The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, Volume XLVIII-M-2-2023
29th CIPA Symposium "Documenting, Understanding, Preserving Cultural Heritage:
Humanities and Digital Technologies for Shaping the Future", 25–30 June 2023, Florence, Italy

METHODOLOGY AND MEANING OF THE 3D MODELLING OF THE LOST BAALSHAMIN TEMPLE IN PALMYRA*

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KEY WORDS: Archives, Palmyra, 3D, PoTree, Heritage, Virtual Archaeology

ABSTRACT:
The Baalshamin temple in Palmyra was completely destroyed by ISIL in 2015. To address this issue, the "Collart-Palmyre Project" at the University of Lausanne (UNIL) digitally published the scientific archive of Paul Collart who was in charge of the excavation of the temple in the 1950'. Since 2017, the Project makes the archives accessible on an online open access database (tiresias.unil.ch). A 3D reconstruction of the temple has been realized by the UNIL team in collaboration with ICONEM. The 3D models (including handily drawn elements) are now being integrated onto a PoTree platform (https://github.com/potree/potree) that allows archival items to be geolocated, associating them with the architectural or archaeological objects they document.

The challenge here was to access metadata on the 3D model and to ease access to the archives through online tools.

We also published a diachronic 3D model showing the different periods of occupation of the site (from the second century BC to the ninth century AD). Partnership with NGO's also permit the presentation of 3D models to displaced Syrian refugees in the Spirit of the Faro Convention. Last but not least, the Project follows the guidelines of the London Charter and the Sevilla principles for Virtual Archaeology and questions the broader facets of neo-colonialist, economic and nationalist agendas that emerges from the 'migration of digital heritage' as assets to be exploited. This project wants to explore how these digital assets provide a scaffold for the memories of migrants.

1. INTRODUCTION

1.1 The Temple of Baalshamin in Palmyra

The temple of Baalshamin in Palmyra was excavated by a Swiss team between 1954 and 1956 and in 1966, under the direction of the archaeologist Paul Collart. The Baalshamin sanctuary was dedicated to the 'Lord of the Heavens', a West Semitic deity. Furthermore, he is the god who is associated with bringing rain and guaranteeing a good harvest: "The lightning he brandishes in his hand is not a representation of terrifying power, but a reminder of the fertile rain which accompanies a storm, which makes the desert green again and prevents the springs from running dry." (Collart and Vicari 1969, 203). In the region of Palmyra, where the economy is fundamentally based on caravans, he also protects people, cattle herders, and farmers from drought. He is also worshipped as an agrarian god, symbolised by the corn ears, fruits, and grapes bouquet he wears.

This temple was situated in the northern part of the ancient city. The whole sanctuary consists of three courtyards with porticoes, a banquet room, and a *cella*. Of this sacred element, only the *pronaos* and the *naos* remained until August 2015. The *cella* was similar to a small building: fifteen metres long and ten metres wide. The morphology of the whole sanctuary (temple, courtyards and walls) changed through time, especially between 17 AD and 131 AD when the tetrastyle temple was inaugurated for the visit of Emperor Hadrian (fig. 1). Later during the Byzantine period, the temple was repurposed. Collart concluded that the temple was converted into a church and he dismantled the Byzantine remains (*spolia*) in order to rebuild the *thalamos* of the Roman temple. A *thalamos* is to be considered as the holiest part of the temple, the innermost sanctuary; a shrine. Today, the interpretation of the temple-church remains under discussion.

Figure 1. The temple of Baalshamin and the Great courtyard during the Swiss excavation (1954-1955). © UNIL - ASA Image Copyright 2023

* Part of the paper is based on a published lecture given in Leiden in spring 2023 (Michel, 2023: 16th Annual Byvanck Lecture, available at: http://www.babesch.org/byvancklecture.html)

The temple was completely destroyed by Da'ish using explosives in August 2015 (fig. 2). Today, the archives of the Swiss mission represent the most complete source for the understanding, the digital restitution, and the transmission of the memory of the temple of Baalshamin. According to Anna Gustavsson of Gothenburg University, "archives are essential for historians of archaeology, but at the same time they are also invaluable for the everyday practice of archaeologists. The process of archiving is one of the most important features of archaeology and it has had a great influence on the professionalisation of the discipline. […] In addition, the archive can work as a resource connecting the past, present and future of our discipline. Archives can also provide a starting point for research projects." (in an abstract of a talk given at the European Association of Archaeologists Conference 2016: https://www.academia.edu/21890527/EAA_2016_Call_for_papers_Deadline_1_March_Session_Archives_and_Archaeology.

