VIRTUAL 3D RECONSTRUCTION OF THE EAST PEDIMENT OF THE TEMPLE OF ZEUS AT OLYMPIA - A PRELIMINARY REPORT

ELŐZETES JELENTÉS AZ OLYMPIAI ZEUS-TEMPLOM KELETI OROMCSOPORTJÁNAK VIRTUÁLIS 3D REKONSTRUKCIÓJÁRÓL

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Abstract

The arrangement of the five central figures of the east pediment of the temple of Zeus at Olympia has been the subject of scholarly debates since the discovery of the fragments more than a century ago. Most recently the author has started a project to approach this controversy in a new way, by producing a virtual 3D reconstruction of the group. Digital models of the statues are produced by scanning the original fragments and by reconstructing them virtually in order to test the feasibility and aesthetic effects of the different reconstructions. The present report focuses on the various technical difficulties encountered during the scanning campaign in the Archaeological Museum of ancient Olympia and gives an overview of the work in progress.

Kivonat

Az olympiai Zeus-templom keleti oromcsoportjának rekonstrukciója a szobortöredékek előkerülése óta folyamatosan heves viták tárgya, amelynek lényegét az öt középső alak egymáshoz viszonyított elrendezése jelenti. Ennek az évszázados problémának újfajta megközelítését jelenti a tanulmány szerzőjének nemrég elindított kutatási programja, amelynek célja, hogy háromdimenziós virtuális modellek segítségével vizsgálja az elméletileg lehetséges rekonstrukciók technikai kivitelezhetőségét illetve esztétikai hatását. Ennek érdekében elsőként az eredeti szobortöredékek 3D szkennelésére volt szükség. Jelen előzetes beszámoló az olympiai múzeumban végzett munka során tapasztalt technikai nehézségekre összpontosít, de áttekintést nyújt a folyamatban levő munkafázisokról is.

KEYWORDS: 3D SCANNING, CLASSICAL GREEK MARBLE SCULPTURE

KULCSSZAVAK: 3D SZKENNELÉS, ÓKORI GÖRÖG MÁRVÁNYSZOBRÁSZAT

The subject

The temple of Zeus at Olympia was built in the first half of the 5th century B.C. (ca. 475–455). Its sculptural decoration consists of two pediments and twelve metopes. Given the large size of the building itself, the sculptures were all well over life-size and were made of white Parian marble. A large number of fragments survived and are conserved in the Archaeological Museum of Olympia and in the Musée du Louvre (Paris). Most of them are quite well preserved and are depicted in practically every handbook on Greek art or on ancient art in general, because nowadays they are generally considered to be one of the most important and most magnificent works of ancient Greek art. They have been thoroughly studied since their discovery in the 1880's, but they still pose some important questions, as indicated by the growing number of monographs and scholarly articles related to them (e.g. Treu 1897, Ashmole-Yalouris 1967, Simon 1968, Säflund 1970, Herrmann 1987, Kyrieleis 1997, Barringer 2005, Westervelt 2009). The most recent debate has started with a series of publications by the author (Patay 2004, Patay 2005, Patay 2006, Patay 2008) and concerns the interpretation of the east pediment (**Fig. 1**), which involves the problematic issue of the correct reconstruction of the central group as well.

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Fig. 1.: Fragments of the east pediment. Actual arrangement in the Archaeological Museum of Olympia.

(Photo: B. Vári, Tondo SP1 Ltd.)

1. ábra: A keleti oromcsoport töredékei. Jelenlegi múzeumi elrendezés Olympiában. (Vári B., Tondo SP1 Kft. felvétele)

The problem

The arrangement of the five central figures of the east pediment of the temple of Zeus at Olympia has been the subject of scholarly debates since the discovery of the fragments more than a century ago (Herrmann 1987, Patay 2008). The basic problem is that the fragments themselves can be arranged in four substantially different ways and there are no obvious clues for choosing the most probable one (**Fig. 2**). There is a fairly detailed description of the group by Pausanias (Description of Greece V 10, 6-7), who saw it in the 2nd cent. AD, but his text is not conclusive regarding the precise arrangement of the figures (he does not specify how to understand his indications „to the left" and „to the right" of the central figure). The findplaces are not unequivocal either, since the pieces were scattered around the temple by an earthquake in the 6th cent. AD and the fragments were subsequently reused in medieval buildings. In sum, there are four substantially different arrangements, all of which have already been selected by certain scholars for various aesthetic, technical and other considerations.

