

Proceedings of
the XXIst International Congress
on Ancient Bronzes

edited by Dávid Bartus, Zsolt Mráv and Melinda Szabó

DISSERTATIONES
ARCHAEOLOGICAE

ex Instituto Archaeologico

Universitatis de Rolando Eötvös nominatae



DissArch

Supplementum 4 | 2024

Dissertationes Archaeologicae
ex Instituto Archaeologico
Universitatis de Rolando Eötvös nominatae

Supplementum 4

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ISSN 2064-4574 (online)

Publisher
László BORHY

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Budapest 2024



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the XXIst International Congress
on Ancient Bronzes



Budapest, 20–24 September 2022

Edited by
Dávid BARTUS – Zsolt MRÁV – Melinda SZABÓ

Budapest, 2024

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Tooth for tooth

The shining white smile of the large bronzes

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Received 12 October 2023 | Accepted 17 January 2024 | Published 30 September 2024

Abstract: Until the Hadrianic period, large bronzes had a naturalistic appearance due to polychrome elements. One element on the statues of gods, heroes and portraits that has been studied rarely are the inserted white teeth. They were invented in the late archaic or early classical period and disappeared on the large statues with the decline of the Hellenistic foundry art. Usually the upper incisors were visible behind the opened lips.

The upper front teeth—and sometimes the lower ones—were made of white metal (silver plating, tinning), light stone (marble), or more appropriately, bone (bone, ivory, tusks). It was still able to reconstruct four variants with several variations used for the installation of teeth in the open mouths. They could be fixed with glue. Other options consisted of hanging rows of teeth on hooks and brackets. In addition, the teeth rows were mounted in front of and on tooth backplates. Often, the installation of teeth was carried out in combination with the fitting of red lips.

Keywords: large bronzes, technology, polychromy, teeth, lips

Ancient large bronzes were almost never just bronze coloured until the Hadrianic period.¹ With the Late archaic knowledge of casting larger figures, the craftsmen also managed to give the statues a naturalistic appearance. Thus, the eyes, which have been intricately assembled from many individual parts, were copied from highly archaic masterpieces like the sphyrrelata and the griffin promotes. The eyebrows were highlighted with inlays of copper in the span of time from the archaic to the early classical and then again in the archaizing period. The same material was used to highlight lips, nipples or even bleeding wounds. For the polychrome design of decorations on garments and attributes, other materials such as gold, silver and the black niello have been great as inlays and overlays. It is also conceivable that the surface of the bronze has been coloured by patination or painting. White teeth, on the other hand, set a less conspicuous accent. Other than many

1 Summarizing the polychromy of antique large bronzes see BORN 1993; LAHUSEN 2010, 69–71, Fig. 2.15–20; FORMIGLI 2013; MATTUSCH 2014, 87–88, 92–93, Figs 65, 68, 69, 77; DESCAMPS-LEQUIME 2015 6; GIUMLIA-MAIR 2015, 176–179, Fig. 11.1.6a–d.8. Many thanks for kind help to V. Brinkmann (Frankfurt), S. Descamps (Paris), A. Furger (Basel), I. Hertel (Berlin), F. Higelin (Geneva), K. Lapatin (Los Angeles), Ch. Lincke (Speyer), C. Mattusch (Clifton), B. Mille (Paris), G. Moraitou (Athens), E. Risser (Los Angeles), C. Sarge (Bremen), A. Stanislawski (Berlin) und A. Wilhelm (Wiesbaden). Thanks a lot to J. Stanislawski (Berlin) for help in translating the manuscript into English and final corrections. Many thanks to D. Greinert (Berlin) for creating the graphics. First results about inlayed teeth will be published soon in German language, see PELTZ in press (a).

polychrome features on the Bronzes of, gods heroes and portraits, the teeth are rarely preserved. And yet the few examples we do have access to are a perfect showcase for the great technical skills needed to make the slightly opened mouth of the large statues appear perfectly natural by incision of the white teeth.

Lips

First of all it is worth mentioning that the installation has mostly been discussed in association with the fitting of red lips. It is noticeable that the installation of teeth has so far often been discussed in association with the fitting of red lips.² The oldest bronze statues with lips are the Poseidon from Livadostra (490–480 BC), the Youth from Herodou-Attikou-Street in Athens (c. 480 BC) and the Warrior from the Athenian Acropolis (480–470 BC).³ Setting a contrast to this are the Zeus of Olympia (end of 6th century BC) and the slightly younger Head of Kythera (Fig. 1).⁴ Which, even although they are already characterized with copper eyebrows and hair bands, are made without inserted red lips. Both their invention and respectively the turn of focus towards a more natural look of the statues, is therefore dateable to the first decade of the 5th century BC.

However, red lips do not become the standard even in the following centuries. Perhaps only a few foundries had the ability to produce this polychrome element. Or maybe the production was expensive, so that it was often avoided. If that's the case, inserted lips become another important indication of the outstanding position of a bronze sculpture. The Berlin Bacchus from the Balkans (2nd half of the 1st century AD; Fig. 2) illustrates as probably the youngest known example of the red accented lips,⁵ which apparently disappeared soon after. This reduction is closely related to the general phasing out of polychrome accents, most of which could probably only be produced by specialists. Their skills were less and less in demand since the developed imperial period.

However, the fact that more bronze statues had inlaid lips than is known today can perhaps be illustrated by some roman marble portraits based on the Greek originals. An example is the Antonine replica of the portrait of one of the 'Seven Sages' at the Prado in Madrid, whose

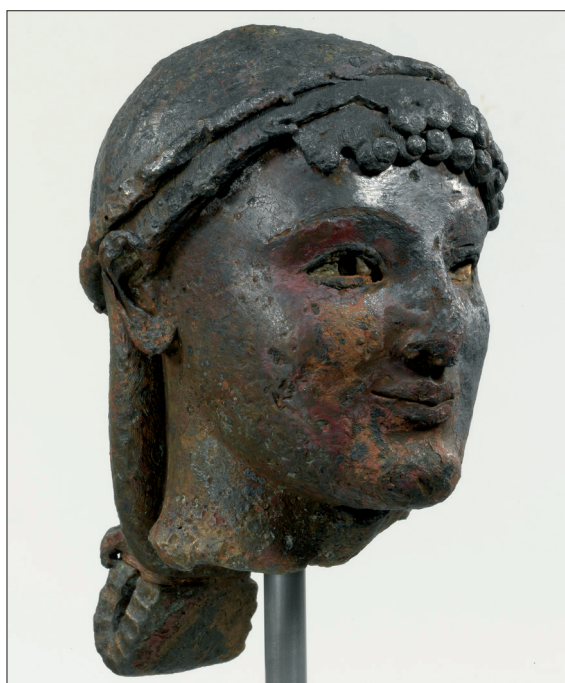


Fig. 1. Head of Kythera (Collection of Classical Antiquities, National Museums in Berlin, Inv. Misc. 6324) with copper inlays on the eyebrows and the Krobylos but without red lips (J. Laurentius, Staatliche Museen zu Berlin, Antikensammlung).

