The Statue of Germanicus from Amelia: New Discoveries

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DIS MANIBVS GERMANICI IVLII CAESARIS
(on the 2,000th anniversary of his death)

This archaeological note presents the findings from a scientific analysis of the bronze of an over-life-sized cuirassed statue of Germanicus from Amelia (ancient Ameria). The examination was recently carried out in the Museo Archeologico di Amelia to determine both the nature of the statue's production and its relative dating. The 41 nondestructive X-ray fluorescence spectrometry measurements taken on 32 different parts clearly show that there were two, not three, phases (as had been proposed in the only major monograph on the statue) involved in the production of this sculpture. Some analyses using inductively coupled plasma-optical emission spectrometry were also carried out on drillings taken from detached fragments of the statue that were recently rediscovered in the Museo Archeologico Nazionale dell'Umbria in Perugia. The new scientific examinations indicate that all parts of the statue except the cuirass were produced at the same time and apparently were originally being prepared for gilding, which in the end was not carried out for reasons that are discussed.[1]

INTRODUCTION

In an article published in the July 2017 issue of the *American Journal of Archaeology*, Pollini argued against the hypothesis that parts of a statue of Germanicus in the Museo Archeologico di Amelia (fig. 1) originally belonged to an image of King Mithridates VI of Pontus that was reused first for a statue of Sulla and subsequently for the Amelia Germanicus.[2] Instead of such a three-phase scenario extending over some hundred years, Pollini proposed that the original statue represented Caligula, whose head was then replaced with that of his father Germanicus after Caligula's assassination in 41 C.E. and the subsequent damnation of his memory.[3] Images of Caligula were consequently destroyed, damaged, or removed from public display under his uncle and successor Claudius.[4]

Supporting Pollini's interpretation is the type of cuirass worn by the Amelia Germanicus. With its skirt of distinctively decorated *pteryges* (the flaps

[1] We gratefully acknowledge the generous grant from the Loeb Classical Library Foundation to carry out analysis of the bronze in the statue of Germanicus. Special thanks are also owed to Riccardo Passagrilli, Responsabile of the Museo Archeologico di Amelia, for his support throughout this project and to the Soprintendenza dell'Umbria for further assistance. Figures are our own unless otherwise noted.

[2] Pollini 2017. Statue of Germanicus: Amelia, Museo Archeologico di Amelia, inv. no. 50207.

[3] Pollini 2017, 435–36, contra the three phases proposed in Rocco 2008a, 2008b.

[4] Pollini 2017, 432 and n. 39.

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FIG. 1. Statue of Germanicus from Amelia, Italy (Museo Archeologico di Amelia, inv. no. 50207).

around the bottom of the cuirass), consisting of an upper row of semicircular *pteryges* and a lower row of longer, tongue-shaped ones (see figs. 1, 2), this form of muscle cuirass is known as the "Butrint" type, so called after two marble statues that were discovered in front of the scaenae frons of the theater at Butrint in modern Albania (fig. 3).[5] Though the breastplates of the Butrint statues are undecorated, the two rows of *pteryges* of each are adorned with the same motifs as the *pteryges* of the Amelia Germanicus: the upper row with lion heads (on the Germanicus, alternating with satyr heads); the lower row with only palmettes (see fig. 2).[6] Marble heads of Augustus and of Agrippa that were also found in the theater quite likely once belonged to these Butrint statues, which thus may have referenced Augustus' victory at Actium in 31 B.C.E. and were probably set up between ca. 23/21 and 12 B.C.E. Although muscle cuirasses are found earlier than Actium, none are of the Butrint type, with its distinctively shaped and decorated *pteryges*.[7] Typologically, this would exclude Germanicus' cuirass from the possibility of having been reused from a statue created a century or so earlier that represented Mithridates or Sulla. A number of variants of the Butrint-type cuirass were used for portraits in the Early Imperial period; some of these cuirasses were left undecorated, while others were embellished on their breastplates and sometimes backplates as well. None, however, show the Scylla or the Achilles and Troilus motif of the Amelia Germanicus.[8]

Though not proposed in Pollini's 2017 article, the Butrint type of cuirass with these combined motifs might have been produced originally for statues of Augustus set up after his victory at Actium. One possible location for such an image was Augustus' great victory

[5] See Cadario 2004, 123–28; Laube 2006, 119–22, cat. no. 8, pl. 50.1 (this statue is now lost) and cat. no. 9, pl. 50.2–4 (Tirana, Albania, National Museum of History).