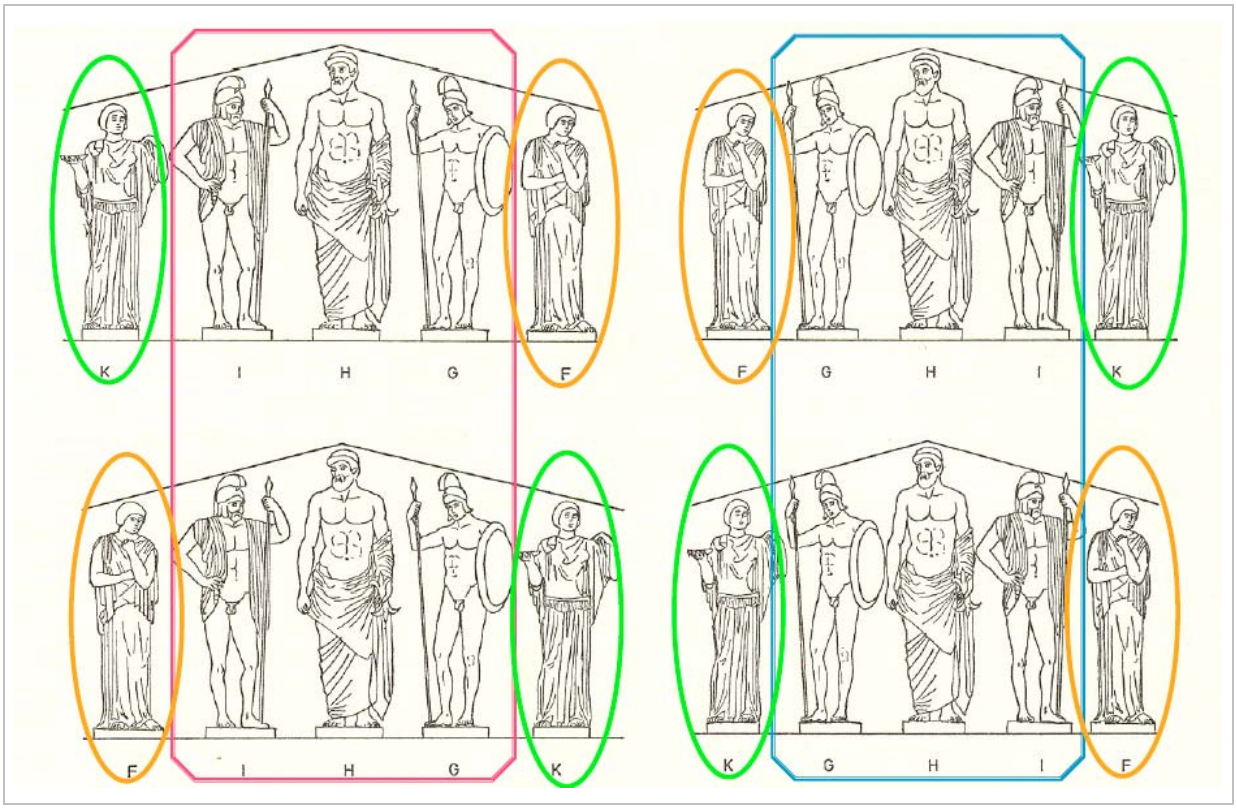

Fig. 2.:- Schematic reconstruction drawings showing every conceivable arrangement of the five central figures (usually referred to as F, G, H, I and K). Different colours highlight the differences between the four variants. (After Herrmann 1987)

2. ábra: Az oromcsoport öt középső alakjának elméletileg lehetséges valamennyi rekonstrukciója. (Herrmann 1987 nyomán; a színes vonalak csak a különféle variációk könnyebb megkülönböztetését szolgálják)

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Fig 3.:

Scanning the fragments of the east pediment with Jimmy Jib crane

(Photo: Zs. Gábor-Szabó)

3. ábra:

A keleti oromcsoport töredékeinek szkennelése Jimmy Jib állvány segítségével. (Gábor-Szabó Zs. felvétele)

Most often the reconstructions were presented in simple drawings, ignoring the three-dimensional form of the statues and the results of an early experiment with life-size 3D models (Treu 1897, 120) are nowadays equally ignored.

The project

Since experimentation with the precious and monumental original fragments is out of question and life-size plaster casts are similarly ill-suited for this purpose, it seemed to be reasonable to apply the latest 3D scanning technology to the problem. The aim of the project is to test the practical feasibility and aesthetic effects of the possible arrangements with 3D models of the reconstructed statues. The digital models are produced by scanning the original fragments and by reconstructing them (i.e. completing their missing limbs and armour) virtually. Scanning was done with Breuckmann smartSCAN Duo structured light scanner by Tondo SP1 Ltd., the reconstruction will be attempted with different software products (e.g. Poser 8 by Smith Micro and Leonard3Do by 3DforAll).[i]

The scanning campaign was carried out with the permission of the 7th Ephorate of Prehistoric and Classical Antiquities in Greece and in close collaboration with the German Archaeological Institute at Athens (conducting the excavations on the site for more than 125 years). Financial support is provided by a research grant of the Norway Grants and the Hungarian National Research Fund (OTKA).

