**[title]The Getty Herm of Dionysos: Technical Observations, Review, and Interpretation**

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**[A-head]Abstract**

[abstract]

Technical studies of the bronze Herm of Dionysos (J. Paul Getty Museum inv. 79.AB.138) using microscopy, endoscopy, radiography, and tomography are summarized in the context of previous studies beginning in 1989. Internal rod remains may represent remnants of a casting sprue system and several areas of miscasting and larger repairs appear to be associated with the rods. Visible bronze spillage may be associated with reworking in the head drapery and suggests repair to the back of the head. Added materials include lead at the base, presumably from the original installation, as well as remains of a composite copper-and-marble eye assembly. Tomographic images taken at one height show some internal correspondences with the Mahdia herm (Bardo Museum, inv. F 107) although there are many dimensional discrepancies. This suggests the two herms may be associated generationally, but indirectly. The object’s surface alteration (from burial?), bronze-alloy composition (previously reported), and lead-isotope data are consistent with ancient production.

**[A-head]Introduction**

**[main text]**

Ancient Athenians are reported to have been the first to erect herms that served as boundary markers in both urban and rural settings and also stood in the entrances of private homes and temples; at one location herms became so numerous that one structure near the Agora was named the Stoa of the Herms. This proliferation and high demand perhaps led to the development of copying and serial reproduction methods, and the Getty Herm of Dionysos (J. Paul Getty Museum inv. 79.AB.138, dated 200–100 BC) may therefore represent one of many examples in both marble and bronze. Further visual, endoscopic, and radiographic examinations provide important details regarding its production technology.

**[A-head]Background**

Studies of the Getty herm (**fig. 41.1**) have characterized the alloy and many casting features. Metallographic study revealed elements of the bronze cast structure and chemical analysis quantified the base alloy.[[1]](#endnote-1) Further comparative technical and art historical studies have focused to an extent on its similarities to the closely related bronze herm from the Mahdia wreck now in the Bardo Museum.[[2]](#endnote-2) Lead-isotopic studies classified sources for lead found in both the bronze alloy and lead fill, and provided baseline information on the smelting history of the bronze. These studies have led to further scholarly discussion on the role of copying and serial production in ancient bronze production.[[3]](#endnote-3)

*Structure:* The herm is characterized by a bearded head topping a tall architectonic shaft. The shaft of the Getty herm was probably cast from a construction of wax slabs, and an internal wax-to-wax join was observed connecting the upper portion of the shaft to the head.[[4]](#endnote-4) Additionally, a series of horizontal ridges or flashings is present at various heights on the interior. The shaft also includes remnants of a rod system attached to the inner walls. The remains have been considered variously to have been part of an armature support used during the building of the shaft in wax, or a sprue system for casting, a feature considered anomalous for ancient foundry work. Metallographic study of a tube-wall section shows a contiguous structure throughout indicating that the rods and wall were cast in the same pour.[[5]](#endnote-5) Woody material found within the cross section has also led to speculation that the rods were initially modeled of wood or reed, which disintegrated during the wax burnout. Carbonized remains may have partially blocked bronze flow during the pour, creating hollow tubes as bronze flowed around charred organic material.[[6]](#endnote-6)

*Copper Alloy Analysis:* The most recent analysis of interior samples (1 and 2) shows compositions consistent with ancient lead-tin bronze alloys (**table 41.1**).[[7]](#endnote-7) Lead concentrations range from 14 to 22% with tin concentrations ranging approximately from 8 to 14%. Cobalt levels were determined to be less than 0.005 weight percent in the internal lead deposit (sample 3) while present in higher concentration in the bronze alloy itself (at 0.15 and 0.20 weight percent).