[6] Pollini 2017, 430.

[7] Cf. Rocco 2008a, 555–92.

[8] For a possible exception, see the bronze appliqué figure of Achilles from Oderzo, Italy, now in the Museo Archeologico Nazionale in Venice: Pollini 2017, 434.

FIG. 2. Statue of Germanicus from Amelia: detail of upper and lower *pteryges* forming the lower border of the cuirass.

monument at Nikopolis in western Greece,[9] about 130 km from Butrint.[10] Whether at Nikopolis (where several bases for now missing statues have been found),[11] Rome, or elsewhere, such a highly decorated cuirass with motifs appropriate for Augustus[12] might then have served as a model for the breastplate of a statue of Caligula, intended to celebrate his putative land and sea victories and to emulate Augustus' successes "terra marique" (on land and sea; Augustus *Mon. Anc.* 4, 13). Even more relevant would have been the reuse of such a cuirass in a statue honoring Caligula's father, Germanicus, for his actual land and sea victories.[13] In accord with this imagery is a travertine column capital decorated with military trophies and ships' prows (fig. 4) that was found with the Amelia Germanicus.[14] This capital probably came from an imperial cult shrine, or Augusteum, that once housed the bronze statue of Germanicus and probably images of other members of the Augustan and Julio-Claudian family.

It has recently been suggested that the head of the Amelia Germanicus belonged to the original statue (i.e., that it was a one-phase statue).[15] However, the lack of alignment between the head and the rivets on the inside of the collar of the cuirass (figs. 5–7) clearly indicates that the head and cuirass were not originally part of the same sculpture.[16] In order to resolve such questions and confirm the statue as having been created in two phases, the first scientific examination of the statue was carried out from 2017 to 2018. The results of that physicochemical analysis are reported here and help to establish which parts belonged to the original statue and which were added to produce the figure as it now appears.

[9] For the Nikopolis Victory Monument: Pollini 2012, 191–96 , with further bibliography.

[10] Both sites were intimately associated with the Julio-Claudian family: Cadario 2004, 123.

[11] Pollini 2012, 193.

[12] Pollini 2017, 432–35.

[13] Pollini 2017, 435.

[14] Now in the Museo Archeologico at Amelia, mus. cat. II, no. 158. See Pollini 2017, 426, 435–36.

[15] As proposed by A. Salcuni (2014, 140–42; 2017, 128–29).

[16] Pollini 2017, 432.

FIG. 3. One of two marble statues from the theater at Butrint, Albania, now lost (after Laube 2006, pl. 50.1).

FIG. 4. Travertine column capital with trophies and ships' prows, found with the Amelia statue (Amelia, Museo Archeologico di Amelia, mus. cat. II, no. 158).

COMPOSITIONAL ANALYSES OF THE GERMANICUS STATUE

Methods of Analysis

As we could not initially take destructive samples from the statue, and as the statue could not be brought to a laboratory, we first used transportable X-ray fluorescence (XRF) equipment and carried out measurements in the museum at Amelia. For this enterprise, scaffolding 3 m high was built around the statue so that most parts could be reached with the XRF beam. The equipment employed for the physicochemical analyses has been especially developed for cultural heritage applications when objects cannot be moved to a laboratory for analysis. The precision is comparable to that of laboratory equipment and is at least one order of magnitude greater than that of portable X-ray fluorescence (pXRF), the now very commonly employed handheld devices that can give only an approximate idea of the composition.

The equipment consists of several parts: an XRF source on a support containing a transformer, a stabilizer, a computer with dedicated software, and various other devices. The head of the system is equipped with an adjustable collimator that allows for enlargement or reduction of the beam diameter (down to 1 mm), as required. A laser pointer indicates the exact spot of the measurement on the item to be analyzed. The correct distance (within a span of 0.1 mm) is confirmed by an audio signal. The spectrometer has a Si(Li) (silicon lithium) detector and operates at a maximum voltage of 50 kV and a maximum current of 0.35 mA. The characteristics of the equipment, the dedicated software, and a suitable number of standards as similar in composition as possible to ancient alloys (produced ad hoc by AGM Archeoanalisi, Merano, Italy) greatly enhance the precision of the system.