Difficulties encountered

The high precision 3D scanning of monumental marble sculpture is a difficult task. There have been only two similar projects so far, the Digital Michelangelo (1997–2007) directed by Prof. M. Levoy (Stanford University) and the Trier Constantine (2007) carried out by ArcTron Ltd.[ii]

The first problem was financial: Our budget was much smaller than in similar cases, the plan itself being equally ambitious and the difficulties comparable or in some cases even insurmountable. In addition, there were only about 3-5 months left for selecting the affordable and state-of-art technology, equipment and company. These difficulties were overcome by intensive consultations with specialists, negotiations with different companies in and outside Hungary and finally by testing the equipment and the skill of the technicians in the collection of Greek and Roman Antiquities of the Museum of Fine Arts (Budapest). As a result two experienced technicians of Tondo SP1 Ltd. (Budapest, Hungary) were employed and the scanning was carried out in the Museum of Olympia from 23.08 to 03.09. 2009.

The difficulties encountered during the data capture resulted primarily from the monumental scale (1,5-2 times life-size) of the fragments exhibited in the main hall of the museum.[iii] The upper parts were not accessible with the scanner mounted in the usual way on a tripod but only with a special equipment, the so called Jimmy Jib (**Fig. 3**).[iv]

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Fig. 4.: Iron bars used to keep the fragments in position. This arrangement close to the wall prevented the scanning of the rear sides of the figures. (Photo: author)

4. ábra: A töredékek rögzítésére szolgáló acélszerkezetek. Ez a falhoz közeli elhelyezés akadályozta meg a szobrok hátoldalának szkennelését. (szerző felvétele)

This type of crane is usually employed in producing movies and has never been employed for 3D scanning. It was tested in Budapest and proved to be practical for the present task: it can be transported and assembled relatively easily, its handling is equally easy, and it does not present any danger for the precious originals. The workflow has thus been optimized, because there was no need to build a massive scaffolding. Since the weight of the large fragments is enormous, they are fastened to the wall with several massive iron bars (**Fig. 4**). As a consequence, the fragments are absolutely unmovable and due to their alignment close to the wall, their rear sides were difficult to reach with the scanner, some parts proved to be inaccessible indeed.

Last but not least, the scanning was made difficult by the restricted working hours. Since the museum of Olympia attracts a very large number of visitors from all over the world, it is open to the public every day from 8 a.m. to 8 p.m. Moreover, the fragments of the pediments of the temple of Zeus are world-famous pieces and belong to the main highlights of the museum, so we were allowed to scan only from 8–12 p.m.

In spite of these rather narrow time limits, our team was able to complete the task of scanning all fragments belonging to the east pediment (13 human figures and two four-horse chariot teams) in two weeks.