- 2 About the technical and chronological development of lips with partly different considerations see BOL 1978, 90–92, Fig. 10; BOL 1985, 149, Figs 104–105; LAHUSEN – FORMIGLI 2001 6, 489–490, Figs 38–41; FORMIGLI 2013, 282–285, Figs 353–362; DESCAMPS-LEQUIME 2015, 154; GIUMLIA-MAIR 2015, 179.
- 3 About the polychromy of Poseidon of Livadostra see HOUSER 1987, 56–57, 63; DAFAS 2019a, 19, Pls 4–5a. About this to the Young Man's Head from Herodou Attikou Street see ZACHARIADOU – STAMPOLIDIS 2000, 198, Figs. About the lips on the Athenian Warrior see HOUSER 1987, 73.
- 4 About the inserts at the Zeus of Olympia, see MATTUSCH 1988, 65, Fig. 4.15; DAFAS 2019a, 119. About this topic at the Youth from Kythera see HELMEYER 1988, 63.
- 5 About the lips with 1 mm thickness see ROHNSTOCK 2002, 228, Fig. 10.

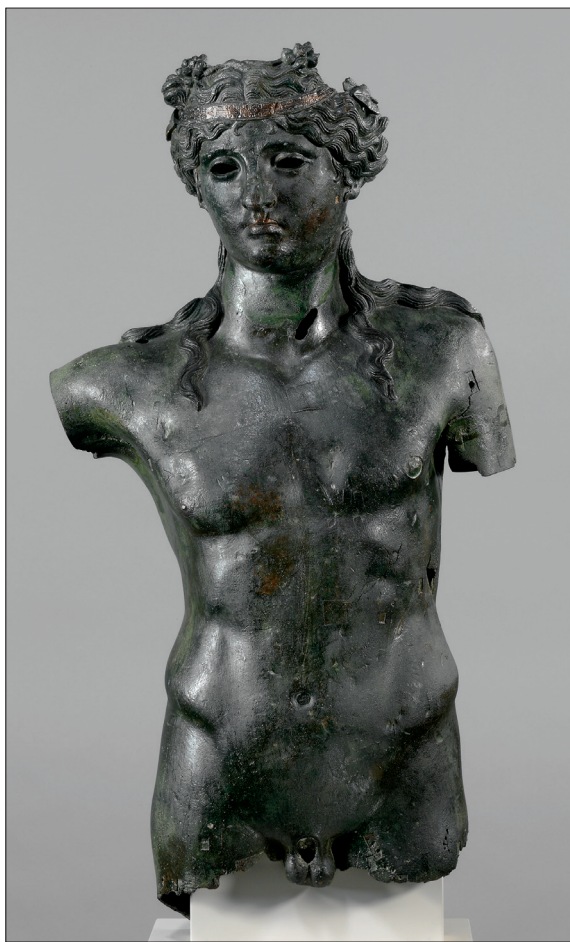


Fig. 2. Bacchus from the Balkans (Collection of Classical Antiquities, National Museums in Berlin, Inv. Misc. 7469) with copper inlay on the lips next to other polychrome elements (J. Laurentius, Staatliche Museen zu Berlin, Antikensammlung).

original dates to around 300 BC⁶ (Fig. 3). Its presented with a deep lip contour, which is typical for bronzes with an inlay. The question is whether a work made of this material can be assumed as the model, and if so, whether the adoption of the dividing line can be understood at the same time as a stylistic device for the reference to the bronze original and its importance? The technical realizations of the lips on large bronzes are dividable in either casting the lips or forming them from sheet metal. The technical realization of the lips on the large bronzes can be divided into those that were cast and those that were formed from sheet metal. The Youth from the Via dell'Abbondanza in Pompeii is the youngest statue right now, with the cast lips.⁷ It seems that the inlayed lips disappeared henceforth. After that, if at all, only the lips made of sheet metal were used. The earliest example of this technique is probably the Apollo Chatsworth (470–460 BC).⁸ The material used for the lips made out of sheet metal was pure copper.⁹ The cast inserts were made out of copper or low-alloyed copper.¹⁰ For these materials, it was known that even a very small amount of tin improved their casting properties. But the amount of tin had to be very small for lips to avoid impairing the bright red colour. It is difficult to cast copper with a smooth and uniform surface because it tends to form bubbles during solidification. But it appears as the craftsmen

used this property quite intentionally. It certainly is an explanation of the porosity often observed in the lips, which helps imitating a natural texture.¹¹ Currently there are three possible methods for casting lips, in the general discourse. The first method is shown by a statue's lips from Olympia.¹²

6 About the portrait in detail see [SCHRÖDER 1993](#), 88–90, Cat. 15, Figs.

7 [FORMIGLI 2013](#), 284, Figs 359–360.

8 [CRADDOCK – GIUMLIA-MAIR 1993](#), 32.

9 To this view without data of material analyses see for instance [FORMIGLI 2013](#), 284–285; [DESCAMPS-LEQUIME 2015](#), 154.

10 About the assumption that cast lips are made of copper without evidence of any analyses see [FORMIGLI 2013](#), 282–284; [DESCAMPS-LEQUIME 2015](#), 152. About this topic at the Riace-Warriors see [DONATI 2013](#), 273; [FORMIGLI 2013](#), 282; [DAFAS 2019a](#), 56. About this at the God of Artemision the Youth from Antikythera see [DAFAS 2019a](#), 42, 75. For the Delphi Charioteer, XRF-Measurements on the lips indicated pure copper, see [DESCAMPS-LEQUIME et. al. 2019](#), 49–50. For this identical to the Boxer from Quirinal see [MERCURI et. al. 2018](#), 38. On the view that the casting material in the classical to the Hellenistic period contained only about 2% tin, see [GIUMLIA-MAIR 2015](#), 179. On such results on Sophocles and the Head from Cyrene at the British Museum see [CRADDOCK – GIUMLIA-MAIR 1993](#), 32.

11 [SANNIBALE 1999a](#), 288, Fig. 16; [SANNIBALE 1999b](#), 114, Fig. 3; [FORMIGLI 2013](#), 284, Fig. 356; [DESCAMPS-LEQUIME 2015](#), 152; [GIUMLIA-MAIR 2015](#), 167, caption of Fig. 11.1.

12 [BOL 1978](#), 91; [BOL 1985](#), 123–124, 149; [WÜNSCH 2003](#), 135.

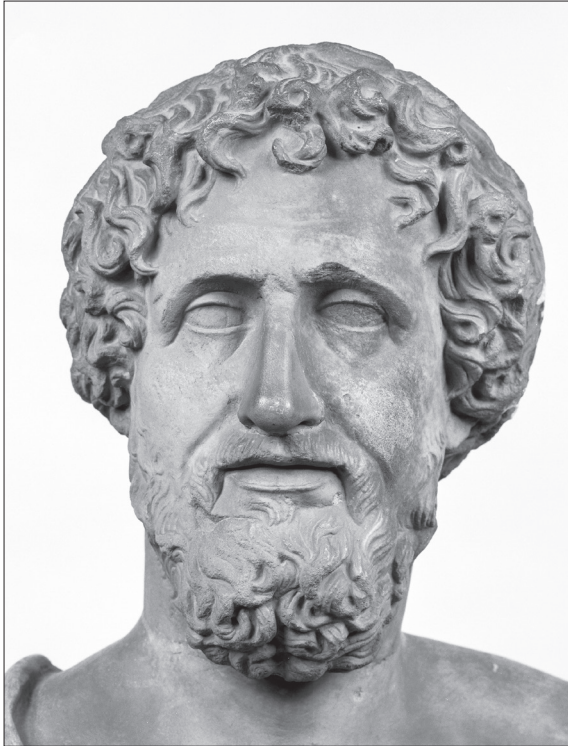


Fig. 3. One of the ‘Seven Sages’ (Prado Museum Madrid, Inv. 399-E) with sharply contoured lips (P. Witte, Deutsches Archäologisches Institut, Madrid, D-DAI-MAD-WIT-R-33-89-12).