This analytical method has been successfully employed on a wide range of materials from many archaeological projects. A large number of elements, in particular metals and alloys, can be simultaneously quantified with a high degree of precision if proper standards and some caution are used.[17] Detection limits vary depending on the element. Here, results under 0.2% have been considered as traces (table 1). Comparisons between previous analyses using both atomic absorption spectrometry (AAS) and XRF on the same

[17] Lutz and Pernicka, 1996.

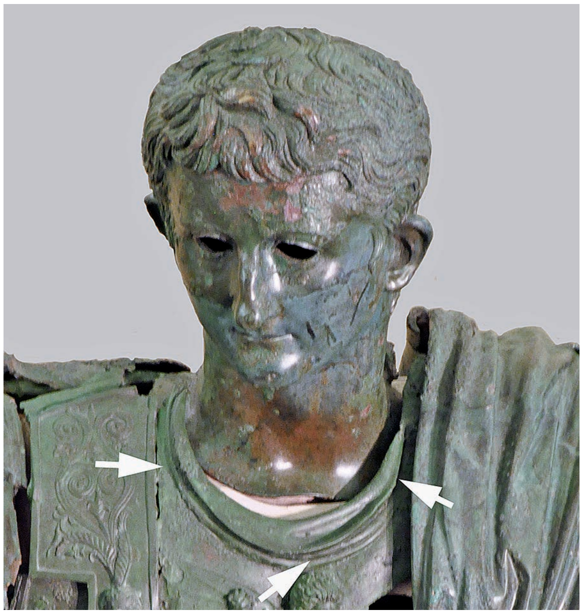

FIG. 5. Head of Germanicus with collar of the cuirass; arrows indicate locations of the three stubs of rivet posts on the inner side of the collar.

FIG. 6. Detail of outer side of collar.

FIG. 7. Inner side of collar; arrows indicate locations of the three rivet posts.

(approximately 100) samples taken from various objects, excavated from another site, demonstrated that more than 90% of the XRF results were well within +20% of the corresponding AAS results. Statistical calculations applied to the tin and lead results showed that the data for these most important alloying elements were well correlated and comparable.[18]

A problem with XRF is that the analyses are superficial, and if corrosion phenomena are present, the data may be enhanced or diminished depending on the kind of corrosion and the structure of the patina. To avoid these problems as much as possible, the parts for potential analysis were first carefully examined to determine their condition of preservation and to identify the best areas for analytical measurements. For all fragments in the museum's vitrine,[19] and the sections of the statue that could be reached with a digital microscope, this examination was done both autoptically and with the digital microscope. On the areas that could not be reached by the digital microscope, the examination was done with magnification lenses of different types and sizes. The aim of the examination was twofold: first, to detect the presence of heavy corrosion that might compromise the measurements, and second, to look for traces of specific working, such as chasing or polishing, employed in the finishing of the statue.

After the original analytical campaign, additional fragments of the statue were discovered in the Museo Archeologico Nazionale dell'Umbria in Perugia. Our

[18] Cf. Soles and Giumlia-Mair 2018, 501–2.

[19] Some detached parts of the original were deformed and could not be successfully reattached; resin-based casts of them have been added to the statue on display and the original pieces are displayed separately. The replacements include: the upper part of Scylla, a section of her fish tail, the Victoria under the (proper) right opening of the cuirass, the right *epomis* (shoulder clasp), the sword and scabbard with sash, the upper and lower sections of the spear with points, and a section of the front part of Germanicus' tunic with the upper part of his left leg.

TABLE 1. Results of compositional analysis of the statue of Germanicus from Amelia.

