

# “Building and reconstructing contexts”. An interdisciplinary approach to the enhancement of Phoenician-Punic archaeological elements exhibited in the Museum of Cádiz (SW, Spain).

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**Abstract** – We present here the knowledge transfer project that we are currently developing as a result of the collaboration between the University of Cádiz and the Provincial Archaeological Museum. The main objective is the virtual reconstruction of certain archaeological contexts of a Phoenician nature documented in the city of Cádiz, with the aim of making them directly accessible to the general public. Employing an interdisciplinary approach, we begin by taking reliable reconstructive hypotheses from a historical-archaeological point of view and transforming them into scientifically cross-checked 3D environments. Within them are incorporated three-dimensional models of the most representative Phoenician-Punic archaeological pieces that are on display in the Museum's Colonisations' Room. Finally, all the information generated by the virtual reconstruction process will be included in the Museum's museography and didactic discourse.

## I. INTRODUCTION

The present-day city of Cádiz is located in the south of the Iberian Peninsula, at the tip of a small peninsula connected to the mainland by a narrow spit of land (Fig. 1). According to classical sources, the city was founded by Phoenicians from Tyre at an early date, which has not been corroborated by archaeology until recently. The most abundant archaeological remains, however, are of a funerary nature and correspond to the various necropolises of the city that have been known since the end of the 19<sup>th</sup> century, thanks to the chance discovery of the first of the anthropoid sarcophagi of the Sidonian type found in the city [1]. This and other pieces, many of uncertain origin, form part of the permanent collection



Fig. 1: The location of Cádiz and the geo-referenced position of the ritual wells.

exhibited in the Colonisations' Room of the [Museum of Cádiz](https://www.museo-cadiz.es/), which houses one of the best collections of objects of Phoenician-Punic origin in the Mediterranean. Other finds have been gradually added to these pieces as a result of the intense archaeological work carried out since

the 1980s in the city, under the protection of the new regulations on heritage matters. However, the particular conditions [2] in which many of the archaeological works were carried out during those years have meant that a large part of the original contexts and the exact origins of the materials are unknown.

Among the recent advances made in research over the last twenty years, particular attention should be made towards the study and analysis of some very abundant structures located in the funerary space, known in the scientific literature as "ritual wells" (Fig. 1) [3].

Despite the relevance that these practices had in the city's past and the extensive scientific bibliography generated around their study, the phenomenon is practically unknown to the vast majority of the population today.

With the aim of making them known to society and taking advantage of the 2022 call for Proof-of-concept projects financed with European "Next Generation" recovery funds, we proposed the project that we are now presenting.

The objectives of the scientific projects developed around the study of ritual wells were focused on the formation of the deposits and the ritual actions that created them, which ultimately explain their origin and development, thereby providing a historical contextualisation of the phenomenon [4]. However, the fundamental problem we face at this point is that, given the specificity of the subject, the discoveries of said study only reach a very limited academic and scientific circle.

To rectify this problem, one of the solutions considered was to use Virtual Archaeology to create virtual reconstructions to disseminate the structures and associated rituals. The main objective of Virtual Archaeology is the 3D representation of the historical-archaeological remains determined by means of a specific methodology and workflow.

The workflow of this discipline begins by carrying out extensive research into the historical-archaeological data necessary to establish the reconstructive hypotheses that are essential for the reconstruction or virtual recreation. In addition to bibliographical research and the search for parallels with which to make comparative hypotheses, if the work requires it, we can obtain information directly from the object or space in question thanks to the use of new technologies.

To reinforce the discourse, it was decided to include many of the pieces exhibited in the Museum of Cádiz in the infographics. Finally, in order to give them context, it was decided to recreate the settings and environments in which the pieces themselves were used during their lifespan, before being discarded as part of the rituals practised in the wells.

## II. ARCHAEOLOGICAL CONTEXT OF THE FINDS

Ritual wells are scattered throughout the Phoenician-Punic funerary space of the city of Cádiz, the former Gadir. The wells found in the necropolis of Cádiz are associated with the rituals that took place in the vicinity. These wells are found in the archaeological record clogged with the remains of libation and commensality rituals. Thanks to this, we have been able to discern the different steps that would have taken place in the ritual, as well as the particularities and characteristics of the ritual, such as the sacrifice of canids and their subsequent placement inside the structures [5].

In the last count carried out, more than 80 structures were counted; however, 80% of them have been excavated with obsolete methodologies and were not correctly documented, meaning we only have reliable documentary data on the process of construction, use and closure of the remaining 20% [6].

However, due to the physicochemical qualities of the geological substrates of the city of Cádiz, as well as the particularities of urban and emergency archaeology, the wells documented, following this classification criterion, do not present reliable information on the stratigraphic relationship of these structures and their spatial context in the necropolis itself.

These handicaps have not been a problem when planning this project for the transfer and dissemination of the knowledge generated by our research, but rather a challenge to be overcome through the application of Virtual Archaeology.

