**[title]The Bronze Sculpture of Alexander the Great on Horseback: An Archaeometallurgical Study**

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[A-head]Abstract

[abstract]

We report here the results of the archaeometallurgical study of the bronze equestrian statuette of Alexander the Great, which was found broken in many pieces during various phases of excavation carried out in Herculaneum around the end of 1761; it was subsequently reassembled in the Royal Foundry of Naples. This famous masterpiece, now in the National Archaeological Museum of Naples, recently underwent a thorough material characterization, which was carried out during a static consolidation treatment at the Restoration Laboratory of Tuscany’s Archaeological Superintendency. This investigation was aimed mainly at interpreting the original execution processes and modern restorations. Although the authenticity of the artifact is supported by its formal coherence and archival information referring to the two figures (Alexander and his horse Bucephalus) and the base, analytical insights were considered of interest in order to assess the material coherence of the many fragments (about fifteen) composing the statuette. The results provide objective material evidence of the antiquity of most of the fragments and shed light on its ancient execution and modern restoration processes.

[main text]

The equestrian bronze group of Alexander on horseback in the National Archaeological Museum of Naples (inv. 4996), which is dated around the first century BC, was found in Herculaneum during the Bourbon excavation campaigns of the second half of the eighteenth century (**fig. 44.1**). According to the sources, the statuette, whose restored height is 49 centimeters, was mostly excavated on October 22, 1761, within a tunnel at the Theater under the Casa dei Colli Mozzi. Upon discovery, the legs and tail of the horse, as well as the legs and right arm of the rider, were missing. Subsequently, between October 24 and November 21, 1761, these were brought to light.[[1]](#endnote-1)

The eyes of the horse and rider, the rosette that holds the mantle (on the right shoulder rather than on the left, as indicated in the excavation report), and the mask that decorates the horse’s breastplate were described as inlaid in silver.

The restoration was carried out shortly thereafter in the Reale Fonderia of Portici, as evidenced by the three rosettes painted on the base (the logo of the foundry), under the direction of Camillo Paderni, Custodian of the Royal Museum, where all of the fragments were transferred. In a report dated June 5, 1762, Paderni writes that “the restoration proceeds very well and that the statuette would become one of the most important items of the Royal Museum.”[[2]](#endnote-2) In 1762, while the restoration was in progress, J. J. Winckelmann, in a letter to Count Heinrich von Bruel,[[3]](#endnote-3) provides an interesting description of the statuette. He says that “an arm of the rider and two legs of the horse are missing,” which, however, “have been restored,” that “the eyes of the horse and rider and bridle are inlaid in silver and that the base is preserved.” Winckelmann also adds that the equestrian group and a prancing horse, found in the same area of the Theater of Herculaneum, “are not shown to visitors because of the restoration, which is still ongoing.”[[4]](#endnote-4)

In 1764, in a letter to Heinrich von Fuessly, Winckelmann once again describes the statuette, which was still under restoration: “missing left arm”; “the right arm is raised”; “the legs are both present”; “the feet are shod”; “lacks the hind legs of the horse”; “the rudder is present”; “the base is decorated with silver inlays on one of the short sides.” By the 1770s, the restoration had been completed and the statuette of Alexander on horseback was exhibited in the middle of the eleventh room of the Herculanean Museum.[[5]](#endnote-5) In 1820, finally, it was displayed among the bronzes in the Real Museo Borbonico in Naples,[[6]](#endnote-6) although the vicissitudes of the various fragments of the artworks were not yet over.[[7]](#endnote-7)

The perception that the Alexander on horseback was an exceptional find is also attested by the fact that a cast of the statue was the first to be created and sent to King Charles III in Madrid. The object had been brought to light, in fact, after the king’s departure for Spain in 1759, and the replica was crafted in order to inform him of the exceptional discovery. The plaster was executed and signed by Antonio Reder (employed in the Reale Fonderia under the direction of Paderni), who made the work so masterfully that it may be considered a sculpture in its own right rather than a simple copy. During transport from Portici to Madrid, however, despite careful packaging, the plaster, currently on display in Madrid in the Real Academia de Bellas Artes de San Fernando, was badly damaged: the arms and legs of the knight and part of the horse’s tail were broken and lost.[[8]](#endnote-8)