In the case of Palmyra, after the destruction of the monuments and the sack of the local museum, archives (including photographs, drawings, plans, inventories, and notebooks) are the only remaining elements that can be used to keep the cultural memory of the monument alive. With such elements it was possible to create a digital replica of the lost monument and estimate the feasibility of reconstructions, using technological devices to create a simulation of the reconstruction — anastylosis. This is how and why the Collart-Palmyre Project was born.

Figure 2. The Temple of Baalshamin after the blast, 2016.
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1.2 Paul Collart (1902-1981)

Paul Collart was a Swiss archaeologist born in Geneva in 1902. In 1926, he was admitted as a foreign member to the French School of Athens, and from 1930 to 1935 he was in charge of the excavations at Philippi in Greek Macedonia. From 1938 to 1940, he worked on the Great Altar at Baalbek in Lebanon. UNESCO entrusted him in 1953 with the inventory of cultural property in Syria and Lebanon. Collart had been sent to Palmyra by Henri Seyrig who, at that time, was the founder of the IFAPO—Institut français du Proche-Orient in Lebanon. From 1954 to 1956, financed by the Fonds national de la recherche, Collart organised the first major Swiss archaeological mission abroad, excavating the Temple of Baalshamin in Palmyra. In 1966, he carried out the anastylosis of several columns in the porticoes of the temple, i.e. their reassembly from the original blocks, and worked together with Syrian architects for the reconstruction of the *thalamus*, the holy chapel inside the *cella*. The context of the presence of Switzerland in the Near and the Middle East cannot be compared to that of other European countries. Switzerland had no colonies, even if Swiss actors were involved in colonial trade.

2. THE PROJECT

2.1 Using archives to preserve heritage

The Baalshamin temple was destroyed in August 2015 and the project at Lausanne University was launched in 2017. After the death of the archaeologist, his family decided to donate the archive to Pierre Ducrey, Dean of the Faculty of Arts at that time, who in turn gave it to the Department of Archaeology and Ancient History at Lausanne University where Collart had been a Professor. When Collart was working in Syria, Switzerland had no official or national archive for archaeological missions. The French School in Athens or the Swiss School of Archaeology of/in Greece now have organised archives, but it was Collart's decision to keep every record of his work at that time.

The Collart archives are the best source in the world to document the Baalshamin sanctuary in Palmyra. This documentation is invaluable for all future restoration or virtual reconstruction projects. There are thousands of black and white photographs, and only a few in colour. All the plans, notebooks, drawings and sketches of the architectural elements, decorations and archaeological furniture have also been preserved. More than five thousand items have been indexed and digitised in the online open access *Tiresias* database (https://tiresias.unil.ch/home), of which approximately 4,500 specifically relate to Palmyra, and around five hundred artefacts are available in the Collart-Palmyre Object-ID Database. We have also documented different phases of the Sanctuary of Baalshamin on *The Reconstruction Argumentation Method database*. Finally, to publish the 3D models created within the project, we have used Sketchfab and PoTree (https://doi.org/10.34946/D6QG6D), making the models available online.

2.2 The aims

2.2.1 To preserve the memory of the monument: By scanning the sites which are under imminent threat of disappearance, we are working to preserve a common asset and to ensure its transmission to future generations. The Baalshamin temple was never 3D scanned before its destruction. During a future field survey, and a study of the remaining blocks, it will be mandatory to consult our documentation to certify the damage and assess the extent and percentage of loss. Finally, the plans will be essential in order to organise the eventual anastylosis.

2.2.2 To produce a digital double of the temple throughout its history: As the monument no longer exists, it is important to produce a digital replica which can be studied and shared. Some questions about the life and the use of the monument remain unanswered. A digital diachronic model helps to study the circulation between the various elements of the sanctuary throughout its history. Furthermore, a digital diachronic model makes it possible to study various periods of time of the monument, from the late Hellenistic period to the Islamic period, whereas a material reconstruction would mean to arbitrarily make a choice regarding the specific period of time to be under conservation. This work of virtual reconstruction was performed following the International standards of the London Charter and the Sevilla Principles for Virtual Archaeology.

