Forever on the Scene: The Theatre in Priene from stone to digital

A photogrammetry and VR work for a proper virtual rebirth

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Introduction

Between 1895 and 1898, two archaeologists, Theodor Wiegand and Hans Schrader, conducted investigations at the archaeological site of the ancient city of Priene. A site located on the slopes of Mount Mycale, in the region of Caria in Turkey, at a short distance from the ancient Latmian Gulf, opposite to the city of Miletus. The excavations revelled an extremely important series of structures, in between of them, a theatre, one of the best-preserved from ancient Greece. Since its abandon and after its excavation it suffered decay that time inevitably imposes on ancient buildings. These remains are situated on the third urban terrace, in the middle between the Market and the Temple of Athena, and stands along the slope leading to the Acropolis. Built entirely using marble blocks, it stands out for the exceptional condition of its scenic structure. The portion that remains visible today can be divided into the Greek theatre's classic parts: stage, *proscenium*, orchestra, *parodoi*, a *prohedria*, and tiers of seats. The semicircular structure of the theatre is delineated by walls that separate the entrances from the staircases closest to the *parodoi*. The lower ranks of the *cavea* are carved into the rock, while the upper ranks rest on an artificial base of stone blocks. More than a century after the first excavations of Priene, in Summer 2022 a workshop from a team of architecture departments from Italy and Turkey, brought on new documentation on the area using advanced measurement methodologies, to restore a new digital dignity to this structure.

A new research, a new survey

The research presented here has the final aim of immersing users in the ancient Doric theatre, "unused" for over two thousand years, through digital reconstruction. This contribution will illustrate all the processes from the specific photogrammetry operated in Priene to the processing of the model obtained to its full optimization aiming to a multimedia result. The goal is to present an efficient workflow with the specific intention of offering an engaging visual experience that allows contemporary visitors to perceive the building as its inhabitants did in their time. The first step is then an accurate digital reconstruction, which is conducted starting from an original on-site photogrammetry, then integrated by existing drawings, photographs, and the observations of the two German archaeologists. The task of digitally model the building was made complex by the intricate nature of the structure. While relying on established techniques such as architectural surveying, the research introduces the use of metadata and integrative tools to enhance the precision and accuracy of the reconstruction. The work follows a clear methodological path, beginning with the acquisition of a

detailed description of the archaeological site, based on the state of knowledge about the theatre itself, then proceeding with architectural surveying based on a mix or UAV/aerial and terrestrial photogrammetry and the creation of digital model. The resulting model is then processed to develop an usable support for creating visitable 3D scenes. In the end, the present theatre and its reconstruction were combined in an APP allowing a full visualization, accessible both via personal devices and VR headsets. The survey campaign of the whole area of the theatre was entirely conducted using a SONY ILCE 6000 mirrorless camera (equipped with a 16-50mm zoom lens on a 24Mp sensor) and a DJI Spark FC1102 drone (12Mp sensor). For the *prohedria* a specific terrestrial campaign was operated using a Nikon D800e camera (36Mp sensor) mounting a Micro-Nikkor 60mm. Through the combined use of both cameras, it was possible to obtain a proper coverage needed to create the photogrammetric model, which was created using Epic Game RealityCapture software. Starting from the obtained polygonal mesh, using the McNeel Rhinoceros 3D 7 modeling software, a spatial coordinate reference system for the scene's objects was established, the building's topology was managed, and the generative elements were determined to define the procedural patterns for the creation and extraction of the model's data. The Grasshopper plug-in was used for the procedural arrangement of the geometries that make up the model and the organization of the metadata. The metadata were exported to XML files for use in a render and virtual development environment. The “deconstruction” of the artifact was determined by analysing and comparing the photogrammetric survey data with the reconstruction hypotheses of Wiegand and Schrader. The two archaeologists, in addition to illustrating the current state, suggest and describe, through drawings, the deductions about the missing construction details of the theatre. The main division made was the subdivision of the building into five distinct parts: the *cavea*, including the retaining walls, further divided into sectors and steps; the *proedria*, including the flooring behind it; the *orchestra*; the stage building with its *proscenium*, the interior of which was chosen not to be surveyed or reconstructed; and the two entrance corridors, also known as *parodoi*, including the entrance portals to the structure. Subsequent subdivisions aimed to deepen the categorization and isolation of the construction details. Each detail, even if repeated with similar dimensions in the theatre’s structure, corresponds to a single mesh geometry. This significantly lightens the modeling workload. Finally, a metadata entry was created for each element, describing the object and the generation of its instances.

