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## ArchXant: Archaeological and Epigraphic Research in Digital Humanities Era

This paper is the result of a collective research<sup>1</sup>, a project mixing archaeology, epigraphy, and “digital humanities”<sup>2</sup> dedicated to Xanthos one of the major Unesco sites of Asia Minor<sup>3</sup>.

The city of Xanthos was rediscovered by the English explorer Charles Fellows in 1838. The first “official” excavations started in 1842 and resulted the same year in the shipment to London of numerous sculpted fragments, architectural blocks, and statues belonging to the major funerary monuments of the site, most of them from the Nereid Monument. More fragments were shipped in 1843 to the British Museum to be exhibited in the “Lycian room” of the Museum. At the end of the 19<sup>th</sup> century, between 1892 and 1894, the Austrian scholars Niemann and Benndorf carried out an epigraphic survey in Lycia and brought back to Vienna the squeezes of the inscriptions on stone they discovered and that were to be published in the *Tituli Asiae Minoris*. From 1950 (Xanthos) and 1962 (Létôon) on, French archaeologists explored the sites and published several monographs in the series *Fouilles de Xanthos* as well as hundreds of articles in different reviews. The collaboration with Quebec epigraphists started in 2000 and lasted until 2010 when the Turkish authorities decided to withdraw the excavation permission from France. We then had to decide how to deal with the large volume of more than 160 years of archives and research data, taking into account their dispersion (London, Liverpool, Vienna, Paris, Bordeaux, Quebec) and the variety of knowledge they contain.

In 2016, we answered to a call of proposal (French ANR-FRSCQ Quebec) in the field of Digital Humanities and obtained a funding for the ArchXant project labeled “Archaeological and epigraphic research in the era of digital humanities: a Franco-Quebec project in archiving, exploiting, and disseminating knowledge”. ArchXant is at the heart of new problems which faces today the world of archaeologists and epigraphists: for the sake of future research how

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<sup>3</sup> Xanthos was the most important city of Lycia in the 6<sup>th</sup> century B. C., at the time of its conquest par the Persians. Though under the authority of the Great King, Xanthos was ruled by regional potentates who embellished the city with their great funerary monuments, pillar-tombs or monumental sarcophagi. These funerary edifices which expressed until Roman times the collective memory of the Lycians still constitute today landmarks in the urban landscape. The most famous of them is the Nereid Monument which was commissioned by the Hellenized potentate, Arbinas, to be his resting place in the early 4<sup>th</sup> century B. C. Today the only remains in situ are the podium erected on a terrace which dominates the south gate of the city-wall.

should one protect the fragile archaeological archives? How should one guarantee the scientific value of knowledge promised to a wide dissemination? Which interactive methods could be designed to share these knowledge with the largest number? How to keep digitized data also called Big Data?

### **Method and objectives**

The objective being, in the long term, to make Xanthos archaeological archives available for open access, we had to start with collecting data and there were two difficulties with this first step. The archives of an archeological mission are constituted by multiple elements which appear under different medias: these may be graphic, as plans, architectural drawings or relevés, notebooks, or photographic as slides, or argentic pictures. We also considered that the material remains exhibited in different museums (statues, reliefs) were part of the archive and had to be included in the program. This heterogeneity forces to digitize these constitutive elements using different tools: simple scans were sufficient for most of graphic elements or slides and pictures; a more complex technology was mandatory for the squeezes, photogrammetry was necessary for architecture. The fact that the archives are geographically dispersed was another obstacle: most of graphic archives are in Bordeaux. The major part of architectural blocks and carved reliefs belonging to the Nereid Monument are to be found in London, a few still are in situ. Some squeezes are stored in Bordeaux, some in Liverpool but the greater part is in Quebec apart from the oldest ones which are stored in the Academy of Science in Vienna (Austria) are too fragile to be moved. Several trips to different destinations would have been necessary to get the whole of the data. We were happy enough to carry out two missions in London and one in Vienna before the pandemic started, which allowed to us to collect quite a large amount of data, still, being exhaustive far beyond the scale and the timetable of the project.

After this first stage, the collected data had to be saved and it was necessary to have recourse to a specialized service: the whole of the digitized documentation was stored as raw data on the TGIR Huma-Num, a Very Large Research Infrastructure supported by the French National Center for Research. This collaboration guarantees the sustainability of the project, both from the point of view of data preservation and of their dissemination as HumaNum will host our website.