No.	Object	Part	Method	%Cu	%Sn	%Pb	%As	%Sb	%Fe	%Ni	%Ag	%Zn	%Co	%Bi	%Mn	%Au
1	spear	point	XRF	93	6.3	0.3	tr	tr	0.3	–	–	–	–	–	–	–
2	spear	*sauroter*	XRF	93	6.2	0.2	tr	tr	0.2	–	–	–	–	–	–	–
3	spear	shaft	XRF	91	6.9	1.3	0.2	tr	0.5	–	tr	–	tr	–	tr	–
4*	1st *pteryx*	base	XRF	84	8.2	7.3	–	0.2	0.2	tr	–	–	–	–	tr	–
5	1st *pteryx*	black inlay	XRF	97	2.2	0.4	tr	tr	0.3	–	tr	–	–	–	–	tr
6*	1st *pteryx*	satyr	XRF	83	8.7	7.9	tr	tr	tr	–	–	–	–	–	tr	tr
7	fitting	hook	XRF	95	4.1	tr	–	tr	0.2	–	–	–	–	–	–	–
8*	cuirass	front	XRF	85	7.9	6.1	tr	0.3	0.6	–	tr	tr	tr	–	tr	–
9*	cuirass	front	XRF	84	8.4	6.3	–	tr	0.8	tr	tr	tr	0.2	–	–	–
10*	cuirass	Scylla's tail	XRF	81	9.8	7.8	–	0.3	0.8	tr	tr	0.3	tr	tr	tr	–
11	cuirass	black inlay	XRF	96	1.9	0.9	tr	–	0.4	–	0.2	–	–	–	–	0.3
12*	*epomis*	right	XRF	83	9.7	6.5	0.2	tr	0.2	–	tr	–	tr	–	tr	–
13	cuirass	black inlay	XRF	96	1.9	0.9	–	0.2	0.4	–	0.2	–	tr	–	tr	0.2
14	sword	blade	XRF	95	3.8	0.7	–	tr	0.3	tr	–	–	–	–	–	–
15	sword	taenia	XRF	95	4.1	0.7	tr	tr	0.2	tr	–	–	–	–	–	–
16*	cuirass	Scylla	XRF	87	6.3	5.6	–	tr	0.4	–	tr	–	tr	–	tr	–
17	tunic frag.		XRF	93	4.6	0.9	–	–	0.7	–	–	0.3	–	–	–	–
18	tunic frag.	repair	XRF	94	3.5	0.8	0.2	–	0.5	–	tr	0.4	tr	–	–	–
19	right Victoria	left arm	XRF	93	3.1	1.7	–	–	0.2	–	–	1.3	–	–	–	–
20	left Victoria	body	XRF	95	2.9	tr	–	–	0.2	–	–	0.8	–	–	–	–
21	head	top	XRF	93	5.2	1.4	tr	tr	0.4	–	–	–	tr	–	–	–
22	cloak	fragment	XRF	89	6.7	2.3	–	0.2	1.3	–	tr	–	–	–	–	–
23	right sleeve		XRF	97	1.8	0.5	–	–	0.3	–	–	tr	–	–	–	–
24	right sleeve	repair	XRF	91	8.2	tr	–	tr	tr	–	–	–	–	–	–	–
25	right arm	forearm	XRF	90	6.4	3.1	–	tr	0.3	tr	–	–	tr	–	tr	–
26	right hand	forefinger	XRF	96	2.6	0.9	–	–	0.4	–	tr	–	–	–	–	–
27	right foot	top	XRF	93	4.7	1.8	–	tr	0.3	–	–	–	–	–	–	–
28	left foot	top	XRF	95	2.9	1.4	–	–	0.4	–	–	–	–	–	–	–
29	left tenon		XRF	3	18	64	–	–	12	–	–	–	–	3	–	–
30	left arm	forearm	XRF	94	4.3	1.2	–	–	0.4	–	–	–	–	–	–	tr
31	left hand	back	XRF	94	3.5	1.8	–	–	0.3	–	–	–	–	–	–	–
32	solder	fragment	XRF	tr	36	62	–	–	1.9	–	–	–	–	–	–	–
33	left knee	fragment	ICP	91	5.22	1.48	–	0.03	0.62	0.023	0.03	0.005	–	–	0.02	–
34	cloak	fragment	ICP	90	6.23	1.59	–	0.04	0.41	0.022	0.03	0.004	–	–	0.01	–
35	spear	shaft	ICP	90	7.94	1.04	–	–	0.77	0.023	0.03	0.004	–	–	0.02	–
36*	*pteryx* frag.	base	ICP	80	9.36	8.64	0.02	0.32	0.53	0.096	0.08	0.004	0.04	–	0.05	–
37*	*epomis*	right	ICP	81	10.82	6.76	0.02	0.27	0.48	0.103	0.09	0.003	0.05	–	0.06	–

XRF = X-ray fluorescence; ICP = inductively coupled plasma-optical emission spectrometry; tr = trace amount, <0.2%; dash = not detected.