The statue of Alexander on horseback, which represents one of the most complete representations of the Macedonian leader, is considered by many to be a miniature copy of the central figure of the bronze group by Lysippos dedicated by Alexander in the sanctuary of Zeus at Dion in Macedonia to commemorate the twenty-five Companions who in 334 BC lost their lives in the battle against the Persians on the Granicus River. The original bronze group, which was renowned in Hellenistic and Roman times, was brought to Rome in 146 BC by Quintus Caecilius Metellus, who exhibited it in the Porticus Metelli. The discovery in Herculaneum, also in the Theater, of two other bronze equestrian statuettes—a prancing horse and an Amazon on horseback—might, according to some scholars, evoke the story told by Kleitarchos of Alexandria of the love between Alexander and Thalestris, queen of the Amazons. Alexander on horseback could be, therefore, a Roman adaptation of Hellenistic prototypes.[[9]](#endnote-9)

[A-head]Visual Examination of the Technological Features

The static consolidation intervention recently undertaken on this work required the temporary disassembly of the four main constituent pieces: rider, horse, base, and rudder (supporting piece), which are mechanically assembled by means of several screws and five bolts. This allowed a careful visual and radiographic examination and the identification of most of the independent metal pieces constituting the statuette.

*Base:* The base (about 230 × 430 mm) is a relatively thin casting (a few millimeters thick) reinforced with a peculiar diagonal metal cross (saltire-like), well-joined on its inner surface. The latter exhibits greenish encrustations along with residues of mortar and lead, which were likely intended to fix the piece on a larger base. Two symmetric plugs in proximity of the short sides are also recognizable on the base, the inner surfaces of which present corrosion phenomena similar to those of the surrounding metal. Very interestingly, one of these plugs is traversed by the threaded end of the rudder (one of the aforementioned bolts).

Floral and geometrical decorations made with white metal are visible on the upper surface of the base, although some motifs are deeply worn and others are obscured by dark patination layers.

*Horse:* The body of the horse appears rather well preserved, while its limbs and tail include very obvious joins. These were executed using various anchoring techniques: small copper alloy inserts, rivets, and soft soldering.[[10]](#endnote-10) The use of a small metal insert is particularly evident on the left hind leg (**fig. 44.2a**).[[11]](#endnote-11) This restoration technique is also attested in other objects from the Vesuvian area, such as the famous Tripod with Sphinxes from Herculaneum preserved in the Naples Archaeological Museum.[[12]](#endnote-12)

The saddlecloth, girth, harness, and reins are fashioned from perfectly shaped thin copper foils and strips, soldered onto the body of the horse with tin-lead alloys (**fig. 44.3**). However, the breastplate up to its lateral soft-soldered phalerae seems more refined than the saddlecloth and girth and presents a clear join at the right point of the shoulder. There are objective clues suggesting that the saddlecloth was likely added during the eighteenth-century restoration. As shown in figure 44.3a, it is shaped from two copper laminae and then carefully cut out and filed along the back and the contour of the terminal part of the mane at the withers.

Figure 44.3 also evidences another crucial feature. The locks of the mane were suitably cut and smoothed (fig. 44.3a) in order to better fit the rider’s skirt (fig. 44.3b).

*Rider:* Examination of the rider indicates that its limbs were anchored to the body by molten copper alloys poured from the inner side, while two damaged zones of the skirt were fixed using a copper foil, which was soft-soldered to the inner side of the skirt (see the left side-arrows in fig. 44.2b). The thighs with the integrated stretches of the skirt perfectly fit the curvatures of the garment and of the ribs at the inner and outer sides, respectively. The limbs were likely originally cast separately and then joined to the trunk of the figure.

[A-head]Radiographic Examination

Several radiographic images were taken in order to identify each of the independent pieces composing the sculpture and to interpret its execution and repair history.

*Base:* In addition to a detailed assessment of features that were already evident to the naked eye, the radiography of the base provided crucial information regarding its authenticity. The base has a variable thickness and moderate porosity. As shown in **figure 44.4a**, the two large plugs mentioned above are very thin and present the typical perimetric housing. The white metal decorations were achieved via a heat process: after creating suitable recesses and cutting the decorative motives from a silver foil,[[13]](#endnote-13) the latter were soldered by first immersing them in a tin-lead bath (see the round porosities in **fig. 44.4b**), and then hammering them into place. Thus, the damascening of the base was not achieved simply by mechanical inlay but a rather through a more elaborate decorative process, in order to increase the durability of the artwork. The authenticity of this decoration and thus of the entire base is also supported by the random consumption of the silver foils and the total loss of some details (see the different radio-opacity of the petals in fig. 44.4b).

