



Figure 1

Fig. 98, Parthenon north frieze panel XXXVI; left: 3D model of Elgin cast

Photo: Emma Payne, courtesy of the Trustees of the British Museum

right: 3D model of original

Photo: Emma Payne, courtesy of the Acropolis Museum

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Abstract
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COMPARATIVE 3D SCANNING OF HISTORICAL CASTS

THE PARTHENON CASTS AT THE BRITISH MUSEUM

THE BRITISH MUSEUM HOUSES a little-known but important collection of plaster casts, taken from the Parthenon sculptures.¹ While the Parthenon marbles rank among the museum's most famous objects, few are aware that Elgin's collection also included moulds and casts of those sculptures left in situ at Athens.² These have great archaeological significance as documentary records of the condition of the sculptures at the time of moulding, but are also illustrative of 19th-century craft practice. The significance of the casts as documentary records depends on their accuracy, which is tied to the practices employed by the plaster craftsmen (*formatori*). This paper explores comparative 3D scanning for enhancing our understanding of these objects.

THE PARTHENON CASTS

The moulds for Lord Elgin's casts were produced in Athens in 1802 by his *formatori*, Ledus and Rosati,³ when the Parthenon stood within an Ottoman garrison. They were

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shipped to London and cast by Papeira in 1808; both moulds and casts went to the British Museum following the purchase of the Elgin Collection in 1816.⁴ The casts include the west frieze: the only whole section remaining on the building at the time of Elgin's campaign.

PRESERVATION OF SURFACE DETAILS

Elgin noted that these sculptures were both neglected and vandalized by the Ottomans.⁵ His remarks were later supported by the findings of Charles Newton, Keeper of Greek and Roman Antiquities (1861–1885). In 1869, Newton noticed that Elgin's moulds had become worn out and in 1872 procured new casts from Consul Merlin in Athens. Comparison of the Merlin casts with the Elgin casts suggested deterioration of the west Parthenon frieze.⁶ The west frieze remained in situ until 1993;⁷ both sets of 19th-century casts will preserve the sculptures in an earlier, better state of preservation. However, their interpretation is complicated because there are known instances where the *formatori* altered the casts, calling into question the reliability of the information they preserve.

ADJUSTMENTS BY THE FORMATORI

Alterations were made to the moulds of damaged sculptures so that they would appear in better condition when cast. There are two documented instances of additions in the Elgin casts: figure 98 on north frieze XXXVI⁸ Figure 1 and figure 30 on west frieze XVI Figure 2.⁹ It is likely that there are further unidentified cases: Elgin's private secretary, William Richard Hamilton, noted that Papeira had "... made some admirable casts, superior many of them in preservation, and equal all in sculpture to the best of the originals."¹⁰ Two factors coexist: reductive processes causing losses to the originals, and additive processes adjusting damaged areas of sculpture in the moulds. Distinguishing between the two is difficult but vital for interpreting the evidence preserved within the casts.

THE ROLE OF 3D SCANNING

3D scanning facilitates the creation of accurate 3D models for comparison of surface morphology. A Breuckmann smartSCAN (structured light scanner) with X, Y resolution

of up to 140 microns was used to scan casts at the British Museum and originals at the Acropolis Museum. Sections of sculpture displaying differences between cast and original were selected for analysis. The 3D models can be used for stand-alone visual analysis, and models of corresponding casts and originals can be compared to highlight and quantify differences between the two.



Figure 2

Fig. 30, Parthenon west frieze panel XVI; left: 3D model of Elgin cast

Photo: Emma Payne, courtesy of the Trustees of the British Museum

right: 3D model of original

Photo: Emma Payne, courtesy of the Acropolis Museum

BENCHMARKS

This comparative analysis is based on the assumption that the casts accurately reproduced the originals, except for areas made up by the *formatori*. Some loss of detail will occur during moulding but Frischer's recent study demonstrates that a good first-generation cast—from a mould taken directly from the original—will reproduce most of its surface to within 1 mm.¹¹

Several of the British Museum's Merlin casts are now lost, but those remaining are first-generation casts. However, when Papeira's Elgin casts were dismantled from exhibition in 1939, it was discovered that their condition had seriously declined. They were moulded in gelatine and two new sets made.¹² These survive to this day, but mean that



Figure 3 Fig. 23, Parthenon west frieze panel XII, top: 3D model of Elgin cast, below: 3D model of Merlin cast

Photo: Emma Payne, courtesy of the Trustees of the British Museum

the “Elgin casts”, as they now exist, are no longer first-generation casts. Nevertheless, gelatine moulds facilitate extremely close copies and retain the seam lines from the original piece moulds. Based on Frischer’s findings, it can be hypothesized that deviations from the original of >1 mm in the Merlin casts and >2 mm in the Elgin casts can reasonably be assumed to relate to subsequent changes to the original or deliberate adaptations by the *formatori*, rather than loss of detail from the moulding process.

PRELIMINARY RESULTS

Both Merlin and Elgin casts reproduce the originals more closely than expected, suggesting accurate moulding and casting. Excluding substantial changes of >5 mm, which are most

likely to be caused by weathering, vandalism, or additions, an analysis area from west frieze XII shows that the Merlin cast has an average deviation from the original of approximately 0.37 mm, and the Elgin cast of approximately 1 mm.