*Lead Isotopes:* Lead isotope studies provided both lead sourcing (206Pb, 207Pb, 208Pb) and smelting information (210Pb) .[[8]](#endnote-8) Isotopic ratios suggest different lead sources for the alloy lead and a lead deposit on the herm interior. While the alloy falls within the Aegean field, the purer lead lies outside this grouping. Lead 210 (210Pb) was also evaluated in the three samples (two alloy, one lead) to better understand the smelting history of the bronze. If present in sufficient amounts, 210Pb ,with a half-life of 22.2 years, could indicate smelting in the last 75–100 years. The study concluded there was negligible 210Pb in the bronze alloy, and none was detected in the sample of purer lead.

*Technical Comparisons to Mahdia Herm:* Studies of the Getty and Mahdia herms point to physical similarities as well as differences between the two sculptures.[[9]](#endnote-9) Comparative facial measurements show close correspondences, although the beard and drapery show greater variation.[[10]](#endnote-10) The physical similarities have led to discussion of ancient serial production and even speculation that the Getty herm is a twentieth-century copy.[[11]](#endnote-11) In the end, there are many similarities but few of the exact correspondences that would be expected from a directly molded copy. The drapery on the heads of the two bronze herms have generally similar masses and proportions, but are completely different in method of execution. While the complex and undercut Mahdia herm drapery is generally attributed to direct working of the wax, the Getty herm drapery, with its simpler and softer form, is seen as the product of molding and indirect casting. As Carol Mattusch succinctly states, “Neither herm is the original, and neither one is a replica of the other, ancient or modern.”[[12]](#endnote-12)

**[A-head]Further Observations**

The Getty herm was studied in an effort to clarify and provide further insights into its production technology and burial alteration. Selected tomographic images of localized areas of the head were used to compare wall cross sections. Microscopic examination of the extant eye also shows a complex assembly consistent with other ancient composite eyes.

*Condition and Mineralization of Bronze:* Inspection of the interior and exterior surfaces reveals a range of copper corrosion types and thicknesses. The exterior patina is generally green (malachite) with scattered blue deposits (azurite); isolated thinly patinated areas reveal bronze metal. Corrosion on the interior is relatively intact where azurite has formed thicker botryoidal deposits, in particular where conditions may have favored its formation, e.g. within the head **(fig. 41.2**).[[13]](#endnote-13) The torn area around the missing boss is heavily mineralized as is the fractured bottom edge of the shaft. A large, gray oxidized deposit on the lower inner wall is a lead remnant possibly related to the original installation (**fig. 41.3**; see table 41.1, sample 3). A smaller unanalyzed gray deposit, presumably lead, can also be noted further up the shaft.

*Herm Pillar:* Discussion of the internal rods has focused on the hollow rod remains, although solid remains are extant as well. The remains are centered vertically on each wall of the shaft, although there are many sections where the rods are only suggested by extant attachment points. Spanning the height of each of the four shaft walls, the total length of rod would have originally reached approximately 320 cm (4 x 80 cm); extant partial remains represent approximately 20% of this total. Preliminary observation indicates more solid rod remains on the side walls, while tubular remains predominate on the front and rear walls.

Large repaired flaws visible in radiographs indicate casting problems below the phallus, at the rear center and on the lower rear wall (**fig. 41.4**). The founder filled most of the voids by casting in bronze; in some instances, cast repairs were mechanically repaired with rectangular patches. Perhaps coincidentally, the large repairs are collinear with the vertical rod remains. Small rectangular patches (approximately 140) are visible elsewhere on the herm (**fig. 41.5**), while some areas of porosity, particularly on the more complex head, were left uncorrected.[[14]](#endnote-14) A curvilinear flow feature is also visible in radiographs extending around the pillar below the head.

*Herm Head:* Interior inspection of the boss and beard cavity reveals extensive metal spattering. The morphology of the metal clusters suggests spillage into an open space, as opposed, for example, to seepage into a cracked or damaged section of core. The splatter is localized toward one side of the head and is absent in other parts of the herm. Perhaps related, the herm head has areas of casting porosity, and external markings at the top rear drapery of the head suggest possible cold working by a flat chisel.[[15]](#endnote-15) These marks are absent from the smoother cast surfaces of adjoining drapery folds (**fig. 41.6**).