A new reconstruction

Once all the elements were recreated and the final model was tested, the project was finally exported for further processing into Unity. Using this software, the visualization environment was recreated through panoramic photos rendered using Blender software. The resulting tour consists of four panoramic views, accessible through an interactive map that allows the selection of the observation point. The camera of the new software developed was programmed to allow a 360-degree rotation in the environment using the gyroscope sensors of VR and mobile phones. The application is available for mobile operating systems that support Android and for Windows PCs. The latter offers the

possibility of VR viewing. Through QR codes, it is possible to access the links for the installation and viewing of the APP.

References

Altunel, E., 1998. Evidence for Damaging Historical Earthquakes at Priene, Western Turkey. Journal of Earth Sciences, 7, pp. 25-35.

Arena, E., 2013. Alessandro 'Basileus' nella documentazione epigrafica: la dedica del tempio di Atena a Priene. Historia: Zeitschrift für Alte Geschichte, 62(1), pp. 48-79.

Bonnet, P., 1920. Observations sur le plan et la construction de Prièǹe. Revue Archéologique, 11, pp. 366-371.

Burkhardt, N. & Wilson, M., 2013. The Late Antique Synagogue in Priene.

Collignon, M., 1901. Les fouilles de Prièǹe. Revue des Deux Mondes, 6(2), pp. 341-364.

Demand, N., 1986. The Relocation of Priene Reconsidered. Phoenix, 40(1), Classical Association of Canada, pp. 35-44.

Fenn, N., 2016. Spathellenistische und fruhkaiserzeitliche Keramik aus Priene.

Fildhuth, J., 2017. Das byzantinische Priene. Casa editrice Gebunden.

Gerkan, A. v., 1921. Das Theater von Priene. Munich.

Hennemeyer, A., 2006. Das Athenaheiligtum von Priene. Casa editrice Gebunden.

Koenigs, W., 2015. Der Athenatempel von Priene. Casa editrice Gebunden.

Kulözü, N., 2006. Transformation of house typology in the ancient Priene city. Ankara.

Leutner, W.G., 1911. A Greek City (Priene) Reconstructed. The Classical Weekly, 5(10), pp. 74-75.

Paganoni, E., 2014. Priene, Il Panionion e gli Ecatomnidi. Aevum, 88(1), pp. 37-58.

Rumscheid, F., 2006. Die figurlichen Terrakotten von Priene. Casa editrice Gebunden.

Stiros, S.C., 2020. Monumental articulated ancient Greek and Roman columns and temples and earthquakes. Patras.

Urban, L., Quatember, U. & Kingsbury, P., 2020. Continuity and Change, Architecture in Asia Minor during the transitional period from hellenism to the roman empire. Istanbul.

Van Berchem, D., 1970. Alexandre et la restauration de Prièǹe. Museum Helveticum, 27(4), pp. 198-205.

Von Gaertringen, H. & Hiller, F.F., 1906. Inschriften Von Priene. Berlin.

Von Kienlin, A., 2004. Die Agora von Priene. Munich.

Wartke, R.-B., 1977. Hellenistische Stuckdekorationen aus Priene. Archäologische Beiträge, 18, pp. 21-58.

Westphalen, S., 2000. The Byzantine Basilica at Priene. Dumbarton Oaks Papers, 54, Georgetown, pp. 275-280.

Wiegand, T. & Schrader, H., 1904. Priene: Ergebnisse der Ausgrabungen und Untersuchungen in den Jahren 1895-1898. Berlin.