Fig. 4. Lips of a statue (Collection of Classical Antiquities, National Museums in Berlin, Inv. Ol. 10647 [relocated due to the war: Moscow, Pushkin-Museum]) probably with solder traces and references to an iron pin to fix the teeth (Staatliche Museen zu Berlin, Antikensammlung, Fotoarchiv, ANT Neg. 4796).

The first step was to cast the head and lips independently of each other in the lost wax process. The head had a rudimentary mouth and the lips were inserted into this opening from the inside or from the outside. The Berlin archaeologist Karl Anton Neugebauer claims, before the Second World War, to have seen “traces of a thin layer of tin [...] from a soldering”¹³ on a pair of lips (mid 5th century BC) that reached Berlin (Fig. 4). Those inserts had to have a cross-section

that could easily fit into the openings that are located at the mouths. If the lip inserts have an undercut or a spherical shape they were manufactured by the casting-on technique (*Überfangguss*). One variant is the cast-on of the lips to the bronze head.¹⁴ In this method, the craftsman fitted lips of wax into the opening at the mouth. After that, the whole head or just the area with the mouth was covered with a casting mould. After melting out the wax, the mould could be filled with melted bronze. However, more commonly assumed is another casting-on process. In this process, the lips had been casted first, which were then inserted into the wax model of the head. This was followed by preparing the casting mould for the head, melting out the wax and filling the mould with liquid bronze. Important examples of this technique are the Riace Warriors (approx. 460 and 450 BC), the Youth of Antikythera (340–330 BC), the Arundel Head (2nd century BC) and the Boxer from the Quirinal (4th–mid 1st century BC), as well as very probably the portrait of a North African from Cyrene (approx. 300 BC) and the Antisthenes from Brindisi (mid 4th century BC).¹⁵

13 NEUGEBAUER 1951, 66. The lips were damaged by fire immediately after the Second World War and were afterwards transported with many Berlin antiquities to the Pushkin Museum in Moscow. The lips are among the objects that were not restituted at the end of the 1950s. The soldered lips are also discussed for the Antisthenes from Brindisi, see DE PALMA – FIORENTINO 2002, 181, Fig. 9. Other research assumes the casting-on technique, see Note 15.

14 WÜNSCH 2003, 135.

15 About the Boxer, see MERCURI et. al. 2018, 38. About the Arundel Head, the Riace-Warriors, the Youth from Antikythera, the Antisthenes of Brindisi and the lips from Olympia see FORMIGLI 2013, 282–284, Figs 353–358. In summary see DESCAMPS-LEQUIME 2015, 152–153. At least about the Youth of Antikythera see DAFAS 2019b, 62, Fig. 6.8. About this statue with the opinion, the separately casted lips were inserted from the inside see DAFAS 2019a, 75, Pl. 70c. With the opinion, the lips were not necessarily fixed as discussed here see DAFAS 2019a, 58.

Teeth

Although it is still unclear for the Charioteer of Delphi (478–474 BC) whether its inset lips were cast or plated with sheet metal, it is to be considered the oldest large bronze with preserved teeth at the moment (Fig. 5.a–b). In the essential parts, this figure already unites the aesthetic aspects also found in the statues from the following centuries.¹⁶ For all of them it is true that the white teeth behind the slightly opened red lips contributed as one of many polychrome elements to the overall lifelike appearance of the statues. Mainly, the accentuation of teeth focused the upper four or even six front teeth. And, the centuries are marked by a contradiction. On the one hand it was very complicated to realize teeth. On the other hand, sometimes, there was no significance in seeing the teeth in the barely opened mouths: You had to stand ‘face to face’ to be able to perceive the white behind the lips!



Fig 5. Charioteer of Delphi (Archaeological Museum Delphi, Inv. 3484). a – photograph from the 1st third of the 20th century or earlier (Staatliche Museen zu Berlin, Antikensammlung, Fotoarchiv, Schrank 8b, Fach 238, Bronzen), b – the silver teeth (here still considerably covered with product of corrosion) were actually hardly visible in the only slightly opened mouth (V. Brinkmann, *Liebieghaus* Frankfurt am Main, Skulpturen-sammlung).

Consequently, the teeth in the figures that were placed on pedestals—the charioteer was situated on a chariot and this one on a stone base¹⁷—were probably not visible to the viewer standing on the ground. Apparently being able to actually see the teeth was less important. More important was the approach to the real human anatomy. This is the only way to explain the enormous technical ef-

For the opinion, with Antisthenes the separately cast lips were soldered to the mouth see [DE PALMA – FIORENTINO 2002](#), 181, Fig. 9. For the portrait from Cyrene, it has been published at least about separately cast lips see [CRADDOCK 1977](#), 113; [CRADDOCK et. al. 1995](#). However, the photographs that are accessible there suggest the working process discussed here. Discussed otherwise lately, the lips were inserted from the inner side see [DAFAS 2019a](#), 137–138. Recently, a casting mold for lips was found in a Greek foundry during excavations in Athens’ Syntagma Square. For a short note about the casting mold see [DESCAMPS-LEQUIME et. al. 2019](#), 50. It can only be assumed that the lips were inserted into the wax model of the head afterwards (casting-on technique). The soldering technique cannot be ruled out.

¹⁶ About the statue, its production and the polychrome design elements see [DESCAMPS-LEQUIME et. al. 2019](#).

¹⁷ [ADORNATO 2008](#).

fort that was made to create a polychrome feature that hardly anyone could perceive on most of the statues. It is striking that simply bronze-coloured teeth are not found in human large bronzes; at least there is a lack of examples so far. In contrary, teeth were made of white metal (silver plating, tinning), light stone (marble) or closer to naturalistic colour bone (bone, ivory, tusks). The insertion of the teeth into the head probably was done before the head was placed on the body, because after this the mounting of the polychrome element was hardly possible. In this regard, it is important to say that ancient craftsmen were skilled enough to produce those joints with flow-welding, even without significant temperature transfer to the surrounding bronze. This knowledge was revealed by experiments carried out a few years ago to verify the theories considerations on joining seams and making repairs with the flow-welding technique.¹⁸ This reflection is significant in that the high temperature would have damaged certain dental inlays.

Again, in the case of the life-size animals, the naturalistic white did not seem to fit the artistic trend. This also applies to the gilded roman equestrian statues. With their monochrome gold layer, those statues where intended to represent the power and the status of the portrayed person. For the time being, the production of teeth in animals can be classified into two basic techniques. Either they were cast together with the jaws or they were mounted as separate casts. The Horse Head from the Medici Collection in Florence (2nd half of the 4th century BC) as well as the one from Waldgirmes (4th BC–16th AD) are two evidences for the first technical possibility in horses.¹⁹ The Hellenistic Aachen Bear probably illustrates this solution for predatory teeth.²⁰ In contrast, the teeth and tongues on the Horse from Trastevere (2nd quarter 5th century BC) were cast separately and welded in the mouths afterwards.²¹ The same happened with the galloping animal from the shipwreck of Artemision (150–140 BC).²² Another technical possibility was the fastening with rivets and pins. This was probably used to attach the now lost upper and lower incisors to the drilled holes in the mouth of the Etruscan Chimera from Arezzo.²³



Fig. 6. Head of Marsyas (Collection of Classical Antiquities, National Museums in Berlin, Inv. Sk 206) with contoured upper and lower incisors (F. Vu, Staatliche Museen zu Berlin, Antikensammlung).