Remnants of the extant eye were investigated microscopically and with X-ray fluorescence spectroscopy (**fig. 41.7**). Use of calcareous stone (not ivory as previously reported) is indicated by high calcium levels,[[16]](#endnote-16) shiny inclusions, and faint abrasion marks.[[17]](#endnote-17) Remnants of broken copper eyelashes surround the eye and are pressed into the eye socket. Inspection from the interior reveals that the eye has been reattached with a modern resin.

Several CT cross sections of the Getty head confirm a fairly uniform wall thickness indicative of a molded wax model. Comparison to the Mahdia head CT at eye level also shows some close internal profile correspondences (**fig. 41.8**).[[18]](#endnote-18) An outer drapery fold of the Mahdia herm (direct work) generally corresponds to a fold on the Getty herm.

**[A-head]Discussion**

*The Herm Model and Ancient Molding:* The herm type is distinct in combining natural and architectonic shapes. The heads themselves could vary in type, style, and material (marble, terracotta, bronze) and some marble versions of herms (of Hermes for example) have lower relief and simpler detail. From the perspective of a copyist/molder, the shaft is perhaps of less consequence than the characteristic face and beard whose production might be expedited through molding. The simpler face and frontal beard could be molded with a single mold section while a more complete mold of the head including any drapery would require a more sophisticated approach. This could be accomplished using a range of materials such as clay, plaster, and possibly pitch/bitumen.[[19]](#endnote-19) Fired clay was typically used for smaller, less complex molds as dimensional instability (warpage and shrinkage) precluded use for multipart and complex undercut molds. In contrast, plaster piece-molding was a more advanced method and, combined with outer mother molds, could capture a higher degree of detail and undercutting.

*Internal Spillage and Casting Quality:* Bronze spillage within the head initially suggested separate metallurgical attachment of the head. Bronze joining around the perimeter of the head would have been hidden in part by the undercut beard. However, further internal and radiographic inspection shows little further evidence of a continuous seam around the lower head. Although separate joining of the head remains a possibility, the bronze splatter may in fact be associated with repair to a miscast at the top rear of the head. Post-cast cold-worked repair is further suggested by the tool marks visible on the rear drapery. The general assumption is that the figure would have been cast upright. Radiographs reveal several areas of repaired damage with some such areas in alignment with the internal rod remains. Combined with variably filled sprues and flow features visible in radiographs, this introduces the possibility that the figure was cast horizontally (possibly face down). This would have ensured a less turbulent pour and more uniform introduction of molten bronze to the entire mold with less heat loss.[[20]](#endnote-20)

*Tubular Remains:* The tubular remains present a more puzzling feature of the herm. As wax model supports, they would have attached to the wax slabs to provide stability (although supports are generally not present in more complex wax models). The approach may also represent an attempt to cast smooth outer walls, reduce post-cast surface finishing, and provide for more easily removable sprues. Scholars have hypothesized that the hollow tubes may have formed as bronze flowed around a carbonized organic (wood, reed, etc.) core during casting,[[21]](#endnote-21) although unimpeded bronze flow would rely on near complete burnout of the organic material. Localized exterior cooling against the investment wall may also have developed variable temperatures within the rod/tube cross section producing a solidified exterior bronze skin while the interior metal remained in a liquid state and continued to flow.[[22]](#endnote-22) Internal sprues may also have functioned as reservoirs supplying the outer walls with molten bronze during cooling and shrinkage.[[23]](#endnote-23) Intermittent sprue/runner attachment along the internal walls would have eased post-cast removal although in instances there was excessive wall contact, possibly a result of outward pressure applied during core introduction. In the end, use of internal sprues may have inadvertently introduced another problem, as points of attachment produced thicker bronze walls that contracted and solidified more slowly than surrounding areas (resulting in large flaws).