* Parts of the statue belonging to the cuirass showing higher tin (Sn) and lead (Pb) content.

initial nondestructive XRF observations of these detached fragments differed from much older analyses carried out in the 1970s[20] and 1980s[21] by scanning electron microscope with energy dispersive spectroscopy (SEM-EDS) on unspecified single fragments. We therefore received permission to take small samples of these fragments with a drill for a more precise analysis by inductively coupled plasma-optical emission spectrometry (ICP). For comparison, we also carried out new SEM-EDS analyses on the same samples. The ICP analyses broadly confirmed our nondestructive observations by XRF with slight differences (see table 1), mainly in the tin content, that can be attributed to the effects of surface corrosion, while the results of the SEM-EDS analyses were not meaningful and were erratic, depending on the area of measurement, for which reason we do not report them here.[22]

Results of the Analysis

Based on analytical data obtained with XRF and ICP (see table 1), the parts of the statue can easily be divided into groups characterized by different compositions. All analyzed parts of the cuirass (see table 1, nos. 4, 6, 8, 9, 10, 12, 16, 36, 37; this excludes the appliquéd figures of Victoria, nos. 19, 20) contain noticeable amounts of tin (XRF results ranging from 6.3 to 9.8% Sn; ICP results up to 10.82% Sn) and lead (XRF results ranging from 5.6 to 7.9% Pb; ICP results up to 8.64% Pb). The other parts (see table 1, head no. 21; arms nos. 23–26, 30, 31; tunic nos. 17, 18; legs nos. 27, 28, 33; spear nos. 1–3; and sword nos. 7, 14, 15) contain much lower percentages of these elements, with a tin content of about 3–7% and a lead content of around 2% or less. The spear (see table 1, nos. 1–3) and sword (see table 1, nos. 7, 14, 15) contain even less lead, less than 1%, most likely because, given their small sizes and simple shapes, they were relatively easy to cast, and an alloy with almost no lead could be used. The addition of up to 2% lead to copper-based alloys improves the fluidity of the metal during casting, while higher lead percentages do not increase the fluidity but do significantly lower the melting point. Additionally, lead is much less expensive than copper or tin. Particularly in the Late Imperial period, when many statues were produced, lead was added in very large amounts to the alloys used for casting statues, up to even 50% Pb.[23] A high lead content, however, darkens the alloy, resulting in a dull-looking surface.

The addition of tin and lead to copper-based alloys was avoided as much as possible when copper-based objects, including statues, were meant to be fire gilded; this was especially true in the case of good quality castings like the Amelia sculpture. When fire gilding (also called amalgam or mercury gilding) was planned from the beginning, lead in the alloy was either completely avoided—as in the horses of San Marco, which contain only about 2% tin[24]—or, when the castings were particularly large and complex, as little as possible was used, ideally only 2% or 3% of tin and the same amount of lead.[25] In the Germanicus statue (with the exception of the cuirass), almost no lead was employed and the tin content is also low.

A higher amount of tin and lead in fire-gilded, copper-based alloys would produce unsightly spots on the layer of gilding and was therefore avoided.[26] In later imperial times, when statues became almost mass-produced and were less well worked, some leaded statues were fire gilded, and the spots were concealed with pieces of gold leaf.[27] By contrast, in early imperial times, when the Germanicus statue was created, metalworkers were more careful, especially in producing statues that represented members of the imperial family. It was quite surprising to find that the Germanicus statue's head, arms, legs, tunic, and weapons were apparently cast with the intention of being fire gilded but were combined with a cuirass that, because of its higher lead and tin content, was not suitable for this type of gilding. Even if we allow for a margin of error (the XRF, as a surface analysis, might have tested corroded areas), the consistency of the compositional data, the large number of analyses, and the new, much more precise ICP analyses carried out on the fragments in the Perugia museum demonstrate that the results are sound. Further, it is not likely that some parts of the figure (the head, body parts, and weapons) would be more corroded than the fragments of

[20] Dassù and Alessandrini 1974.

[21] Leoni 1991.

[22] The details were photographed with a digital camera equipped with two macro lenses and with a microscope with different magnifications (esp. 50X and 200X).

[23] Giumlia-Mair and Craddock 1993.

[24] Vittori 1979.

[25] See, e.g., Craddock 1985, 1995; Giumlia-Mair 1999, 2002a, 2002b, 2002c; Giumlia-Mair et al. 2002.