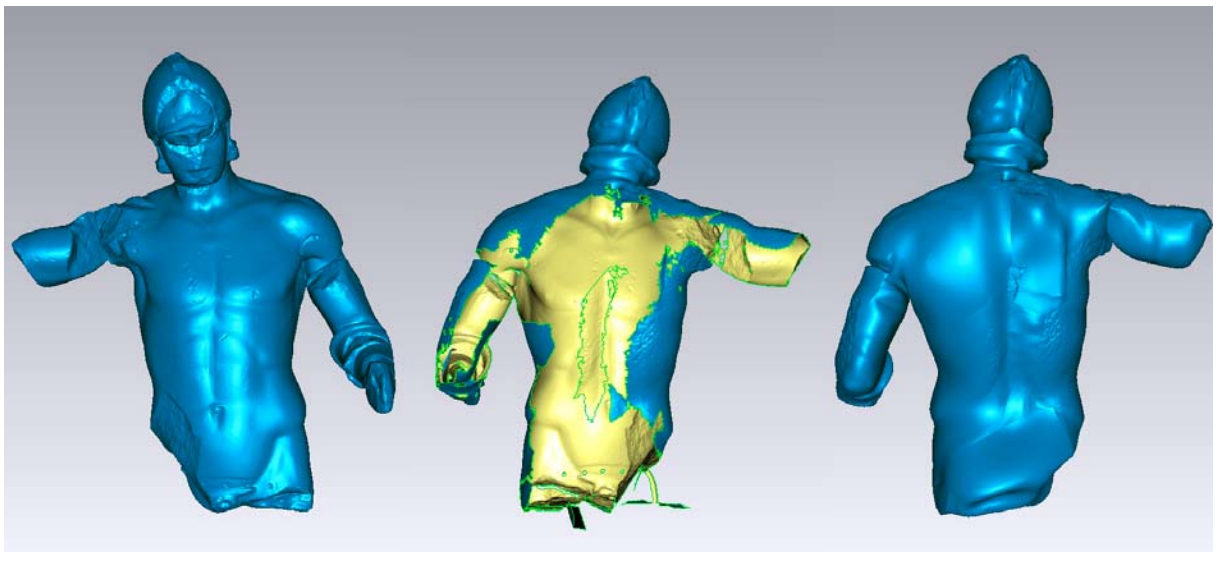

Fig. 5.: The scanned torso of figure G of the pediment. Front view (left) and back view (middle) showing data voids resulting from the close alignment to the wall. Completed 3D model of the piece on the right.

5. ábra: A G jelű alak törzsének szkennelt modellje. Balról jobbra: szkennelt állomány elölről, hátulról a hiányzó részek feltüntetésével, a töredék kész 3D modellje hátulról.

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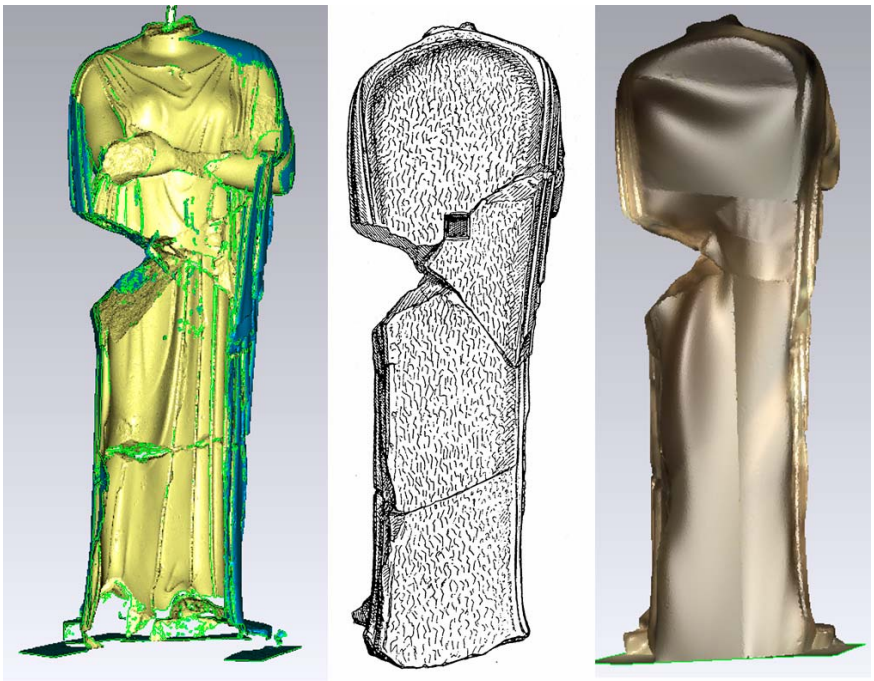

Fig. 6.:

The rear side of figure F. Data void on the scan (left), drawing of the original roughly modelled surface (middle) and completed 3D model (right)

6. ábra:

Az F jelű alak hátoldala. Balról jobbra: a szkennelt állomány, az eredeti töredék rajza (G.Treu 1897 nyomán), kész 3D modell.

Work in progress

Triangulation, meshing and smoothing of most scans is already completed. This process required more than 4 months of constant work by an assistant trained especially for this task. Data voids, which are sometimes of considerable size (due to the inaccessibility of the rear sides of the statues) were filled in by using Geomagic. These artificially completed parts are clearly visible on the models (**Fig. 5**). As these parts were in most cases only roughly hewn from the block, their exact rendering is actually irrelevant for the reconstruction. Moreover, they are sufficiently documented in drawings and photographs, and can therefore be approximately completed during the processing of the scans (**Fig. 6**).

Fig. 7.: The central group of the east pediment. 3D models of the fragments (from left to right: K, I, H, G, F)

7. ábra: A keleti oromcsoport középső alakjainak 3D modelljei. Balról jobbra: K, I, H, G, F.