18 About such experiments using the example of the Trapezophori of Xanten see [LEHNER – ROSSMANN 2011](#); [PELTZ 2017](#), 226–228, Figs 4–7. About the flow-welding technique on this statue and the develop on others see [PELTZ 2011a](#), 49–51, 56–58, Figs 21–26, 35–39; [PELTZ 2011b](#), 124–125.

19 About the teeth made out together with the wax model of the Horse Head in Florence see [SALVIOLI 2017](#), 323–325, Fig. 39.7–10. About this topic on the Waldgirmes-Horse Head see [RASBACH – ULBRICH 2013](#), 9, Figs 11–12a–b. Currently, A. Wilhelm (Wiesbaden) is investigating the presumably Roman-period characteristic of presenting dentitions with more than just the six regular incisors. Wilhelm pointed out that, for example, the horses from San Marco and the head from Augsburg have more than six incisors. In contrast, the Greek head from the Medici collection and the horse from Artemision are characterized by anatomically correct teeth.

20 About the teeth without any notes about casting separately or any hints of mounting see [KÜNZL 2002](#), 11–15, Fig. 20.

21 [PARISI PRESICCE 2013](#), 178, Fig. 181.

22 [HEMINGWAY 2004](#), 67.

23 [SIANO et al. 2012](#), 218–219, Figs 13, 42, 43.



Fig. 7. Boxer from the Quirinal (National Museum of Rome, Bath of Diocletian, Inv. 1055). a – photograph from the 1st third of the 20th century or before (Staatliche Museen zu Berlin, Antikensammlung, Fotoarchiv, Schrank 8b, Fach 239, Bronzen), b – The open mouth with red lips was probably intentionally toothless or perhaps rather designed with gaps in the dentition (U. Peltz, Staatliche Museen zu Berlin, Antikensammlung).

Considering the Bronzes of great gods, heroes and portraits with open mouths it is reasonable to assume, that far more of them had teeth than we can prove today. This is again indicated by marble copies after greek originals, which were most likely made of bronze. Two impressive examples can be seen in the Berlin head of the Hanging Marsyas (Fig. 6) and in the portrait of an Old Woman at the British Museum.²⁴ In the case of the maltreated demigod, the rows of teeth in the consumedly opened mouth emphasize the naturalistic expression of the inconceivable pain. And the woman looks her age not only by the wrinkles, but also by the state of her teeth. When we think of the bronzes, statues as the early classical Youth (approx. 470 BC) in Copenhagen's Glyptothek leave room for discussions about teeth lost today.²⁵ Because if this bronze really depicted a singer, logically it is to assume that there were teeth in the wide opened mouth. For the bronze head from Herodou-Attikou-Street, which is nearly ten years older, a slightly open mouth is described.²⁶ If teeth were inserted behind the lips, the statue would be evidence of the prominence of polychrome inlays even in this early period. A more recent example is the Jockey to the Horse from the Artemision wreck, for which teeth are discussed, but technical evidence is lacking.²⁷

But, precisely because it seems tempting to want to add teeth to open and now toothless mouths,²⁸ some caution should be exercised with these. For the Riace Warrior B it can be said with some certainty that, in contrast to his probably little older counterpart, the Riace A, he did not have any

24 About the Marsyas see FLASHAR 1992, 169–171, Fig. 151. About the Elder Woman see ADORNATO 2015, 58, Fig. 3.6.

25 About the statue see BELL 2000.

26 ZACHARIADOU – STAMPOLIDIS 2000, 198, Figs.

27 HEMINGWAY 2004, 77.

28 HOUSER 1987, 338.

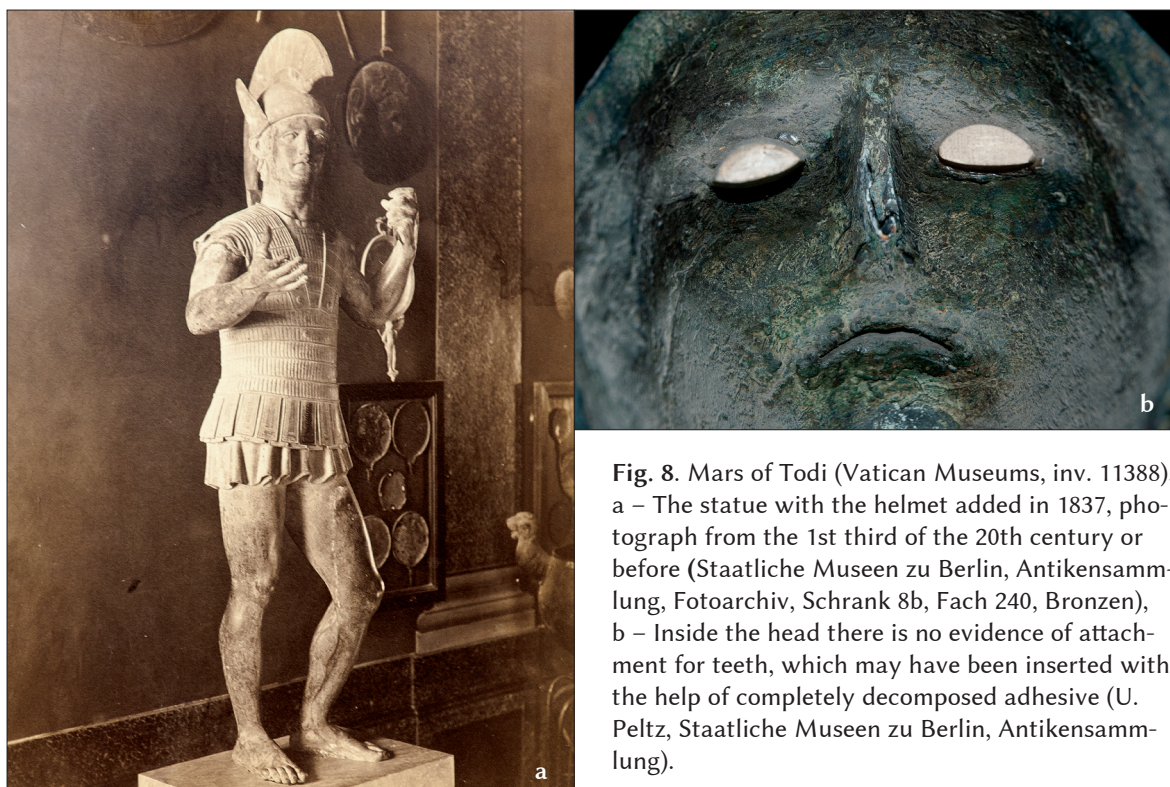


Fig. 8. Mars of Todi (Vatican Museums, inv. 11388). a – The statue with the helmet added in 1837, photograph from the 1st third of the 20th century or before (Staatliche Museen zu Berlin, Antikensammlung, Fotoarchiv, Schrank 8b, Fach 240, Bronzen), b – Inside the head there is no evidence of attachment for teeth, which may have been inserted with the help of completely decomposed adhesive (U. Peltz, Staatliche Museen zu Berlin, Antikensammlung).