2.2.3 To make the whole documentation available via an online platform, allowing geo-localisation of items: The open source online platform PoTree web viewer is a research tool with measuring functions that also gives access to unpublished documents from the archive. Online users can access 3D models, read the notebooks, study the plans, see the drawings, and download pictures from the online archive. We, therefore, provide all the necessary conditions to enable scholars to conduct scientific research on the original documentation directly online. To integrate the archive with the 3D models on PoTree, every picture or drawing in JPEG and/or PDF has been localised manually on the general mapping of the sanctuary. In collaboration with the French platform archeologie.culture.fr, developed with the help of the *Département de l'innovation numérique du secrétariat général,* a project coordinated by the *Département des affaires européennes et internationales,* our model is to be integrated in the general mapping of the whole Palmyra site created by the French Département and Lausanne University. This collaboration aims to avoid the production of incompatible models. The use of the PoTree web viewer also allows us to fulfil the international standards by giving access to the sources (pictures mostly) used to produce the 3D models for more transparency about the decision-making process.

2.2.4 To participate in fighting the illicit trade of cultural goods: We also produced a specific database following the Object-ID international norm (https://catima.unil.ch/palmyre/en) in order to align the project as closely as possible with the criteria used by law enforcement agencies. Some Palmyrene artefacts from the Baalshamin sanctuary were transferred in the 1950s to the local museum, and some sculptures had also been sent to the national museum in Damascus. As the museum in Palmyra was damaged by Da'ish, once the group left, the Syrian authorities transferred the remains of the local museum to Damascus. Our updated list of objects, with detailed state of preservation and inventory numbers (both of the excavation and of the Palmyra or Damascus museums) could help to identify missing or damaged pieces currently in Damascus.

2.2.5 To share our knowledge with future generations: The project of the University contributes to work on collective memory, and especially on cultural memory. The next generations, the future inhabitants of Syria and Palmyra who now live far from their homes, need this knowledge and these memories to recall their various identities. By working today on the history of the Temple of Baalshamin and by sharing its archives, the University of Lausanne aims to make this possible. Cultural memory is the way a society ensures cultural continuity by preserving, with the help of cultural mnemonics, its collective knowledge from one generation to the next. It is our duty to help people to keep their collective knowledge and to make sure this knowledge endures for the generations to come. In order to share the data of the archive with Syrian refugees and archaeologists keywords of the databases have been translated into Arabic. Furthermore, Syrians from Azraq Camp in Jordan have created texts and images which have been integrated into a pedagogical booklet in Arabic produced by the project for activities in refugee camps.

2.3 Methodology

The main problem today is how to both preserve the monument itself and the digital replica. Concurrently, one must ask about the conservation of the cultural memory of the location for local people. To address these problems, the Collart-Palmyre Project has digitally published almost all the scientific data of Collart's archives: photos, plans and notebooks. Since 2017, the Project has made the archives accessible to researchers and Syrian refugees around the world on the aforementioned online *Tiresias* database.

Based on this material, 3D reconstructions of the Temple of Baalshamin have been realised. From a unique dataset of polygons, usable in a Blender file, and thanks to a wide variety of partnerships, we were able to create two VR experiences and one AR experience, and to publish our models on Sketchfab. The technical processing of this 3D modelling and the VR experience was completed by the French start-up ICONEM, Ubisoft and ArcheoVision. To create the model, photographs had been used first for a photogrammetric reconstruction (using the software Reality Capture), then modeling had come to complete and specify the elements of the model following successive exchanges between archaeologists and ICONEM. The final polygonal model made of polygons was a model sculpted with Zbrush and Houdini (applying texture). Finally, a simplified version of it was used in Blender.
In order to visualise the model, PoTree web wiever (https://github.com/potree/potree) has been chosen. It allows archival items to be geolocated, associating them with the architectural or archaeological objects they document. PoTree is a web-based point cloud viewer which allows users to stream extensive 3D models in a browser. The polygonal model has been resampled into points generating a pointcloud of it[1]. The simple implementation, building on open source tools, allows you to easily visualise and link complex objects and collections, promising to improve the way we capture, visualise, analyse, archive, and disseminate our data.