By virtue of the existence of protocols and tools associated with this discipline, such as the Extended Matrix [7], it is possible to generate virtual reconstruction contexts from which we can obtain data in relation to the original contexts of the pieces, as well as a graphic expression of the rituals associated with the structures.

With this information, optimised qualitatively and quantitatively, we will be able to depict aspects related to the morphology of the wells themselves, their immediate spatial environment, as well as the ritual processes associated with their closure as functional structures.

### A. Chosen archaeological context

The ritual pit we have chosen for this project is one of the best documented. It is located at number 10 of the current Avda. San Severiano (Cádiz, Spain), and was excavated between 2012-2014. In its interior, it has been possible to document different deposits formed from the different ritual actions performed both in the structure itself and in its immediate surroundings (Fig. 2b). Notable among them, for the remarkable nature of the ritual, is the sacrifice of canids and their ritual deposit inside the wells as offerings. This ritual action is repeated in most of the wells and is only known so far in the Phoenician-Punic city of Cádiz (Fig. 2c) [8].



Fig. 2: a. Section of well 4 at Avda. San Severiano nº10. b. Deposits found inside the pit. c. Canid sacrificed and deposited inside the well.

### III. METHODOLOGY OF VIRTUAL RECONSTRUCTION – IMPLEMENTATION OF EXTENDED MATRIX VERSION 1.4

The application that we want to carry out based on the Extended Matrix tool, and on the other protocols already mentioned, will result in the creation of reconstructive hypotheses on which we will base the 3D work. These reconstructive hypotheses, and the decision-making developed during the process of creating them, will be shaped depending on the different tools implemented.

We are not starting from scratch; prior to this work, we had the opportunity to apply Virtual Archaeology in a practical way to the analysis and dissemination of other structures from the Phoenician-Punic period in the Bay of Cádiz, namely the construction process of the wall of the Phoenician settlement of Cerro del Castillo, in Chiclana de la Frontera, a town close to Cádiz [9]. In this work, the main tool used in the virtual archaeological record was the Extended Matrix [10]. However, to develop specific workflows that overlapped different protocols for recording and presenting the results of the 3D work, other protocols were included, such as the Scale of Historical-Archaeological Evidence [11] and the Reconstructive Units [12]. The first of these consists of the graphic representation, using a colour scale, of the level of historical-archaeological evidence with which the reconstruction or virtual recreation has been carried out. The second of the tools, the Reconstructive Units, consists of the creation of stratigraphic data sheets, similar to those used in the field of common archaeology, in order to document the virtual reconstruction process in the best possible way. As for the final product, although

we were generally satisfied with the results of the workflow, we would like to implement some improvements in its practical application for the current project.

#### A. Project particularities

The project of virtual reconstruction of the ritual wells of the necropolis of Cádiz has some particular characteristics that version 1.0-1.1-1.2 of the Extended Matrix do not solve. In order to resolve the record problems generated, we will use the version currently under development, version 1.4. We want to materialise our work of generating reconstructive hypotheses in this new version, as it includes new aspects that are very well adjusted to the needs and particularities of the project we are presenting, two of which are of vital importance.

The first is that, in the current case, we want to reconstruct a specific time and solar orientation, with a specific climatology. Moreover, we do not have a photogrammetric model of the space or geographical context, only an overall spatial approximation developed thanks to LiDAR technology and the most recent topographic data from the Phoenician-Punic period [13].

The second particularity of this project is the insertion, almost as protagonists, of characters participating in the ritual process. This complicates the proposed reconstructive hypotheses, as they are not only limited to archaeological structures but also to actions that are not archaeologically recorded (gestures, postures, body physiognomy), a whole intangible heritage related to the ritual aspects intended to be represented. This means that the virtual reconstruction is not linked to a particular period but to a moment captured in the form of a photographic snapshot.

#### B. Methodology and approach

The process of integral reconstruction of the space and the insertion of the museum pieces from the Phoenician-Punic period has three distinct phases.

The first of these focuses on the creation of the 3D reconstructive hypotheses by gathering as much information as possible. This data should not only be limited to the archaeological aspects of the intervention but also to the immaterial aspects of the intervention. In this phase, collaborative work between the heritage virtualisers and the team of specialist archaeologists is of vital importance.

The second phase consists of the photogrammetric documentation of the selected pieces from the Museum of Cádiz, as well as the generation of the final models for their insertion into the 3D scene. This photogrammetric intervention on the pieces must be carried out jointly with the museum's curatorial-restoration staff. In addition, in this phase, the 3D terrain modelling or DTM is also developed, based on the LiDAR data and the topographical relationship of the chosen geographical

framework in the Phoenician-Punic period, in order to configure the physical space in which the recreations will take place.

Finally, the 3D work itself is carried out, based on the modeling of the scene, its animation, and the export of the results that are deemed appropriate for their correct dissemination (2D infographics, 360° images, etc.). The results obtained will be integrated into the museography discourse following a didactic plan that is developed simultaneously with the professionals in charge during the first two phases of the project.