*Review of Analysis:* Analysis of the herm alloy points to a lead-tin bronze with traces of cobalt, and radiographic images suggest the composition may actually be quite variable.[[24]](#endnote-24) The higher (by 30–40 times) amount of cobalt in the bronze alloy samples as compared to the lead sample suggests that cobalt was present within the source copper ore.[[25]](#endnote-25) Initial studies of Bronze Age copper sources traced higher cobalt ores to Anatolia, although further studies demonstrate the more widespread occurrence of cobalt in copper ores (including on Cyprus). Combined with more recent lead isotope studies, this may indicate other points of origin for the herm and its raw materials.[[26]](#endnote-26)

**[A-head]Comparison to the Mahdia Herm**

To produce a bronze copy of an original work of art, an artisan may (1) use methods similar to those of the original artist; (2) use an old mold; or (3) generate a new mold from the original bronze.[[27]](#endnote-27) Production of the Getty herm in antiquity may have entailed a combination of these approaches.Comparisons between the Getty and the Mahdia herms have demonstrated the general similarities in the proportions and heads, with the closest correspondences in the more easily molded faces. Comparison of plaster reproductions of the two heads shows a general similarity of the drapery masses at the rear although they are slightly offset with different overall volumes. This suggests a less direct relationship. Additionally, one-to-one width comparisons of the drapery bands show little to no dimensional correspondence.Some contour similarities noted in CT sections may however suggest a relationship to a common source in the initial wax production (to produce a similar inner profile) with greater variation resulting from further modeling of the exteriors. The initial basic model may have been a herm with simplified head drapery as, for example, might be found in some marble types (e.g. herms of Hermes). Artisans may therefore have started with the same general model but interpreted more freely (and directly) in the drapery modeling process. Facial similarity may have been achieved through molding with clay, plaster, or pitch-containing material (**fig. 41.9**).[[28]](#endnote-28)

**[A-head]Conclusions** As concluded in previous studies, the Getty herm with slightly undercut detail suggests molding and an indirect cast. The herm shaft would be easily formed by pouring bronze into a mold formed from joined wax slabs but the more complex head required a more complex process. This work may have focused on more simply formed elements, such as the face and frontal beard, and possibly the molding of a simpler head model. The internal rods were most probably designed as casting runners/sprues aiming to reduce the finishing of the outside wall and feed bronze during cooling. The approach created some problems as evidenced by several wall repairs in line with the vertical internal tube remnants. These flaws may have developed in areas where too much wax was used to join the sprue/gate to the inner wall, increasing overall wall thickness and causing variable wall shrinkage on cooling. Additionally, the wax sprues may have contacted and bonded to the inner walls at different points during core introduction. Variable bronze flow through the mold may have resulted in both solid and hollow rod sections (piping). Metal splatter in the head initially suggested separate molding of the head and metallurgical attachment. However, the absence of a clear seam/join and probable repaired porosity at the rear of the head indicate some casting problems. This may also indicate horizontal casting, face down.

Previously published analytical results for the herm (isotopic and alloy composition) are consistent with ancient production and, although the lead-tin bronze composition is broadly similar to that of the Mahdia herm, it does not present the same alloy composition. Isotopic results suggest an Aegean origin for lead in the bronze alloy, although the origin of the separate lead deposit is different and perhaps associated with the installation locality. The cobalt concentration in the bronze is higher than in the lead, possibly associating the cobalt with the copper ore and a more specific copper source, possibly Anatolian. Considered in combination with stylistic Aphrodisian and Pergamene parallels and a signature by Boethos of Calkedon (on the Mahdia herm), more consideration should be given to possible workshop origins in the eastern Mediterranean for both figures.