*Horse:* **Figure 44.5** shows the reconstructed general view of the horse composed from two images as well as two side details of its neck. These confirm that this artifact is a hollow casting including several interesting structural details described below. The thicknesses of the metal walls are not entirely contrasted in X-ray images because of the radio-opacity of the core, which is mostly still inside the horse; note the abrupt change of radio-opacity at the ideal line between the chest and the withers. A significant macroporosity, produced by fragments of the core materials and air bubbles trapped in the metal, extends from the head to the chest and shoulders of the horse, while the rest of the body shows a higher casting quality. Joint stretches are evident in the repair zones of the limbs and tail (see arrows in fig. 44.5). Furthermore, figure 44.5 proves that the head, body, and limbs of the horse were originally cast independently and then joined by means of hard heat joins (i.e., by filling the gaps with molten bronze). The intentional cut of the wax model before casting can be argued from the straight stretches of unfilled zones of the joins of the neck and left forearm (solid arrows in fig. 44.5). The join of the neck includes a kind of parallelogram-shaped bronze patch at the right side, which exhibits a slightly higher radio-opacity than the main metal wall, possibly due to a higher lead content and/or thickness. Drips are also recognizable in this join zone. They descend from the apex of the joint itself. However, the latter also shows a relatively high radio-opacity, thus making it difficult to determine the origin of the drips: they could have been produced either by cutting wax with a hot tool or by a modern repair using a tin-lead alloy.

All the joins of the limbs and tail were thoroughly investigated. In each case, the repair includes the preparation of suitable housings to be used as mechanical anchors. In particular, the assembly of the forelegs and cannon bones are apparently purely mechanical, while other joins also involved soft solder, such as those at the level of gaskins (see fig. 44.5) and tail (**fig. 44.6**).

Radiographic investigation also demonstrated the perfect fit of the middle stretch of the hind legs and tail, which definitely belong to the original artifact. It is also evident that the lower parts of the limbs were originally solid, although nothing can be said about the authenticity of the present terminal zones from cannons to heels and cannon to hoofs, respectively.

*Rider:* The cast of the rider is mostly hollow, with the exception of most of the limbs, whose initial hollow stretches (see for example the right leg in **fig. 44.7b**) were exploited by Bourbon restorers for anchoring them to the body of the figure by pouring in molten bronze. These modern repairs were not entirely successful since the limbs are not perfectly blocked. The neck seems to show traces of a possibly original heat join, although this cannot be objectively demonstrated.

The wall thicknesses of the body vary considerably. In particular, thickenings are observed at the reliefs of the armor and draping of the mantle, suggesting the direct shaping of the wax model for casting.

[A-head]Chemical Analysis of the Alloys

The results of the examinations described above allow us to identify most of the individual pieces comprising the present sculptural group. These are rendered in different colors in **figure 44.8**, where the sites of the compositional characterization are also marked. The latter was carried out using laser induced plasma spectroscopy (LIPS or LIBS). In this noninvasive technique, short laser pulses are focused on the material of interest and its elemental weight fractions are derived through spectral analysis of the bright plasma plumes generated at the laser focus. Several spectra are usually collected at the measurement point, which allows for an elemental depth profile within several hundreds microns, thus providing information on corrosion processes and bulk composition.[[14]](#endnote-14) In addition to LIPS, X-ray fluorescence (XRF) was used for quick qualitative assays of the silver decorations.

The results are summarized in tables 44.1–2, where the main alloys and those of plausible independent castings are grouped. The average composition of the horse (**table 44.1**) is 11.7 ± 0.7 wt% tin and 3.6 ± 0.7 wt% lead. The lead content of the limbs and tail is significantly higher, thus supporting their probable independent casting, although the only clear evidence of an ancient join is that of the left foreleg (fig. 44.5, far right). The saddlecloth, breastplate, and reins were crafted in pure copper (impurities <1%).

The rider (**table 44.2**) has an average tin weight fraction similar to that of the horse and a higher lead content: 11.0 ± 0.9 wt% tin, 10.4 ± 1.5 wt% lead. The right arm and the lower part of the sword, which is an integral part of the hand, is the only piece with a slightly different composition: 7.3 wt% tin, 7.6 wt% lead. Finally, the base has an intermediate composition between rider and horse—12.0 ± 0.2 wt% tin, 7.6 ± 0.5 wt% lead—while that of the rudder is similar to the main alloy of the horse.