Raw data had to be indexed and this was the most time-consuming stage: each file had to receive a number according to its type. Since the beginning of the exploration of the sites, the different archaeologists produced a huge amount of images. Concerning, for example, fragmentary architectural blocks, a perfect knowledge of Greek and Lycian architecture was necessary to identify their type on the basis of photographs taken, for the oldest ones, sixty years ago and which were not systematically captioned at that time. This operation goes hand in hand with work on the images themselves, which must be cropped before being given a caption. This preliminary operation was mandatory for the constitution of databases which follow the Dublin Core model, internationally used in the processing of metadata. This operation guarantees the inter-operability of databases which have become an essential component of archaeological research.

The Quebec team was in charge of the digitization of the squeezes. It was performed at Laval University with the use of Metrascan, a 3D handy laser scanner initially developed by Creaform for industrial applications (Fig. 1). This tool provides accuracy and resolution of metrological

quality. The squeezes and their critical apparatus are integrated in PETRAE, a database dedicated to Latin and Greek inscriptions developed by the Institut Ausonius (University Bordeaux Montaigne). ArchXant website will provide a link to PETRAE.

After three years of work, the whole of the documentation stored in Bordeaux — mainly archaeological data (notebooks, stratigraphical data), plans and architectural inventories — and the whole of the squeezes are digitized, saved, and indexed. The documents are included in databases which in turn are integrated into the website that has been launched in May 2021.

### **The power of images**

As we intend to open the archives to the scientific community but also to the students and the non-specialist public, we decided to take the Nereid monument, as a case study and illuminating example of new methods of diffusion of knowledge. While information is transmitted via the Internet and social networks, most often without any scientific guarantee, it is urgent to propose reliable data to the public particularly vulnerable to the traps of the web, like that of the students. Although the online publishing of 3D models is becoming more and more widespread, a reflection on its repercussions still needs to be carried out. Though, we may admit that we don't have any real control on this issue. By contrast, we can act on the manufacturing process of 3D images in order to give to the user the possibility of checking their validity by making the whole of information available to him.

Since its discovery in the 19<sup>th</sup> century, the Nereid monument has given rise to numerous graphic representations, all based on the knowledge of the time in which they were made. These images, no matter how accurate, played a role in the reconstruction process of which ArchXant is the most recent actor.

During his second travel to Lycia in 1843–1844, Ch. Fellows was accompanied by architect Major Rohde Hawkins who was the first to sketch a reconstruction of the monument. Maybe influenced by the recently reconstructed temple of Athena Nike on the Athenian acropolis, Hawkins fancied a tetrastyle amphiprostyle temple-like building of the Ionic order. The monument was restored on top of a high podium decorated by two sculpted friezes and equipped with a door that would open into a hypothetical funerary chamber. In Hawkins' mind, the door was probably reminiscent of the Roman tomb at Mylasa (Milas), today known as Gümüşkesen, he had seen with Fellows in Caria. Hawkins placed three Nereid statues between the columns of the façade, a fourth one standing between the left angle column and the left anta wall.

A new reconstruction was published in 1848 by Ch. Fellows as the frontispiece of his book *Account of the Ionic Trophy Monument excavated at Xanthos*. The monument was restored as peristyle tetrastyle with five columns on the sides. Three Nereid statues were standing in the façade intercolumnations and three in the central intercolumnations of the sides. Crouching lions were placed in the four extreme intercolumnations. According to E. Falkener [2, p. 258], Hawkins [3, p. 100] had at that time revised his own reconstruction and had proposed in 1845 a new hypothesis consisting of a peristyle tetrastyle with six columns on the sides. Falkener's reconstruction followed this line but increased the width of the cella and fancied a distyle in antis design.

In 1921, G. Niemann published a new reconstruction [4]: the monument was restored as peristyle tetrastyle with six columns on the sides, without the distyle in antis design hypothe-

sized by Falkener. For the first time the sculpted friezes are placed on top of each other, on the uppermost layers of the podium. This drastic change may be attributed to the discovery and consequent publication by Benndorf and Niemann of the Trysa heroon [1] where such an unusual design was visible. Niemann's hypothesis remained unchallenged until the study carried out by the French archeologists P. Coupel and P. Demargne. They published in 1969 an extremely accurate architectural study of the monument and consequently corrected Niemann's reconstruction on several points (estimated height of the column, height of the dentils, dimensions of the cella, existence of a second door, location of the *lacunaria*). They also raised the issue of the existence of an hyposorion. This exemplary study published under the title "Le monument des Néréides. L'architecture", in the series *Fouilles de Xanthos*, provided the basis for the manufacturing of the 3D model of the monument we propose on our website.