The challenge here was to access metadata on the 3D model and to ease access to the archives through online tools. The high poly digital model of the Baalshamin temple is composed of more than sixty-one billions polygons. A part of the model was hand drawn for accuracy. The model is accessible together with a photogrammetry of the actual state of preservation of the temple on the PoTree web viewer (platform).

We also wanted to publish a diachronic 3D model showing the different periods of occupation of the site. The digital models reproduce then the story of the Baalshamin sanctuary from the second century BC until the ninth century AD. This range of time also includes the Byzantine reuse of the *cella* of the temple. The diachronicity of models is a way of linking different memories and identities to the same monuments used through centuries (fig. 3).

Figure 3. PoTree web viewer with "Timeline" scene.

[1] Baalshamin (BS) Walls: 766,4 Mo / points: 83502329
BS Thalmos: 266,4 Mo / points: 30851090
BS Door: 2,3 Mo / points: 237855
floor_solid: 7,5 Mo / points: 1049600
BS Tree: 351,9 Mo / points: 44320646

For sites under threat of disappearance, this technology guarantees that the archaeological knowledge is preserved. The whole memory of this area of Palmyra is held within a scientific tool for research and for future generations. Partnership with UNDP and local NGOs in Jordan, Turkey, Lebanon and Syria also permit the presentation of 3D models to displaced Syrian refugees located in camps, especially in Jordan, in the Spirit of the Faro Convention.

2.4 Ethic

Access in terms of technologies and language is a real issue when dealing with archives outside the country where the research has been conducted. Our project takes this ethical issue into close consideration while dealing with the archive.

First, it takes into account the Faro Convention which "emphasises the important aspects of heritage as they relate to human rights and democracy. It promotes a wider understanding of heritage and its relationship to communities and society. The convention encourages us to recognise that objects and places are not, in themselves, what is important about cultural heritage. They are important because of the meanings and uses that people attach to them and the values they represent" (from https://www.coe.int/en/web/culture-and-heritage/faro-convention).

This convention offers different and creative means to manage heritage with the active involvement of local communities in order for heritage to contribute to the cultural dynamics of the communities. In this convention, the definition of 'heritage' is enhanced by including the principle of shared responsibility.

In order to follow the Faro Convention's spirit, and to integrate the populations and social groups directly affected by these cultural objects into the creation processes, we have worked with a local NGO and the Development Program of the United Nations (UNDP) and translated summaries of our activities and learning tools about the history of Palmyra into Arabic. The activity with UNDP was integrated with thematic days on 'Women's empowerment', during which the portraits of notable Syrian women figures were presented, particularly Queen Zenobia in Palmyra. Moreover, based on the figure of Zenobia, we developed a pedagogical booklet and an embroidery activity. Despite the challenges involved in organising such activities in Syria, this embroidery activity has been run in several Syrian cities, such as Aleppo, Hama, Damascus, and its suburbs, Sweida and Quneitra. It was well received and participants shared their positive messages.
In a first collaboration with the MIT Future Heritage Lab in Boston in 2019, we produced an embroidery pattern, the iconography of which is inspired by the decoration of the Baalshamin temple. The embroidery project focusing on this heritage took place in several places in the Middle East, including the Idlib Region in Syria. The Collart-Palmyre Project produced an Arabic pedagogical booklet about the history of Palmyra with an emphasis on the multicultural aspects of the city during antiquity. This booklet also functions as an educational tool with explanations accompanying the embroidery activity. While dealing with the issue of the conservation of cultural memory, we came up with the idea of linking intangible and tangible heritage. We decided to use ornamental designs from the now destroyed Baalshamin temple to produce embroidery patterns. The iconographic repertoire of motifs in ancient Palmyra was the same for architecture and for textile (Schmidt-Colinet 2019, 477–485).
Therefore, we produced models and canvases to be used for embroidery in the refugee camps or schools. These patterns lead to activities which take into account tangible and intangible heritage. In turn, it helps to integrate the cultural value of the Baalshamin temple, as part of the collective past of Syria, with the local tradition of embroidery.
That is a crucial point in the education of the next generations. Life in refugee camps is more than difficult, and people have little to occupy their time with. That is why we are participating in creating a place where culture could be expressed. With the help of images of the virtually reconstructed temple, we also hope to create intergenerational dialogue. With IULM University of Milan (Libera Università di Lingue e Comunicazione), the InZone program from Geneva University, and an art therapist, Syrian refugees created images that have been included in the latest edition of the Arabic booklet. VR workshops have also been organized in Azraq Refugees Camp in order Syrian to test and use the VR experience developed within the project (fig. 4).