Fig. 9. Installation of teeth on large bronzes. Variant 1: teeth installed with adhesive. 1 – upper lip, 2 – lower lip, 3 – row of teeth, 4 – adhesive (D. Greinert, Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte).

teeth.²⁹ Those, or at least hints of them, would have come to light during one of the restorations or at the least during the final removal of the casting core material from the head a few years ago. For the Boxer from the Quirinal it is assumed that his open mouth with copper-red lips remained intentionally toothless. The statue is supposed to represent Amykos, the ruler of Bithynia, and shows him after Polydeukes has knocked out all his teeth³⁰ (Fig. 7.a–b). On the other hand, the loser might as well have had some teeth left after he met the Argonaut.³¹ Possible technical hints for the installation of any amount of teeth will be discussed in a moment.³²

However, even if those features are missing, there is no certainty that the lost teeth were not inserted with an adhesive that decomposed completely. This is assumed for the Etruscan Mars of Todi (mid-4th century BC; Fig. 8.a).³³ In this case, the inner surface of the red mouth is

29 DONATI 2013, 270–273. Recent to contrary view see DAFAS 2019a, 56, note 281.

30 About the interpretation, see BRINKMANN – KOCH-BRINKMANN 2018.

31 About the assumption that the teeth of the Boxer were only knocked out on the upper jaw see ZANKER 2005, 34.

32 See Fig. 7.a–b.

33 SANNIBALE 1999a, 284; SANNIBALE 1999b, 114.

actually free of any technical traces of tooth attachment (Fig. 8.b). So, whether the Mars had teeth or not in ancient times is indeed hard to find out. Anyway, gluing for example with tree resin, wood pitch, bitumen, wax and others even a mixture of them³⁴ seems quite probable as a simple technical method for fitting teeth, called Variant 1 (Fig. 9).

The Charioteer of Delphi is also the earliest example for covering a tooth backplate with a sheet of silver including a contoured tooth stand.³⁵ This construction is to be understood as the Variant 2a (Fig. 10.a). For the charioteer, the exact method is currently being studied.³⁶ Therefore, right now it is not possible to say with absolute certainty whether the piece of lead once removed from the head of the statue can be addressed as a tooth backplate, already mentioned it being made of lead. For the Riace Warrior A, the exact shape of the backplate—here made of bronze—is not entirely clear. It is very likely that the backplate was cast together with the head with only a small cross-section. Whether it already shows the outline of the individual six upper teeth there has been a different discussion.³⁷ It is assumed that fixing the covering made of a quite thick silver sheet was done mechanically. The silver was pressed into the corners of the mouth using a precise hit with a pointed punch.

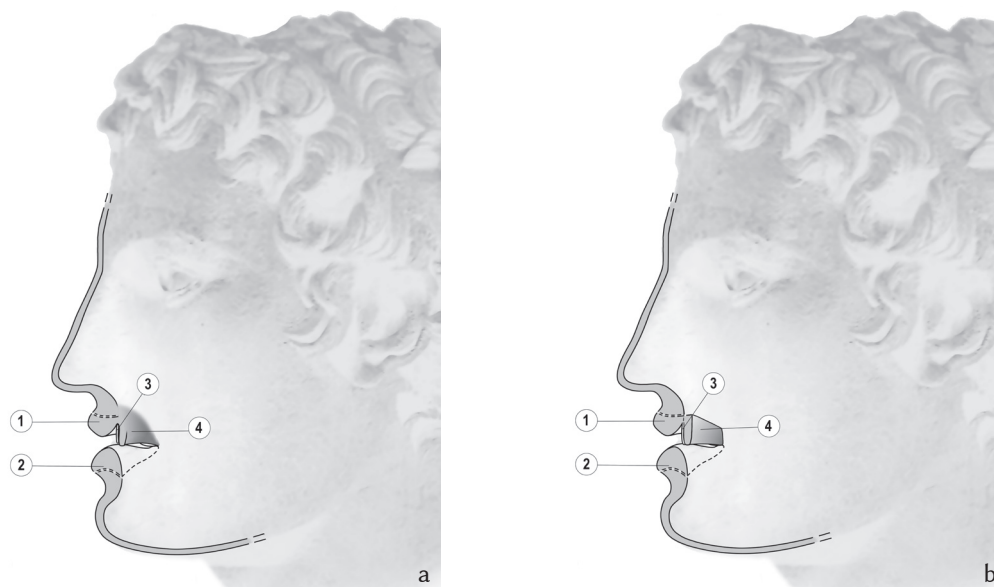


Fig. 10. Installation of teeth on large bronzes. a – Variant 2a: silver plating on a tooth backplate of bronze (and perhaps lead), 1 – upper lip, 2 – lower lip, 3 – silver plating, 4 – tooth backplate (D. Greinert, Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte); b – Variant 2b: tinning on bronze tooth backplate, 1 – upper lip, 2 – lower lip, 3 – tinning, 4 – tooth backplate (D. Greinert, Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte).

34 About ancient metal adhesives see ANHEUSER 2001, 247–263; FURGER 2009, 31–32; KOLLER et. al. 2001, 99–112; VOLKE 2009, 587–592; WILDER et al. 2008, 35–37; PELTZ 2013, 121–126, Figs 39–43; PELTZ in press (b).

35 About the teeth in the Charioteer see FORMIGLI 2013, 285–386; DESCAMPS-LEQUIME 2015, 154, Fig. 10.4; DESCAMPS-LEQUIME et al. 2019, 50, Fig. 5.6; DAFAS 2019a, 28. For other statues, the material silver is sometimes assumed for inserted teeth without any evidence of this. About such considerations for the Mars of Todi see SANNIBALE 1999a, 284; SANNIBALE 1999b, 114. The same for the Portrait in the Getty-Villa see DAHNER 2015a, 206, Cat. 11. The same for the Arundel Head see DAHNER 2015b, 244, Cat. 27, Fig.

36 The current research at the Charioteer will be published soon by S. Descamps (Paris) and B. Mille (Paris). Thanks to both for a lot of information.

37 DONATI 2013, 269–270, Fig. 309. On the opinion that the silver teeth were set on a flat base, see FORMIGLI 2013, 285–286, Fig. 353. Recently about the teeth see DESCAMPS-LEQUIME 2015, 153–154, Fig. 10.3; DAFAS 2019a, 56, Pls. 44–45b.

This Variant 2a is most commonly used and can even be found in smaller formats beyond the greek foundry tradition. An example of silver plating with punched outlines for again six upper incisors is seen in the St. Louis Boy (2nd – mid 1st century BC) with the eyes also inlaid in silver.³⁸ The same applies to the Head of a Centaur³⁹ in Speyer (mid-late 1st century BC;⁴⁰ Fig. 11.a). However, it has an upper and additionally a lower row of teeth behind the wide opened red lips, which were probably cast and mounted. Both tooth backplates have been cast together with the head and on both of them the interdental spaces were contoured with punching after casting (Fig. 11.b). On the upper six teeth, the correspondingly structured silver plate is preserved until right above the grinding surfaces of the tooth crowns. The precious metal overlay is missing on the lower row of teeth. The separation of the rows of teeth presented for the first time the opportunity to get a small peek of the inside of the mouth with its well-formed silvery white front teeth. In even smaller bronzes, the technique of silver-plated tooth backplates is found on high-quality statuettes as well as appliqués and attachments of vessels from the classical to the roman period; even on artworks made of iron, teeth were plated with silver.⁴¹

An advancement of Variant 2a can be discussed as Variant 2b (Fig. 10.b) for the Drunken Satyr from the Villa dei Papyri (late 1st century BC).⁴² As the evaluation of the technical examinations shows, the teeth backplate was made out of bronze, mounted by soldering and covered with a silver-colored tin coating.⁴³



Fig. 11. Head of Centaur (Historical Museum Speyer, Inv. HM_0_15044). a – current appearance (P. Haag-Kirchner, Historisches Museum der Pfalz Speyer), b – behind the opened copper-red lips the upper incisors with silver plating can be seen, which has been lost at the lower row of teeth (U. Peltz, Staatliche Museen zu Berlin, Antikensammlung).