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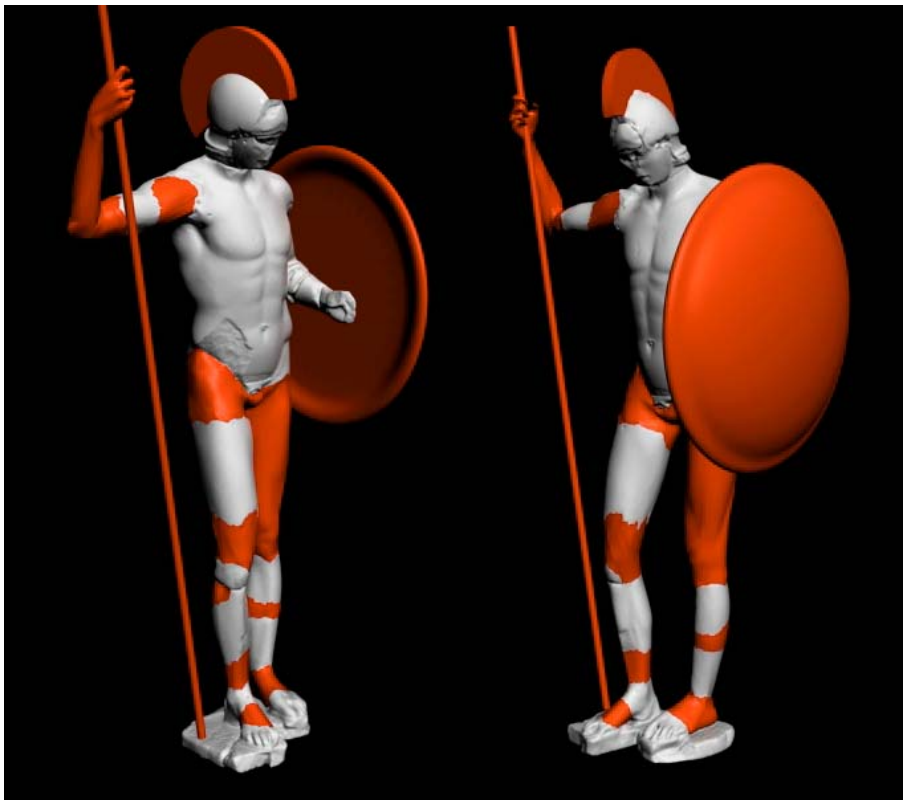

Fig. 8.:

Tentative reconstruction of figure G using Poser8 (design by G. Z. Horváth)

8. ábra:

A G jelű alak első rekonstrukciója a Poser8 szoftver felhasználásával (Horváth G. Z.).

Currently every fragment of the five central figures is processed and the resulting 3D models are ready for the virtual reconstruction. (**Fig. 7**).

Missing parts (limbs, heads, armour, etc.) are currently being completed and the reconstruction of the pediment itself will hopefully follow soon. (**Fig. 8**) We try to make use of different software products since they are not equally suitable for the rendering of each kind of objects. The most problematic issue is the completion of the missing arms, because their exact position is far from being certain. Modelling each possible pose separately and testing them in connection with the other figures in every possible arrangement would be very time-consuming. Missing human limbs can be thus completed most conveniently by using Poser 8, because it enables easy experimentation with slightly different poses.

For objects made up of simple geometric forms (shield, lance, staff) Bentley Microstation and Autodesk 3ds Max are completely sufficient, for the rendering of non-geometric objects (e.g. horses and garments) Leonar3Do is employed, because it enables much faster modelling than the other tools. The pediment will be reconstructed in ArchiCAD and the completed models will be set into this frame in order to test the feasibility and the aesthetic effects of each reconstruction. Our aim is to achieve a complete virtual reconstruction of the east facade of the building and to present a full documentation similar to the CD-ROM of SIBA (Lecce) on the metopes of temple C at Selinunte (ISBN 8883050398; cf. BERALDIN et al. 2009).[v]

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[i] For more information on these see http://www.breuckmann.com; http://leonar3do.com; http://my.smithmicro.com/win/poser/index.html.

[ii] See http://www-graphics.stanford.edu/projects/mich and http://www.arctron.de/3D-Vermessung/3D-Laserscanning/Beispiele/Konstantin/PresseArcTron3D.pdf.

[iii] Small fragments, which are not exhibited, have also been scanned. The difficulty with them was not their monumental scale but the fact that they were hardly traceable in the storerooms of the museum. One fragment, published more than a century ago (TREU 1897 fig. 59) has seemingly disappeared.

[iv] http://www.jimmyjib.com; http://www.jimmyjib.co.nz/default.asp.

[v] http://siba3.unile.it/land_lab/selinunte_cdrom.htm. (all websites accessed 13.01.2010)

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