### The 3D model of the Nereid monument

Our intention was not to make an umpteenth 3D model of an emblematic Greek monument but to give the public the opportunity to understand its construction process. For this purpose, each architectural block had to be precisely modelled and this generated a first problem as many blocks are not drawn nor measured. Moreover, some are missing, several still are in situ, and some have been used for the partial anastylosis of the monument at the British Museum. Whenever architectural drawings were available, 3D modelling was used. The models reproduce the exact dimensions of the preserved blocks (a total of 293, 60% belonging to the elevation) but also the specificities such as mortises for clamps or dowels and all the refinements such as mouldings, decorations, and anathyrosis frames. At the end of the process, we obtained a digital clone with millimetric precision for each preserved block. In a second phase, the missing blocks were modelled on the basis of Coupel and Demargne reconstruction. A total of 1256 blocks have been modelled by V. Baillet, using 3D Studio Max, in our research center in Bordeaux. In 2018, we started a fruitful collaboration with Peter Higgs, curator of Greek antiquities at the British Museum and we got the permission to carry out photogrammetric surveys of all the blocks stored or on display in the museum. The French start-up Iconem was in charge of the operation and used the technique of dense correlation photogrammetry which consists in creating a digital duplicate of a real object from photographs. The digitization campaign that took place in April 2018 resulted in the collection of sixty-one blocks. In addition, Iconem made a photogrammetric survey of the reconstructed facade of the monument on display in the "Lycian room" (Fig. 1). After validation by the scientific team, these photogrammetric data (namely sculpted friezes of the podium) were inserted into the digital anastylosis of the Nereid Monument. We also have combined technologies by creating models with multiple layers of information (Fig. 2), namely original drawing and photogrammetry (sculpted decoration). We are now finalizing a searchable digital model which will link Xanthos' archives to 3D data.

Finally, the digital model will be online and in open access through ArchXant web site. The user will be able to select the various blocks that compose the monument. By clicking on a block, he will have access to the whole of documentation related to it such as individual 3D model of the block itself, sketches, drawings, pictures, bibliography, etc. The 3D model thus will be used as a pedagogical tool thanks to which the validity of the reconstruction can be checked.