[26] Cf. also Brehpohl 1987, 217.

[27] Giumlia-Mair 1999, 2002a.

the cuirass, since they were all found randomly mixed together in the same findspot.

As mentioned above, the location of the three rivet stubs inside the collar of the cuirass (see fig. 7) indicate that the original head must have had a somewhat longer and wider neck than the present head of Germanicus in order for the rivets to affix the previous head to the breastplate. The position of the right arm also does not appear to correspond to that of the right shoulder. These discrepancies, together with the differences in the composition of the metal, seem to show that the head, limbs, and attributes were at some point adapted to a reused cuirass taken from a preexisting, dismantled statue. All the parts of the present statue would probably have been held together by an internal support, presumably made of iron bars. The head may have been attached to the back of the cuirass, possibly with a hard solder, but we do not have data on this, since it was impossible to reach this area with the XRF beam. Even if the gap between the head and collar of the cuirass were not somehow closed, the neck of the tunic above the collar of the cuirass would have masked the gap when the statue was seen from below. The figure itself was over life-sized (2.09 m tall) and stood on an 88 cm high uninscribed travertine base (see fig. 1, left), which sat on another architectural element that once would have borne an inscription.[28]

It is interesting to note that the Victoria appliqués affixed to the cuirass (fig. 8)[29] have a chemical composition that is different from that of the cuirass itself but similar to that of the head and limbs of the statue in their low tin and lead composition (see table 1, nos. 19, 20). The same is probably true of the palmette appliqués on the breastplate just above the *pteryges* (see fig. 1, right), as well as of the *saltantes Lacaenae* appliqués added to the backplate on either side of the central incense candelabrum, which was cast as part of the backplate itself.[30] Regrettably, these appliqués could not be analyzed because they could not be reached with the XRF equipment. That all the figural appliqués were most likely added to the cuirass at a later date is also borne out by the substantially lower quality of their workmanship as compared with the skillfully crafted Scylla, Troilus, and Achilles that form part of the breastplate itself. Unlike these relief figures with their fine details, the two Victoriae and *saltantes Lacaenae* are rather crudely rendered, with simplified anatomy and summarily treated garments.[31] The

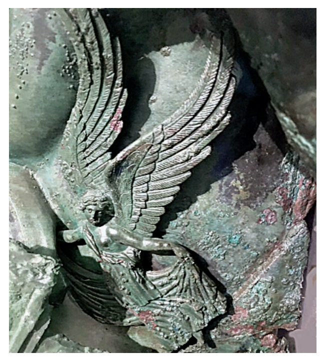

FIG. 8. Details of the statue of Germanicus from Amelia: Victoria appliqués on the cuirass under the armpits: *top*, proper right side; *bottom*, proper left side.

[28] Pollini 2017, 425–26 with nn. 2, 3, fig. 3. This additional architectural element has been reproduced in its setting today in the Amelia museum. The upward-turned, deformed base of the neck shows slightly in the photograph in fig. 1, left, which was taken when the statue was in the Capitoline Museum in Rome in a special exhibition, without any other architectural element below the travertine base.

[29] For the location of these two Victoria figures under the arm openings in the cuirass, see Pollini 2017, 429, fig. 4c; 431, fig. 5d.

[30] For the *saltantes Lacaenae* and the incense candelabrum, see Pollini 2017, 431, fig. 5e. For the rare representation of a similar candelabrum in relief on a breastplate, see the bronze figure from Sancti Petri, near Cadiz, Spain, now in the Museo Arqueológico de Granada. Interestingly, instead of Scylla or the more common *gorgoneion* on the breastplate, a head of the god Oceanus is used for the Sancti Petri statue. For this statue, see Rodríguez Oliva 2009, 122–24; Olcina Doménech 2017, 143, fig. 3.

[31] The conventional and monotonous repetition of the folds of their garments and lack of proportions of their limbs has also

paludamentum (the cloak; see table 1, no. 22) covering Germanicus' left shoulder has the same composition as the head and the other parts, with only 6.7% of tin and 2.3% of lead, and is therefore to be considered an addition to the cuirass; the same is true of the spear and sword, both of which, as noted before, have lower tin content and no lead added.