The areas where traces of silver decorations were found using XRF are: the pupil, the sword pommel, the phalerae, and pendant of the rider; right phalera of the breastplate and the pupil of the horse. The presence of silver was confirmed for most of the base decoration, while in areas where the foil was consumed or completely lost, tin-lead alloys were detected.

The elemental depth profile used to derive the above-reported compositions included approximately 1,500 spectra collected at each measurement point. They mostly exhibited the typical broad modulations associated with the corrosion effects observed in archaeological objects. The only anomalous behaviors of the tin content were those of the horse’s left hind cannon (meas. 24), right fore hoof (meas. 3), and left fore pastern (meas. 4). The depth profiles measured in these areas were rather flat, something that is typically observed in bronzes that have aged for a relatively short period.

Very interestingly, the rudder exhibited a broad profile congruent with lengthy burial. This piece has threaded ends and the top is screwed into a threaded copper insert in the girth of the horse.

[A-head]Conclusions

The equestrian group of Alexander the Great is composed of four authentic ancient bronze sculptures: rider, horse, rudder, and base. They demonstrate known as well as new aspects of the ancient foundry production. The rider and the horse were cast in pieces, and the main alloy of the latter recalls those used in the Hellenistic period for large bronzes. The alloys of the rider, base, and independent castings of the horse are more leaded, as is usual for ancient statuettes and other small bronze objects. The technological examinations and the study of the elemental depth profiles indicates that the terminal parts of three limbs were likely cast and integrated after the discovery of the artifact. The saddlecloth was either adapted to the horse or completely fabricated in modern times, while at least the front part of the breastplate is ancient.

None of the three sculptural pieces of the group present traces of slush casting of the waxes and the rider exhibits clues of direct shaping (i.e., it seems an original model). Further investigations are needed in order to assess whether the rider and horse belong together. In particular, we suggest that future studies include the other prancing horse found in the same area of Herculaneum in order to gain further insights.

**[A-head]Acknowledgments**

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1. Excavation daybook notes for the relevant dates are as follows: October 24, 1761: “part of the sword”. October 31, 1761: “the metal base and a fragment of the embellishments of the horse”. November 3, 1761: “the right leg of the rider”. November 19, 1761: “a hoof of the horse”. November 21, 1761: “the right hoof, two feet of the horse, sword, right arm, right leg and left leg of the rider”. [↑](#endnote-ref-1)
2. Scatozza 1982. [↑](#endnote-ref-2)
3. Winckelmann 2011, 94. [↑](#endnote-ref-3)
4. Winckelmann 2011, 186. [↑](#endnote-ref-4)
5. Allrogen-Bedel and Kammerer-Grothaus 1980, 207. [↑](#endnote-ref-5)
6. Gelas 1820, 32. [↑](#endnote-ref-6)
7. Ruggiero 1885, 372–75. In 1897 the decoration of the chest disappeared for several years as evidenced by the note C5 IV, 24, unpublished, of the Historical Archive of the Soprintendenza Archeologia of Campania. Even the sword is no longer preserved. It appears in Brogi’s photographs of the late nineteenth century and even in those of 1959 preserved at the Photographic Archive of the Soprintendenza Archeologia of Campania. After that date, it is no longer recorded. [↑](#endnote-ref-7)
8. Alonso Rodriguez. [↑](#endnote-ref-8)
9. Lapatin 2015, 189. [↑](#endnote-ref-9)
10. Using tin-lead alloys as the filler. [↑](#endnote-ref-10)
11. Similar studies on the presence of mechanical joints were carried out both at the Restoration Center of Florence and at the Getty Center, where the bronze group underwent a further static consolidation carried out by conservator Jeffrey Maish before the exhibition *Power and Pathos: Bronze Sculpture of the Hellenistic World* (2015). [↑](#endnote-ref-11)
12. It was considered for a long time that the Tripod with Sphinxes, National Archaeological Museum of Naples (NAMN) inv. 72995, dated between the end of the first century BC and the beginning of the first century AD, came from the Temple of Isis in Pompeii. Recent studies attribute it instead to Herculaneum. In 1997, the Tripod underwent restoration at the Laboratory of Conservation and Restoration of the NAMN under the direction of Luigia Melillo by the restorer Giovanni Cirella. The data are unpublished. [↑](#endnote-ref-12)
13. See the compositional analysis reported below. [↑](#endnote-ref-13)
14. More details on this technique can be found in Agresti, Mencaglia, and Siano 2009, and Siano and Agresti 2015, S107–S108. [↑](#endnote-ref-14)