38 MATTUSCH 1996, 238–239, Cat. 25, Fig. 25.c.

39 PETROVSZKY 2016, 253, Cat. 192, Fig. Many thanks to Ch. Lincke (Speyer) for the possibility of own examinations on the head with new results about the technique and the condition of the teeth.

40 The Centaur's Head was changed to a weight for a scale in roman times. Previously, with its height of approximately 15 cm, it may have been the partial piece of a figure slightly more than half life-size. This statue was probably created before the beginning of the imperial period. This is indicated by the type of joint between the head and neck, see FIG. PELTZ in press (a).

41 About such examples see PELTZ in press (a).

42 So far, only one variation of variant 2 have been discussed see PELTZ in press (a).

43 See RISSER et al. 2024, 237, Fig. 13. Many thanks to E. Risser und K. Lapatin (Los Angeles) for a lot of information. So far about the teeth see MATTUSCH – LIE 2005, 321, Fig. 5.275. Study at the J. Paul Getty

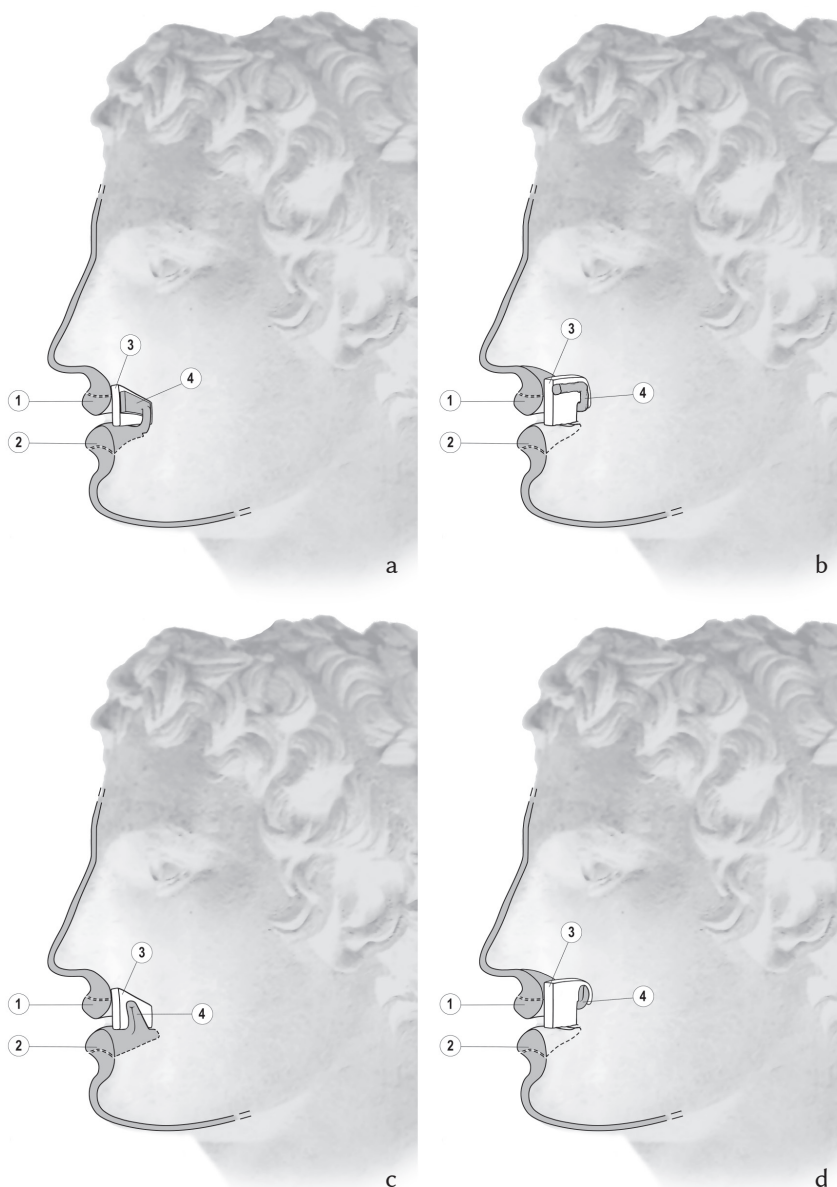


Fig. 12. Installation of teeth in large bronzes. a – Variant 3a1: teeth hooked in bracket below the lips, 1 – upper lip, 2 – lower lip, 3 – row of teeth made of bone, ivory, marble, 4 – bracket; b – Variant 3a2: teeth hooked in bracket above the lips, 1 – upper lip, 2 – lower lip, 3 – row of teeth made of bone, ivory, marble, 4 – bracket; c – Variant 3b1: teeth mounted on hooks below the lips, 1 – upper lip, 2 – lower lip, 3 – row of teeth made of bone, ivory, marble, 4 – hooks; d – Variant 3b2: teeth mounted on hooks above the lips, 1 – upper lip, 2 – lower lip, 3 – row of teeth made of bone, ivory, marble, 4 – hooks (D. Greinert, Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte).

So, the Satyr is an example, in the context of large bronzes, for what was very common for other genres in that time.⁴⁴ That is, that the craftsman substituted the expensive silver by the less expensive tin for the same polychrome effects.

Museum of the Diana from Pompeii (1st century BC) found that the lips were cast as part of the head but that she too has a teeth backplate that, if indeed ancient, may well have been covered in silver or tin. On this and on polychrome see [RISSE – SAUNDERS 2015](#), 90. Many thanks for kind help and numerous information to E. Risser.

⁴⁴ About the ancient technique to tinning the surface of bronze see [PELTZ in press](#) (b. About the pre-roman tinning see [BORN 2014](#), 138, note 1075.

Until the Hellenistic period it is observable that the teeth made of white stone and bone or ivory were used and attached on brackets and hooks.⁴⁵ These structures devices were part of the separately made lips or were obtained during casting the head, if it had co-cast lips. It is possible to specify the methodology concerning the placement of the hooks and brackets: either they are located below the lower lip or to the left and right of the philtrum (Variant 3a1, 3a2, 3b1, and 3b2;⁴⁶ Fig. 12.a–d).