The Merlin cast displays overall surface loss and some substantial losses to the high points of the relief when compared to the Elgin cast. The surface of the original is much closer to the Merlin cast than the Elgin cast. To some extent this is expected: the Elgin casts derive from moulds taken 70 years earlier than the Merlin casts. However, given the additional 121 years between the creation of the 1872 Merlin casts and 1993 when the west frieze was removed to a museum environment, it is surprising that the differences between the Merlin casts and the originals are not also more substantial. The theory that the Elgin cast deviates from the Merlin cast to a greater degree than expected because of additions by the *formatori* must be investigated.

The analysis area of west frieze XII includes the head and outstretched arm of figure 23. Much of the face and forearm are missing in the Merlin cast and original, but present in the Elgin cast (Figure 3). The comparative 3D models reveal some patterns of change characteristic of



Figure 4 Parthenon west frieze panel XII, image of Elgin cast overlaid with 3D data from original

Photo: Emma Payne, courtesy of the Trustees of the British Museum

Dark grey areas show sections with the greatest deviation between original and cast. Note the seam lines and rectangular area around the hand.

Figure 5 Fig. 23, Parthenon west frieze panel XII, 3D model of Elgin cast

Photo: Emma Payne, courtesy of the Trustees of the British Museum

Note the distinction in texture between the features of the face and the rest of the head.

human intervention in the Elgin cast. These are visible around the moulding seam lines, as expected; however, there are also clear indications of intervention around the hand **Figure 4**. The face also reveals a distinction in texture between those parts extant and those now lost **Figure 5**. It is possible that these sections had already been lost by 1802 but were made up artificially by Elgin's *formatori*.

FURTHER COMPARISONS

From 1787, Louis Fauvel took casts from the Parthenon sculptures on behalf of the Comte de Choiseul-Gouffier. Many were lost or damaged en route to France, but derivations of some still exist.¹³ A number made it to Paris, from where casts were purchased by the Akademisches Kunstmuseum of the University of Bonn, in 1821.¹⁴ These can be compared with the British Museum's casts. It should not





Figure 6 Fig. 23, Parthenon west frieze panel XII, photograph of cast at Akademisches Kunstmuseum – Antikensammlung der Universität Bonn

Photo: Emma Payne

The potential for alterations adds complexity and significance to the Parthenon casts.

necessarily be assumed that they are more reliable than the Elgin casts. Pinatel has shown that casts based on those by Fauvel and now at the Petite Malmaison in Paris display significant restorations; alteration of casts was clearly not uncommon.¹⁵ Nevertheless, it is unlikely that different moulders working at different times would make precisely the same interventions.

Crucially, the face and arm of figure 23 from west frieze XII is present at Bonn; photographic comparisons reveal considerable similarities between the Fauvel and Elgin casts (Figure 6). This points to the conclusion that these areas are original and that the observed distinction in texture indicates the poorer condition of these areas, leading to their complete disappearance by 1872. It is also possible that the intervention revealed around the hand in the Elgin cast may be related to a functional insert to prevent undercutting during moulding, rather than an aesthetic addition. However, there are other smaller, unexpected distinctions between these casts, which suggest that Elgin's *formatori* did make aesthetic interventions beyond the two cases discussed above.

The Fauvel and Elgin casts were first produced from moulds taken directly from the Parthenon sculptures within 15 years of each other. The Fauvel casts, being the earlier, might reflect the originals in a marginally superior state of preservation. However, there are instances where the opposite appears to be the case. For example, the noses of the bearded man and youth of west frieze III appear more complete in the Elgin than the Fauvel cast (Figure 7-8). There is a high probability that these parts of the Elgin cast have been adjusted by the *formatori* and that the extent of surface deterioration between 1802 and 1872 is a little less severe than might be assumed by looking only at the Elgin casts. Fairly considerable weathering had already occurred by Elgin's day, but was disguised to some degree by the *formatori*.

CONCLUSIONS

The potential for alterations adds complexity and significance to the Parthenon casts, relating to what they reveal about casting in the 19th century and the time frame for



Figure 7

Bearded man (Fig. 5), Parthenon west frieze panel III;
left: Cast at Akademisches Kunstmuseum -
Antikensammlung der Universität Bonn

Photo: Emma Payne

right: Elgin cast

Photo: Emma Payne, courtesy of the Trustees of the British Museum



Figure 8

Youth (Fig. 6), Parthenon west frieze panel III;
left: Cast at Akademisches Kunstmuseum -
Antikensammlung der Universität Bonn

Photo: Emma Payne

right: Elgin cast

Photo: Emma Payne, taken courtesy of the Trustees of the British Museum

It also prompts questions about the nature of the evidence the casts preserve and their archaeological significance.

deterioration of the original sculptures. It also prompts questions about the nature of the evidence the casts preserve and their archaeological significance, which depends quite considerably on how accurately they reproduce the originals.

Digital techniques like 3D scanning do not always provide easy answers: definitive conclusions concerning the extent of additions made by the *formatori* have not yet been reached. The techniques help to identify and quantify surface differences, but this data requires interpretation. This does, however, encourage greater understanding of the intricacy of casts and interplay between their status as historical objects and role as documentary sources. This underlines the importance of continuing to preserve the physical ‘analogue’ casts, in addition to conducting digital investigations into their properties.

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