Figure 4. Users of the VR experience in Azraq Camp, Jordan, 2021. © UNIL – ASA – CARE - InZone Image Copyright 2023

Secondly, the question of the authenticity of replicas is at the heart of the debate on the safeguarding of heritage. Experts have been involved in this debate, which led to a founding text: the Nara Conference (1994) based on the Venice Charter (1964). As early as 1970, the World Heritage Committee included the notion of 'authenticity' in its texts (Operational Guidelines). This question, which originally concerned the reconstruction of historic buildings, now also applies to digital replicas of cultural property. How can a digital replica of a monument be considered as authentic or, more broadly, capable of participating in the memorial transmission of a culture or in the reconstruction of identity in a post-conflict context? Paradoxically, the digital replica constitutes a conceptual threat to the authenticity of material heritage, as "aura" (a quality integral to an artwork that cannot be communicated through mechanical reproduction (https://www.tate.org.uk/art/art-terms/a/aura) and authorship compete. Following Manzuch (Manzuch 2017, 9), authenticity is defined as the "quality in a thing of being what it claims to be (...) through a process of investigation known as authentication." Thus, we are faced with the challenge to maintain the authenticity of the object in its original meaning, despite the fact that the notion of authenticity is a social construct (Manzuch 2017, 10).

3. CHALLENGES AND RESULTS

A range of activities has been carried out in the course of five years.
One of the early challenges we had to face was documenting the 3D image production process using different databases. Taking into account the level of accuracy of the 3D models from the various phases was challenging. Only the 3D model of the temple was designed and produced as a textured high poly model. To explain the choices we have made, we had to give users access to the source documents from the relevant archives.

3.1 Databases

We used different databases based on our need to track the typology of information and our varying project aims. The first challenge here was to use or create specific tools for online access to the documents. That is the reason why we now have three different databases. All the photographs, plans, and notebooks are accessible in a database created in the Institute of Archaeology and Classical Studies of the University of Lausanne to study the ancient world: *Tiresias* (https://tiresias.unil.ch). Then, to publish the archaeological finds and objects excavated by the Swiss archaeologists, we have created a specific English database using the generator of online catalogues of the Faculty of Arts of the University of Lausanne, *CATIMA*. This database is called *The Collart-Palmyre Object ID Database* (https://catima.unil.ch).
The second main challenge was to follow the *London Charter* and the *Sevilla Principles* for Virtual Archaeology, which is why we published our research on the online database of the *Technische Universität Darmstadt*, the Digital Design Unit database called *The Reconstruction Argumentation Method*. This third database allows transparency to understand the 3D modelling made in the project (http://dmz-39.architektur.tu-darmstadt.de/reconstruction/).
The *London Charter* aims to enhance the rigour with which computer-based visualization methods and outcomes are used and evaluated in heritage contexts, thereby promoting understanding and recognition of such methods and outcomes. It is valuable to cite here two of the principles.

After several years, we can share the following results. More than five thousand items have been indexed in the *Tiresias* database, of which *c.* 4500 are specifically on Palmyra, and approximately five hundred artefacts are available in the *Collart-Palmyre Object ID Database*. We also have documented three different phases of the Sanctuary of Baalshamin on *The Reconstruction Argumentation Method* database. Finally, to publish the 3D models created within the project, we have used Sketchfab and PoTree, making the models available online.

3.2 3D modelling

The digital modelling was a work in progress in collaboration with the French start-up ICONEM in Paris. The 3D model is now integrated onto a platform (PoTree) that allows archival items to be geolocated, associating them with the architectural/archaeological objects they document (fig. 5).

