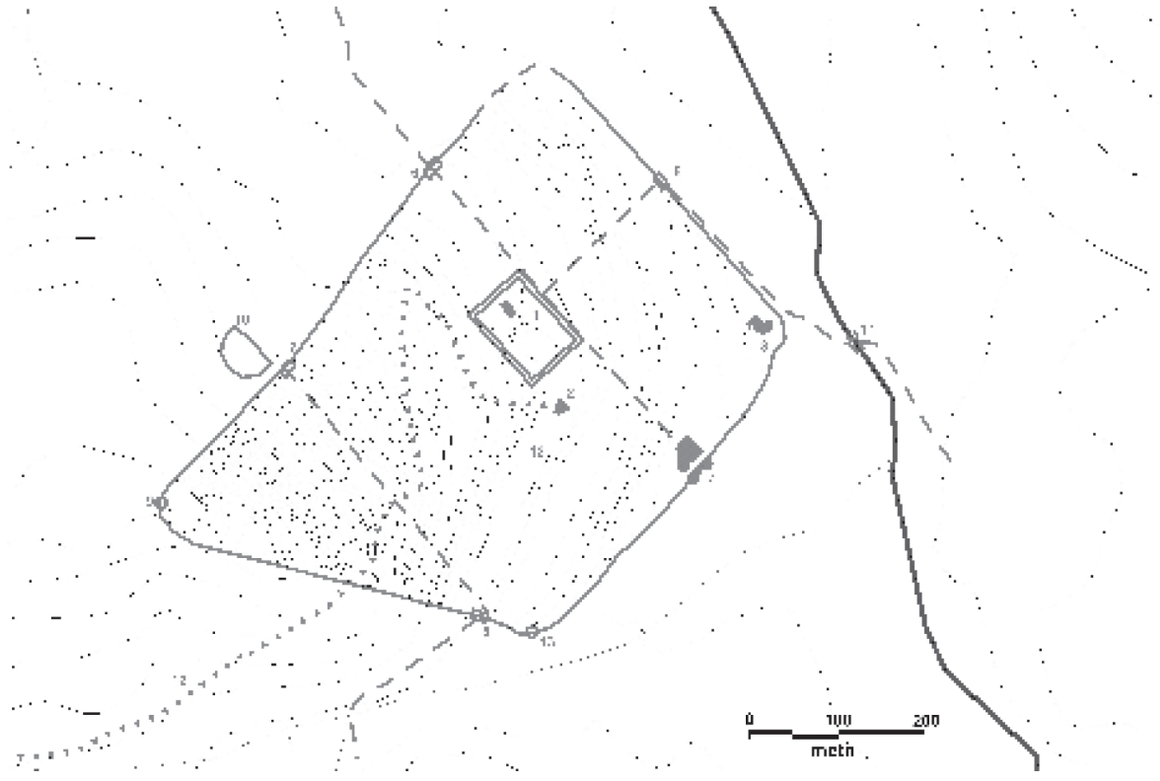

Fig. 2 Archaeological map of Ammaia, based on the geoarchaeological research (2001-2009). Legend: 1: forum; 2: thermal baths; 3: residential area around the Quinta do Deao (Museum); 4: Porta Sul (Southern gate); 5-8: hypothetic gates; 9: tower?; 10: theatre?; 11: bridge; 12: hypothetical itinerary of the Western aqueduct; 13: tower?

The intra-urban pattern and its degradation

The results from recent excavations and surveys, procure us also a clearer image of the main characteristics of the urbanisation of Ammaia. Although the ancient site is for the most part unexcavated, we can understand the main layout of this city during the Early Empire (1st-3rd centuries AD) [4]. It can be assumed that the town was built from scratch under guidance of Roman architects, and that its main structure respected the principles of new town organisation at the time. Its circa 1800 m long walled enclosure was certainly interrupted by several gates, possibly only five, and reinforced by an unknown number of towers, of which we have located only two with some certainty: the excavated Southern gate and a gate almost centrally placed on the North-Western city side. Both of them seem connected with the main street axes of the town: the cardo maximus and the decumanus maximus, which lead to the heart of the city, the forum. Study of the aerial photographs, and the system of terraces observable today, suggests that the classical city had quite a regular layout in most parts of its urban area, probably with the exception of the steep Western extension. This "regular layout" and the grid orientation was partly confirmed by our 2008 campaign of geophysical prospections (mostly geo-radar survey), that procured many details about the setting of the monumental forum area and the adjoining streets and thermal complex.