#### IV. VIRTUAL ARCHAEOLOGY APPLIED TO TANGIBLE HERITAGE: NECROPOLIS AND WELLS

With regard to the approach of the current work being carried out with a view to generating specific reconstructive hypotheses for the particular case study in question, the following steps have been taken so far.

##### A. *Compilation of archaeological contextual documentation*

We have a large amount of information on the structure chosen for its reconstruction, both on the immediate spatial environment and on the process of deposition of the materials: planimetric information, archaeological drawings, photographs, measurements, etc. Once all the available primary archaeological documentation has been gathered, the second step is to complete the relative data on the instruments and objects used and the (possible) food eaten or used as offerings, in order to obtain an overall view of the ritual processes carried out in the necropolis of Cádiz around these structures.

This "secondary" information is the product of intensive research and years of work on these structures, which has made it possible to gather an extensive corpus of documents and document numerous examples of ritual wells and ritual variants.

Once all of the aforementioned information has been gathered, it is now time to propose the appropriate reconstructive hypotheses. The main tool used is, as we have already specified, the Extended Matrix 1.4dev. All the data and documentary sources from which data have been extracted or which have provided information, either directly or indirectly, are collected in it. This is done with the intention of being as transparent as possible both in the decision-making process and in its subsequent publication.

##### B. *The pieces exhibited in the Museum of Cádiz*

Simultaneously the first phase of the project is being carried out by the team of archaeologists specialising in the Phoenician-Punic period and the heritage virtualisers, while work is underway to virtualise the objects on display in the "colonisations' room" of the Museum of Cádiz. This work, of vital importance for the achievement

of the project's objectives, is being carried out using digital photogrammetry. The pieces chosen are directly related to the well structures, or indirectly to the associated rituals.

Before starting the virtualisation process of the pieces themselves, it is necessary to make a selection of those that are to be included in the virtual reconstruction. This selection of pieces is made following the technical criteria of both the archaeologists specialising in the field and the conservation and restoration staff of the Museum of Cádiz itself.

This work requires careful planning of the data capture, whether due to complications derived from the morphology of the piece, the particular characteristics of the material in which it is made (the shine, for example), or the condition of the piece itself, the deterioration and its state of conservation. Some pieces, such as terracottas or bronzes, pose a real challenge in terms of gloss management, while others, such as sculptures, require specific planning to capture all the details of their morphology.

After the photogrammetry process, the resulting models are being post-processed in all cases (Fig. 3).

Firstly, a photogrammetric optimisation is carried out, with an intensive re-topology of the models. After this intervention, in some cases, various virtual restoration interventions are carried out in conjunction with the restoration and conservation professionals.

In this way, the pieces can be understood volumetrically and functionally, since in some cases, due to post-depositional deterioration, they cannot be correctly interpreted with the naked eye. This work is concluded with a reprojection of textures and their post-processing to improve the optimisation of the model, with the aim of inserting them into the 3D scene.



Fig. 3: On the left optimised and post-processed photogrammetric model. On the right, original photogrammetric model

#### V. VIRTUAL ARCHAEOLOGY APPLIED TO INTANGIBLE HERITAGE: ACTIONS AND

## CHARACTERS

Meanwhile, the intervention of characters as protagonists of the scene to be virtually reconstructed is planned and documented. This is also a key moment, as it requires the participation and collaboration of both the heritage virtualiser and the team of archaeologists and historians, as well as those responsible for the insertion of the virtual products in the museum's museographic and didactic discourse. The choice of the number of people, gender, age, social status or physical characteristics involves complex historical-archaeological and even anthropological research in order to represent the rituals as faithfully as possible as they must have been in reality, many aspects of which escape us. This decision-making has a direct influence on the discourse to be disseminated, as well as on the development of the 3D works themselves. The 3D work of recreating characters, postures and social contexts will be represented as a hypothesis in the Extended Matrix, using the tools implemented in the new version.

Once this research, decision-making and 3D development have been undertaken, the reconstruction work itself can be completed and the results can be exported (Fig. 4). In this scene, carried out as an example of the work we are carrying out, we can see the historical-archaeological reconstruction of the ritual well, as well as the recreation of its immediate geographical context. In this scene, we can also see the insertion of a character, by way of a recreation context, in which the characters acquire a major importance for the correct interpretation of the archaeological remains. Furthermore, in this scene we can appreciate the insertion of two photogrammetric models, the instrumental shell being used by the character, and the perfume burner at the top of the well. Thanks to the generation of this virtual recreation, these pieces acquire meaning and can be seen in their original context.



Fig. 4: Example of virtual reconstruction presented for the project.

## VI. CONCLUSIONS

The philosophy of the project, as it is conceived, has a clear vocation towards the dissemination and transfer of

the knowledge generated by the research, but it is also (perhaps for this very reason) complex in its execution. A complexity that requires the participation and involvement of an interdisciplinary team made up of professionals from different areas of knowledge and which poses a scenario in which decision-making is key to success and which, at the same time, entails a high degree of responsibility on the part of all the specialists involved to ensure the veracity of the reconstructions, which will be attested and recorded in the tools and protocols of Virtual Archaeology.

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