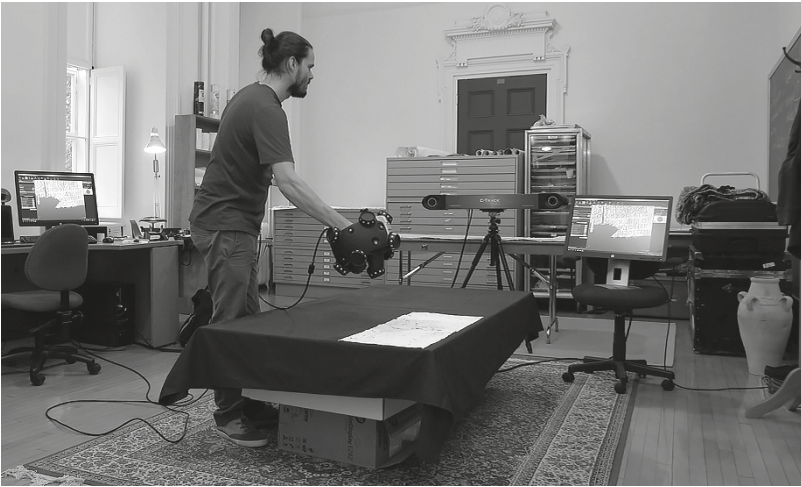


Fig. 1. Scanning the squeezes at Université Laval, Quebec. Photo by L. Cavalier

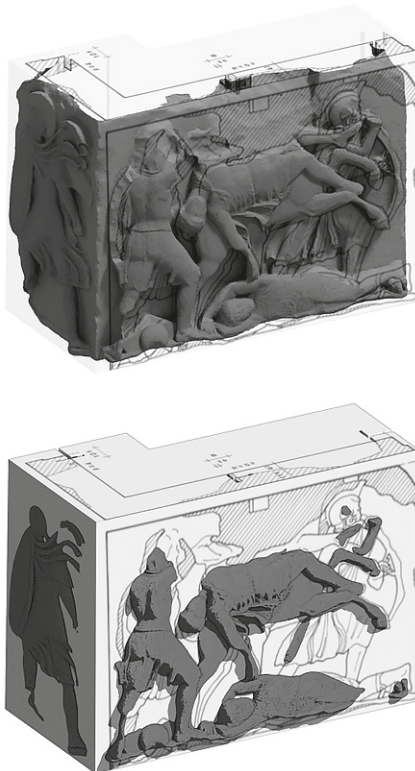


Fig. 2. 3D model of a block integrating multiple information layers (Iconem)

### Towards a new reconstruction of the Nereid monument

We have followed the virtual anastylosis process, step by step, during working sessions (Fig. 3)<sup>4</sup>, in order to check Coupel and Demargne's assumptions. The confrontation between the text and the 3D model has generally confirmed their conclusions but we differ from them on two points: the proportions of the edifice and the question of the hyposorion. Our own conclusions will be the subject to a detailed scientific publication in which a new reconstruction will be proposed. We are not finished with the Nereid monument: we now plan to work on the polychromy of the edifice, but it will be the theme of a new research program.



Fig. 3. Working session at Université Bordeaux Montaigne. Photo by J.-F. Bernard

ArchXant joins in the most current trend of archaeological researches in the Mediterranean area, a region of unequalled cultural wealth, but troubled by ceaseless conflicts. The concentration and conservation of the archives of Xanthos-Letôon expedition in a virtual and accessible location include a safeguard, or even rescue dimension that is, in our opinion, one of the most striking benefits of the program. But we also must point out that the new restitution of the monument of the Nereids that this digitization and archiving work has made possible is an unexpected scientific result of capital importance for the history of Greco-Lycian architecture.

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<sup>4</sup> We would like to express our gratitude to Stéphanie Cardoso, (Université Bordeaux Montaigne) head of the program LID (Laboratoire des pratiques Innovantes en Design) for her collaboration.

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**Title.** ArchXant: Archaeological and Epigraphic Research in Digital Humanities Era

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**Abstract.** This paper presents shortly the ArchXant program, the aim of which is to digitize and make available to the public the whole of the archives of Xanthos-Letoon expedition. It will then focus on the most famous edifice of Xanthos, the Nereid Monument which was discovered by Charles Fellows in 1840 and is today partially reconstructed in the British Museum. On the basis of the architectural study of the edifice, published in 1969 by the French archaeologists Coupel and Demargne, and thanks to photogrammetric pictures of architectural elements stored in London, the use of 3D technologies allowed to produce a model of this edifice, assisted by interactive educational tools. This process made it possible to evaluate the monument reconstructions from the 19<sup>th</sup> century to the present day. Problems or inadequacies in the publication came into light and lead us to propose a new virtual reconstruction that will be published soon.

**Keywords:** Xanthos, archives, Digital humanities, Nereid Monument, 3D modelling

**Название статьи.** ArchXant: археологическое и эпиграфическое исследование в эпоху цифровизации гуманитарного знания<sup>5</sup>

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**Аннотация.** Статья представляет программу ArchXant — проект, целью которого является оцифровка и предоставление общественности всех архивов экспедиции Ксанф-Летоон. Внимание сфокусировано на самом известном сооружении Ксанфа — памятнике Нереид, обнаруженном в 1840 г. сэром Чарльзом Феллоузом и частично восстановленном ныне в Британском музее. Архитектурное изучение памятника, опубликованное в 1969 г. французскими археологами Пьером Купелем и Пьером Демарном, а также фотограмметрические снимки хранящихся в Лондоне архитектурных деталей и использование 3D-технологий позволило создать модель этого сооружения с помощью интерактивных образовательных инструментов. Этот процесс позволил критически оценить реконструкции, предлагавшиеся с XIX в. по сегодняшний день. Были выявлены проблемные места и неточности в публикации и предложены новые варианты виртуальной реконструкции, которая будет опубликована в ближайшее время.

**Ключевые слова:** Ксанф, архивы, цифровые гуманитарные науки, памятник Нереид, 3D-моделирование

<sup>5</sup> Это исследование получило финансовую поддержку Правительства Франции в рамках программы Университета Бордо IdEx «Investments for the Future» program / GPR Human Past.