The black inlays in the palmettes of the lower *pteryges* (see figs. 1, right; 2) and in the stylized sea-wave inlay pattern under the figure of Scylla (fig. 9) deserve particular mention, as they are an instance of the use of a special alloy known as *Corinthium aes* on bronze works of art. This alloy, containing small amounts of gold and silver, achieves its black patina after a chemical bath in an aqueous solution containing copper salts and other ingredients.[32] This black alloy is mentioned by many Latin and Greek authors as the most precious copper-based alloy. As Pliny states (*HN* 34.1), it was "valued before silver and almost even before gold."[33] Propertius (3.5.3) even lists *Corinthium aes* together with gold, precious stones, and land property, while Seneca the Younger (*De Brevitate Vitae* 12.2) describes passionate collectors "who spend most of the day with their *aeruginosis lamellis* ('rusty metal sheets'),"[34] referring to the characteristic purple-black patina. Suetonius mentions that both Augustus (*Aug.* 70.2) and Tiberius (*Tib.* 34.1) possessed a collection of *Corinthia* (Corinthian objects), while Pliny the Younger describes his *Corinthium signum* (statuette) with its beautiful patina (Plin., *Ep.* 3.6.1). Many contemporary authors also clearly state that *Corinthium aes* is an alloy of copper with gold and silver.[35]

While the analysis of the background metal of one *pteryx* (see table 1, no. 4) of the Amelia statue showed a composition similar to that of the cuirass, the examination of the black inlays (see table 1, nos. 5, 11, 13), which have always been described as being of unalloyed copper,[36] revealed low traces of silver (ca. 0.2% Ag) and gold (up to 0.3% Au), as well as low traces of lead (up to 0.9% Pb) and tin (ca. 1.9–2.2% Sn). The tin and lead percentages compare well with those of the red copper inlays commonly employed for the lips of statues because the low amounts of these elements render the metal more malleable, therefore facilitating its casting and working. However, the low amounts of gold and silver determined in all measurements of the statue's black-patinated material (i.e., in the palmettes of the *pteryges* and in the stylized waves; see figs. 2, 9) are too regular and too high to be considered just an impurity. Normally, the traces of silver and gold present in Roman copper are very low (Ag in the range of 0.02–0.1% and Au 0.0002–0.001%) and are barely or not detectable by XRF. Copper was apparently routinely treated to recover the precious metals present in the raw copper after smelting.

As demonstrated by many analyses of ancient materials in the last two decades, there were various recipes for *Corinthium aes,* some of which are given in the texts

FIG. 9. Details of the statue of Germanicus from Amelia: *top*, black *Corinthium aes* inlays in sea-wave pattern below Scylla; *bottom*, detail of stylized wave.

been pointed out by Rocco (2008a, 626–28).

[32] Craddock and Giumlia-Mair 1993; Giumlia-Mair and Craddock 1993; Giumlia-Mair 1996, 1997, 2002d, 2015a; Giumlia-Mair and Lehr 2003; Giumlia-Mair and Mráv 2014.

[33] Trans. Rackham 1984.

[34] Trans. Basore 1932.

[35] Cf., e.g., Flor. 1.32 (2.16); Paulus Orosius 5.3; Petron., *Sat.* 50; Plin., *HN* 9.139, 34.5; Plut., *Mor.* 395b–396c; Quint., *Inst.* 8.2.8.

[36] See, e.g., Rocco 2008a, 517.

of Zosimos, the most famous alchemist of antiquity.[37] The quantity of precious metals present in the different alloys varied, while some other metals, such as arsenic and iron, could be added in very low amounts (0.2–0.3% As and Fe). To achieve this composition, a rather complex procedure had to be performed. As explained in the recipe found in Zosimos "for producing thin strips of black Corinthian in the manufacture of idols or those bronze statues, which you want to be black,"[38] eight drachmas of gold and eight of silver had to be added to one mina of Cyprian copper (i.e., unalloyed and well purified). These indications correspond to an alloy of copper (82.6% Cu) containing 6.9% gold and 6.9% silver. This alloy, containing gold and silver, in Zosimos' words, "had to be colored to be able to color"; that is, it had to be first treated in a solution. After treatment, the metal was divided into small portions that were then added to unalloyed copper to obtain the final alloy, which had to be treated again in a solution containing copper salts in order to achieve the final patination. In this way, the gold and silver content present in the final patinated alloy was reduced to around one-tenth or less of the amount of precious metals present in the primary alloy containing eight drachmas of gold and eight of silver.[39] Various experiments have also demonstrated that copper alloys with low amounts of precious metals, such as the inlays in the statue of Germanicus, can be patinated.[40] The presence of low amounts of precious metals is the important factor in achieving the beautiful purple-black patina of the alloy that, before treatment, has a red color. A further important characteristic of this patina is that, after it has been damaged, the color regenerates by itself after a while.[41] The statue's inlays, which turned red after cleaning, were considered to be simply copper, but they have now turned black again, since the patina continues to grow—a typical characteristic of *Corinthium aes*.