Post-Roman degradation of the old terrace system, on which most of the city quarters were probably build, coupled with the gradual abandonment of the inhabited area, explains many of the erosion processes that occurred in the central and Western parts of Ammaia. Our fieldwork in the sector of the footslope, immediately West of the newly proposed city area, showed the existence of many breaches in the actual terrace walling. Heavy degradation of culture terraces in the upper parts of the walled town, and immediately West of this sector, could therefore be responsible for most of the post-Roman colluvium cover of the forum area and of other areas of the town situated to the East of it.

Tracing the aqueducts

The monumentality of the town structures, with public buildings (e.g. bath houses) and paved streets, possibly adorned with some public fountains, was needed for the start of a well functioning system of aqueducts bringing running water at a constant flow to certain parts of the town. As the Romans usually followed the "no nonsense – lEast effort" principle for bringing this water to town, geoarchaeological fieldwork and GIS modelling can be very helpful in reconstructing the routes of distribution. Thus, the field campaigns allowed the tracing of the main places for easy and logical water caption in Roman times, and the mapping of connected ancient aqueducts.

The best evidence comes from the so-called Western aqueduct. To reach the upper parts of the city the Romans had to collect and derive water from the hilly area West and SouthWest of Ammaia. This is an area of numerous and abundant springs containing several small water courses connected with the valley floor of the river Sever. During fieldwork in the summer of 2004 we were able to locate the most important Roman point of capture on the Southern flank of Malhadais hill. This emplacement, recognised in a narrow passage of the steep and rocky valley, deviating a small stream of water from the mainstream of the river, is still in use today for local water supply. Several intense cuttings in the granitic bedrock suggest the presence of a now lost small river dam. Along the left bank of this rivulet, a narrow gully was clearly cut into the steep rocky valley flanks. Further downstream, the gully passes into a classical Roman type specus, discovered by us in situ. A series of connected U-shaped monolithic blocks, with a length averaging around 1.5 m, and an internal gully, were set in a neat rectilinear construction just above the winter bed of the rivulet. This construction, now completely hidden by intense vegetation, could be partly cleared and mapped over a distance of several meters. Further fieldwork made clear that this aqueduct follows neatly the left bank of this tributary of the river Sever until it reaches the higher parts

of Ammaia. Once inside the walled city area, probably after passing a not-yet discovered castellum aquae, the aqueduct can be linked to a granite specus of exactly the same type, which was hazardously found in situ, West of the forum area some years ago (figure 3). Information on aerial photographs and results from the recent georadar survey allow us now to connect it to the area of the forum and its monumental bath-house.

Fig. 3 Two granite blocks from the conduct of the Western aqueduct accidentally found in the urban area of Ammaia.

Stones for the city

Another important aspect of man's past relation with the landscape around Ammaia is the provisioning of raw materials for the Roman city. As part of an on-going project to do a thorough site catchment analysis of the ancient town, the team is at the moment mapping all essential locations with natural resources crucial for the economy and development of the centre. As the provisioning of stone building materials is essential for the creation and elaboration of Roman towns, these mapping efforts first concentrated on finding the quarry areas of the main building stone for the circuit wall and the public buildings: granite. Our team located the main quarry that provisioned the town with fine grey granites at some 8 kilometers East of the city site, near the present border with Spain. This quarry of Pitaranha shows all evident traces of large scale, probably state organised, quarrying of granite. The open air quarrying activities left many traces of wedge use for rock splitting, while several platforms and internal roads within the quarry display the Roman sense of organisation. Many half-finished or not further used stones for the production of big rectangular blocks and column drums well testify to the long-term use of the site, and several peripheral structures, such as a basin to strengthen the iron tools, show us details of the ancient activity. Large heaps of quartz debris, found near this site, demonstrate that apart from granite quarrying the place was probably also used as a source for the exploitation of crystal rock, a fine material for which, according to Pliny the elder, the city of Ammaia was famous [5].

Conclusion

The on-going research in and around Ammaia demonstrates that the integrated application of an array of techniques of investigation and a sound interdisciplinary approach are essential to understand how Mankind transformed its surrounding landscape. With the eyes and mindset of archaeologists and geomorphologists combined, we can better recognize the significance of the locational choice for a new town foundation, taking into account all possible natural resources and geographical connections. The flourishing of Ammaia in early Imperial times was surely due to the acknowledged skill of the Romans in "Living with their Landscapes", forging their environment more than adapting to it, and accessing all the resources available with the techniques of the time.

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