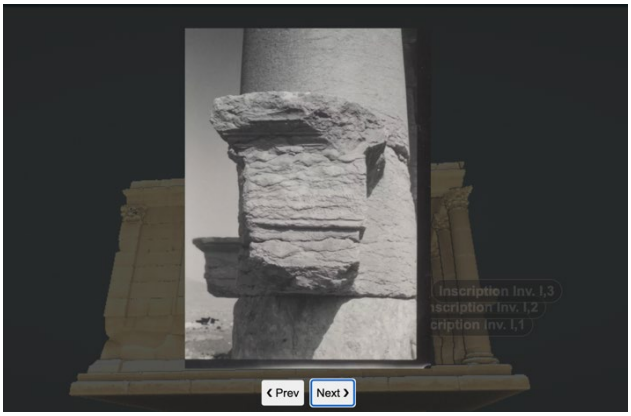

Figure 5. Geolocated picture of a Palmyrene Inscription in PoTree web viewer.

The challenge here was to access metadata on the 3D model and to ease access to the archives through online tools. To produce the digital doubles, hundreds of pictures and plans have been used. The high poly digital model of the Baalshamin temple is composed of more than sixty-one billion polygons. These have been drawn to reach such accuracy in the rendering. The model is accessible together with photogrammetry of the actual state of preservation of the temple.
Furthermore, we wanted to publish a diachronic 3D model showing the different periods of occupation of the whole sanctuary. Therefore the digital model reproduces the story of the Baalshamîn sanctuary from the second century BC (during the Hellenistic period, when a funerary monument was in use on this area) until the ninth century AD, when the courtyards were occupied by Islamic houses and workshops. This range of time includes the Byzantine reuse of the *cella* of the temple during the fifth or sixth century AD.
As a challenge, was texturing of the various 3D models. The texture of 3D models is important, but the work could be expensive, and takes time. The lack of time and money affected our choices to invest in this part of the project. Furthermore, we had to face a shortage of documentation available for the pre- and post-Roman period compared to what was available for the temple. As a classical archaeologist, Paul Collart worked extensively on the Roman level. Thereafter, the other periods are less well documented.
Also, the late Hellenistic tombs were made of mud bricks and poorly preserved, allowing the conservation of fewer vestiges. We decided to virtually reconstruct an example of the covering of the tombs to show the ancient shape of the structures. Using PoTree, users can explore the funerary material that was found in each *loculus* of the tombs. Jars, jewelry and skeletons are visible by using the 3D model to access geolocated pictures. This gives online users a better idea of the monument's function without having to consult the printed publication about the excavation (Fig. 6).

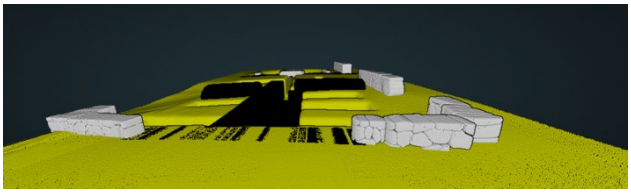

Figure 6. Reconstitution of Hellenistic tombs in PoTree web viewer.

In the project, we therefore invested more time and money on the 3D model of the Roman-era temple and were not able to reach the same level of accuracy for the modelling of the other phases of the sanctuary: the late Hellenistic tombs, the Byzantine reuse of the temple, and the Islamic levels in the great court. We however decided to create digital doubles of the monuments as they were before the destruction and not as they were in Antiquity. That is why neither the roofs nor some of the wall heights could be recreated for the Byzantine structures. For the pre- and post-Roman periods, we produced models that give an idea of the architecture and the monuments' size without dealing with the obvious assumptions and hypothesis that a full reconstruction would involve. Regarding the late Hellenistic funerary monument, we tried to reconstruct two vaults made of bricks to help users visualize the morphology of the funerary monuments. Concerning the post-Roman houses discovered in the great court, we decided to recreate some specific areas, such as small rooms with domestic elements (basin, stairs), and only rebuild the wall of the other elements, whose height is still unknown.

ACKNOWLEDGEMENTS

The author wish to warmly thank Nadia Spang Bovey and her team at Lausanne University (Céline Restrepo Zea, Luca Guindani); Wissam Wahbeh from Fachhochschule Norwestschweiz, Hochschule für Architektur, Bau und Geomatik Institut Digitales Bauen and his team at Lausanne University.

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