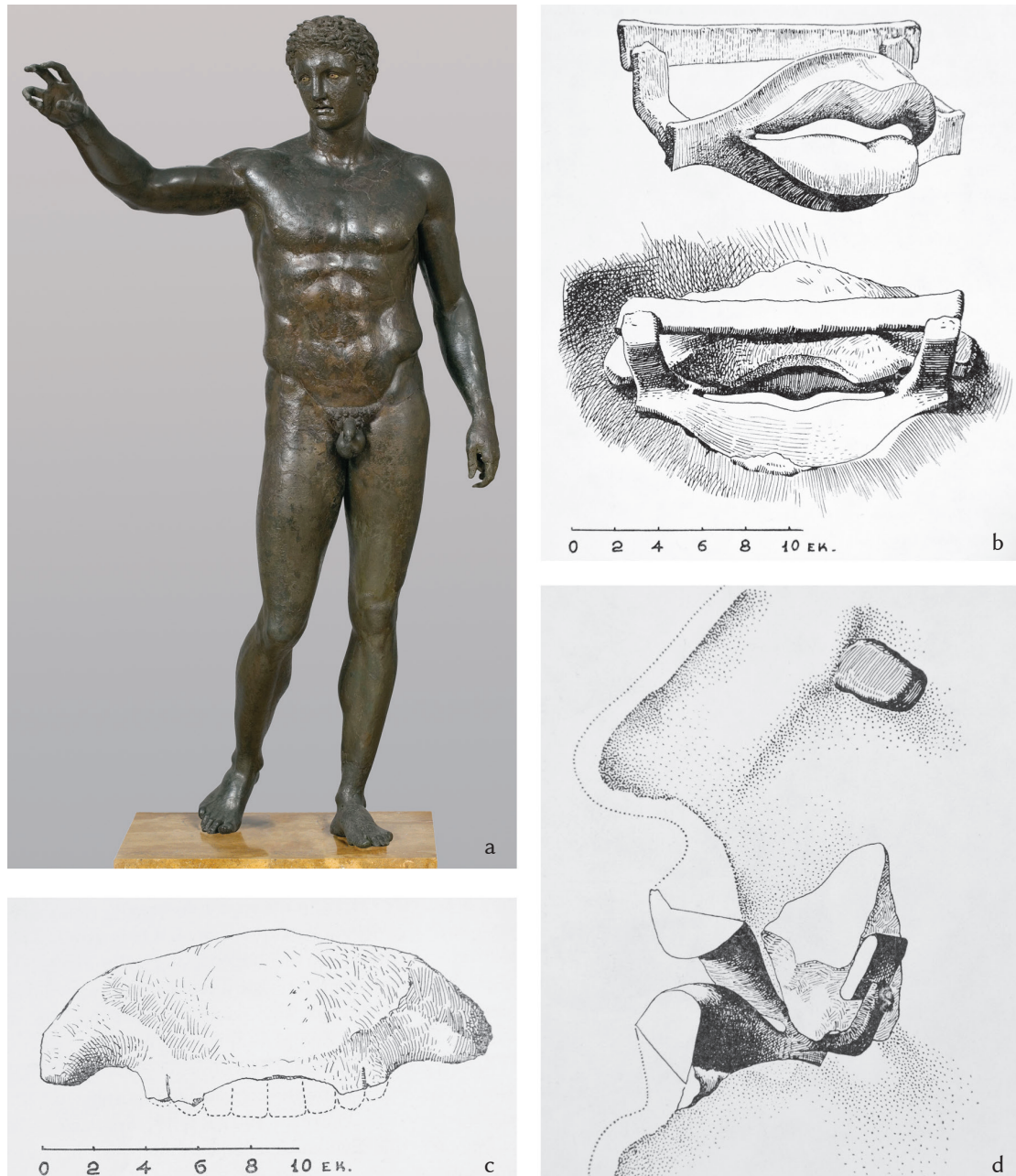


Fig. 13. Youth of Antikythera (National Archaeological Museum of Athens, inv. 13396). a – current appearance (Archäologisches Nationalmuseum Athen), b – separately cast lips with bracket to inserting the upper jaw, reconstruction drawing (see KAROUSOS 1969, Figs 1–3); c – stone upper jaw, drawing with reconstructed incisors (see KAROUSOS 1969, Figs 1–3), d – lips inserted in the head with bracket and upper jaw attached to it, sectional view (see KAROUSOS 1969, Figs 1–3).

45 General about teeth made out of bone on large bronzes see DESCAMPS-LEQUIME 2015, 154.

46 So far, only two variations of this variant have been discussed see PELTZ in press (a).

For the Youth of Antikythera (Fig. 13.a), the construction of Variant 3a1 (Fig. 12.a) became apparent during its new restoration in the 1950s, and the drawings published in 1969 did not require any further explanation in order to understand the crafting process.⁴⁷ Together with the separately cast lips, a bracket was created which attaches to the back of the corners of the mouth (Fig. 13.b). Firstly, the bracket fulfilled a task during the casting process. After inserting the lips on the wax model of the head, the bracket stuck out into the casting core material. In this way, it secured the position of the lips in the casting mold after melting out the wax. Recently, it has been suggested that Figure 1 (Fig. 13.d), published in 1969, shows a stone hooked to the bracket, which assisted in stabilizing the bracket in the casting core.⁴⁸ However, the illustration shows the inserted upper jaw without the lost eight teeth as a sectional view. Its reconstructed appearance in the jaw can be seen in Figure 3 (Fig. 13.c) published at that time. Whether the ancient craftsman only hooked the jaw with teeth into the bracket or additionally fixed it, cannot be exactly seen on the published photograph of the head inside.⁴⁹

If the lips were not a cast which was mounted, but rather were cast together with the head, it is of course equally possible to use internal casting channels as a suspension device for the teeth. However, that even with this consideration a certain caution is required proves a somewhat larger-than-life portrait of Aphrodite in the British Museum.⁵⁰ In the head, the bridge-shaped channels in the area of the hairstyle as well as on the chin may have simply enabled the better flow of the molten metal during the casting process. This assumption is obvious because the channels are not located in positions where teeth could have been attached.

On the other hand, in the portrait of a Woman with Corkscrew Curls (1st century BC) from the same Villa, the mouth is slightly open.⁵¹ Inside, a bracket spans the corners of the mouth, which has also only been interpreted as a casting channel so far. Its exact position cannot be made out in the published photography. However, it appears that the casting channel runs along the upper lip.



Fig. 14. Lips of a statue (Olympia Archaeological Museum, Inv. Br 14431) with hooks for hanging in a row of teeth (G. Hellner, Deutsches Archäologisches Institut, Abteilung Athen, D-DAI-ATH-1972/3602).

It would additionally supply the neuralgic point during the casting process—the abrupt change to the forward-jumping nose—with molten bronze during the casting process. This kind of support was common, as become clear in a moment on other statues. However, the casting channel in the Head of the woman certainly have been used afterwards as a bracket for holding teeth. This Variant 3a2 (Fig. 12.b) differs from Variant 3a1 (Fig. 12.a) by the apparently better position for the installation of the upper incisors. A stone upper jaw with inserted teeth could just as well be attached to a bow like the one described for the Youth of Antikythera. The advantage would be that it would not have to be too massive.

47 About the drawings published without any comments see [KAROUSOS 1969](#), 63–64, Figs 1–2, 66, Fig. 3. Chr. Karousos noted on page 61 the author of the drawings is V. Zissis. He worked at the museum in Athens in the conservation laboratory as a chemist. Thanks to G. Moraitou (Athens) for this information. About the drawings extensively see [HOUSER 1987](#), 187, Fig. 11.9–11. About the mounting of the teeth recently see [DAFAS 2019a](#), 75, Pl. 70.c; [DAFAS 2019b](#), 62, Fig. 6.8.

48 [FORMIGLI 2013](#), 284; [DESCAMPS-LEQUIME 2015](#), 154.