Some fragments of other large statues decorated with this material have also come down to us, as well as several statuettes or small-scale statues, including the 50 cm high image in the British Museum of the emperor Nero wearing a cuirass decorated with a black Corinthian alloy and silver inlays.[42] The best-known example of *Corinthium aes* is a section of drapery with a large number of multicolored inlays from the *paludamentum* of a large-scale statue, possibly of Caracalla, discovered at Volubilis in Morocco.[43] There are also fragments of another cuirassed statue in the Museo di Antichità in Turin that have never been analyzed and are decorated with black and silver inlays that might be *Corinthium aes*.[44] There exist some patinated alloys with a silvery-beige color from Japan as well, but up to now only one Roman example has been identified.[45]

CONCLUSIONS

The compositional analysis of the statue from Amelia leaves no doubt that its cuirass comes from a previous figure, probably of Caligula, as previously suggested. The reuse of this cuirass for the present image of Germanicus seems to have been an afterthought, resulting in the abandonment of the idea of fire gilding the other parts of the sculpture that had already been cast using the alloy appropriate for gilding. It is likely that these parts of the statue—other than the cuirass—were intended for one of a number of gilded images of Germanicus being produced as part of the dynastic propaganda of Germanicus' brother Claudius, who succeeded Caligula as emperor.[46] The cuirass was richly decorated to begin with, but apparently not sufficiently so for whoever commissioned this statue, for which reason appliqué figures and other decorative elements were added, together with the *paludamentum*, the sword, and the spear.

From what we know in general about copper-based alloys from archaic to classical Greek times, copper was alloyed with about 10% of tin, while lead only appears in low percentages, up to around 3%.[47] This alloy composition changes somewhat in the Hellenistic period, when some lead is added to castings, albeit in a rather erratic way. Only in the early Roman imperial period does lead begin to be added regularly in higher

[37] Berthelot 1888; Giumlia-Mair 2002d; Halleux 2002; Mertens 2002.

[38] Quoted in Giumlia-Mair 2002d, 319.

[39] Giumlia-Mair 2002d.

[40] Giumlia-Mair and Lehr 2003.

[41] Giumlia-Mair and Lehr 2003.

[42] Stapleton et al. 1995 (London, British Museum, inv. no. 1813,0213.1).

[43] Boube-Piccot 1969, 54–64; Giumlia-Mair and Craddock 1993, 38–40, fig. 20 a–d (color photograph).

[44] Giumlia-Mair 1993; Mercando and Zanda 1998, 112–17 (color photograph).

[45] Giumlia-Mair 2000.

[46] See, e.g., Hanson and Johnson 1946, 393, no. 18; Levick 1990, 45.

[47] Giumlia-Mair 2015b, 167.

amounts to alloys for casting, while the tin content diminishes slightly.[48]

From ancient literature, we know that in the time of Augustus *Corinthium aes* became the rage among wealthy Romans.[49] No examples are known from Asia Minor, and no statues decorated with the Corinthian alloy are known before Roman imperial times.[50] In view of the Augustan emergence of *Corinthium aes*, the results of the XRF and ICP analyses presented here, and the conclusions reached in Pollini's 2017 article, the theory that the cuirass or any other parts of the statue of Germanicus from Amelia might have once come from a portrait statue of Mithridates VI is untenable. The chemical analyses of the Amelia Germanicus has added a great deal to our knowledge not only of the history of the statue itself but also of the manufacture of large-scale bronze statues in classical antiquity.

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[48] Giumlia-Mair 2015b, 169.

[49] Giumlia-Mair and Craddock 1993.

[50] The oldest examples of these alloys are Egyptian and are dated to the 19th century B.C.E.: Giumlia-Mair 1996; Giumlia-Mair and Quirke 1997.

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