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1. Scott and Podany 1989. [↑](#endnote-ref-1)
2. Willer 1994b; Mattusch 1994; and Mattusch 1995. [↑](#endnote-ref-2)
3. See Mattusch 2002. [↑](#endnote-ref-3)
4. Scott and Podany 1989. [↑](#endnote-ref-4)
5. Scott and Podany 1989. [↑](#endnote-ref-5)
6. Scott and Podany 1989; Willer 1994b. [↑](#endnote-ref-6)
7. Initial analysis was conducted by Scott and Podany (1989). Subsequent analyses of the Getty and Mahdia herms’ alloys show a very general alloy correspondence (see Pernicka and Eggert 1994; Schwab et al. 2008. Comparison of cobalt traces has led to speculation regarding specific bronze alloy sourcing and workshop control of the alloying process. [↑](#endnote-ref-7)
8. Schwab et al. 2008. [↑](#endnote-ref-8)
9. Willer 1994b; Mattusch 1994; Mattusch 1995. [↑](#endnote-ref-9)
10. Willer 1994a, 1994b. [↑](#endnote-ref-10)
11. See Ridgway 2015 and 2016; and Barr-Sharrar 2016 [↑](#endnote-ref-11)
12. Mattusch 1995. [↑](#endnote-ref-12)
13. Azurite forms as a conversion product of malachite within specific oxygen, pH, and carbonate burial conditions; see Vink 1986. [↑](#endnote-ref-13)
14. The author thanks Eli Ohara, Getty graduate intern 2015–16, for her study and tracings of the herm patches. [↑](#endnote-ref-14)
15. See Willer 1994a, 1994b. [↑](#endnote-ref-15)
16. Lee 2015. [↑](#endnote-ref-16)
17. As observed by author. [↑](#endnote-ref-17)
18. Interior contours may be truer to the mold shape. [↑](#endnote-ref-18)
19. Although mentioned in ancient sources (Lucian *Zeus Tragoidos* 33, see Richter 1951), there is no material evidence for the use of pitch for molding in Classical antiquity. Pitch was used centuries earlier nearer to its Near Eastern sources as a component of adhesives, coatings, and caulks (Connan 1999). Pitch may also have been combined with other materials (such as clay fillers and fiber strengtheners) to create a stronger and more effective flexible mold material. [↑](#endnote-ref-19)
20. S. Decker, pers. comm. 2016. [↑](#endnote-ref-20)
21. Scott and Podany 1989; Willer 1994a, 1994b. [↑](#endnote-ref-21)
22. See Kalpakjian and Schmid 2008. The formation of thin bronze layers during shrinkage is also termed “piping” (S. Decker, pers. comm. 2016). However, leaded copper-tin alloys with wide solidification ranges (due to separation between solidus and liquidus) may, to an extent, inhibit formation of thin skins (D. Scott, pers. comm. 2016). [↑](#endnote-ref-22)
23. S. Decker, pers. comm. 2015. [↑](#endnote-ref-23)
24. Correlation of smelted copper to a specific source using trace elements is somewhat problematic. Gale and Stos-Gale (1992, 66) point out that “ore deposits are not homogeneous in chemical composition, even on the small scale” and “the smelting of ores under primitive conditions also introduces poorly controlled changes in the pattern of minor and trace elements in copper metal when compared with the pattern in the copper ore, especially when one considers the contribution of elements contained in the added flux” (1982, 11­­–12). [↑](#endnote-ref-24)
25. Gale and Stos-Gale 1982; Wheeler et al. 1975. [↑](#endnote-ref-25)
26. Interestingly, plots of isotopic fields for Tunisian sources also correlate generally with the herm lead deposit. See Skaggs 2012. [↑](#endnote-ref-26)
27. Allison and Pond 1983. [↑](#endnote-ref-27)
28. A parallel marble Herm head from Aphrodisias (H. 35 cm) is illustrated by Mattusch 2015, 117, fig. 8.4. The author would also like to acknowledge F. Bewer of the Harvard Art Museums for sharing her thoughts on the complex production genealogy of Renaissance bronzes and inspiring this hypothetical flow chart (fig. 41.9). [↑](#endnote-ref-28)