49 [KAROUSOS 1969](#), 73, Fig. 9.

50 [MATTUSCH 1996](#), 303–304, Cat. 42, Fig 2; [LAPATIN 2015a](#), 235, Cat. 23, Fig.

51 [MATTUSCH – LIE 2005](#), 232, Fig. 5.104.

A separately cast pair of lips from Olympia reveals Variant 3b as a single find even without further assistance⁵² (Fig. 14). On the back, there are hooked attachments at the corners of the mouth with an approximately round cross-section and tapering ends. They are to be understood as the remains of cast channels. Even before they were shortened, they certainly had the same function as the bracket on the Youth of Antikythera. They connected the lips to the casting core of the head and kept them in the right position after the wax was melted out. Only after this they were further used as hooks for hanging teeth. This essential function was already recognized by Peter C. Bol in 1978 with the reference that “the attachments of the cramps [...] held the teeth pressed on from the inside”⁵³ (Variant 3b1; Fig. 12.c). The dating of the pair of lips is difficult, but its creation in classical times cannot be ruled out. The portrait of a North African from Cyrene (Fig. 15.a) and the so-called Arundel Head at the British Museum furthermore the Antisthenes of Brindisi demonstrate the spread of the technical solution in the later classical until the Hellenistic period.⁵⁴ Regarding the portrait from Cyrene, an examination report reads: “The [four] teeth, which are now black, were examined [...] and identified as being of bone [...]. They are held mechanically to the lips on the inside of the hollow casting”⁵⁵ (Fig. 15.b). It should be added that this upper row of teeth was made from a thin, elongated oval strip of bone. On the Arundel Head there are very similar, only slightly smaller remnants of casting channel, and on the portrait of Antisthenes only a little more than their foot points are preserved.



Fig. 15. Head from Cyrene (British Museum London, Inv. 1861,1127.13). a – current appearance, b – interior with remains of the casting channels like hooks below the lips for the attachment of the upper incisors in form of bone strips (discoloured black) (The Trustees of the British Museum, London).

52 BOL 1978, 91, Cat. 408, Pl. 67.408. About the lips see FORMIGLI 2013, 284; DESCAMPS-LEQUIME 2015, 152.

53 BOL 1978, 91.

54 FORMIGLI 2013, 284; DESCAMPS-LEQUIME 2015, 152–154. The head of a boxer from Olympia (330–320 BC), currently being restored at the National Archaeological Museum in Athens, shows, after its own brief autopsy, the same evidence of the lips being cast separately and finished with hooks as the bronze heads mentioned above.

55 CRADDOCK et. al. 1995. Sometimes corroded silver is assumed, see HOUSER 1987, 174; MATTUSCH 1996, 83; DAFAS 2019a, 138. Recently with a short note about the teeth see LAPATIN 2015b, 247, Cat. 28; Fig; DAFAS 2019b, 62, Fig. 6.8.



Fig. 16. Portrait of a Man (J. Paul Getty Museum Los Angeles, Inv. 73.AB.8). a – current appearance (U. Peltz, Staatliche Museen zu Berlin, Antikensammlung), b – interior with remains of the casting channels like hooks above the lips (left and right of the philtrum) (U. Peltz, Staatliche Museen zu Berlin, Antikensammlung).

The teeth are lost in both cases. For them we can assume ivory or bone rather than stone as the material: A row of teeth made out of stone would be not malleable enough to be clamped between the mounting points.

A noticeable variation of the Variant 3b1 in classical times is perhaps shown by the already mentioned pair of lips from Olympia with the soft solder remains.⁵⁶ As indicated, it is no longer available for autopsy, but Neugebauer wrote: “Behind at the ends on the right as well as on the left are irregular thickenings with a short fold at the top; through them on both sides at the bottom from front to back passes an iron nail, the rusted remains of which are preserved”.⁵⁷ Is it possible that a thin row of bone incisors was hooked onto the iron pins at the thickenings of the corners of the mouth?

Another technical solution for mounting teeth was discussed a few years ago for the Portrait of a Man in the J. P. Getty Museum (1st century BC; Fig. 16.a).⁵⁸ Inside the head, there are hook-shaped formations above the corners of the mouth to the left and right of the philtrum, which are easily recognized as shortened cast canals (Fig. 16.b). It is only logical to think that these hooks were again used to hold an upper jaw with teeth (Variant 3b2; Fig. 12.d).

However, some caution is required when identifying this variant for attaching a row of teeth. An example is the bust of an equally slightly larger than life style Young Man from the Villa dei Papiri.⁵⁹ For this bust, the ends of cast channels above the corners of the mouth inside the head are mentioned. Even though the mouth is deeply cut between the lips, it is just not open. Therefore, it would be unusual to insert teeth that could not have been seen.

On the other hand, in approximately the same places, the most recent technical examinations of the Boxer and the Ruler of the Quirinal revealed equally hook-shaped formations.⁶⁰ And their mouths actually open. However, it is assumed that the Boxer should be the Amykos and was intentionally portrayed without any teeth in the open mouth.⁶¹ The question is whether the hook shaped objects

56 See Fig. 4; NEUGEBAUER 1951, 66, Kat. 60, Taf. 28.60.

57 NEUGEBAUER 1951, 66. P. C. Bol interpreted the iron rust as possible remains of mounting points for teeth, see BOL 1978, 134, Cat. 407, Pl. 67.407.

58 DAEHNER 2015a, 206, Cat. 11.

59 MATTUSCH – LIE 2005, 268, Fig. 5.177.

60 ALESSANDRI – FERRETI 2018, 106, 110–111, Figs 124b, 134a, 135.

61 See Fig. 7.a–b.

are again just remains of internal casting channels or did they serve another function? If so, think about the intensity of a tooth stand with significant gaps. This would support the drama of the beaten and battered fighter more clearly than a completely toothless mouth. What applies to the Boxer should also apply to the Ruler. He certainly had a row of teeth too, which, however, will have been without gaps.

Looking at the large bronzes of Piraeus, the attention immediately moves to three statues with teeth still preserved today behind the inserted red lips. For Artemis A (mid-4th century BC), Caroline Houser wrote in 1987: “The teeth, upper row only, are carved of marble and suspended in place like those of the Piraeus Athena, through an oval wire support which fits under the projecting marble struts which extend from the teeth”.⁶² For Athena (4th century BC) herself, teeth made of ivory have been mentioned.⁶³ And for Artemis B (1st half of 3rd century BC) we can only read: “Behind her parted lips is a white indistinguishable mass, the remains of inset teeth”.⁶⁴ However, they can only be those made of stone or bone.⁶⁵ Before a precise examination it can only be assumed that the installation technique used for the teeth of the three goddesses is to be classified as one of the four possibilities from Variant 3. Nevertheless, the last variant discussed here is also thinkable.

This Variant 4 (Fig. 17) for the installation of teeth on the large bronze sculptures was discovered at one of the conservation control patrols on the Berlin Museum Island during the COVID19 pandemic. Although the Trapezophori from Xanten (Fig. 18.a) was extensively published in art technology a few years ago,⁶⁶ it was only in the bright light of a new type of lamp that the protuberances of corroded bronze behind the slightly open lips became visible (Fig. 18.b). Approximately at the ancient position between the anterior and lateral maxillary incisors are two pins; the left one is bent. Both pins are probably drilled into the bronze behind the upper lip. The pins end approximately in the centre of the open mouth. A bronze strip behind it, only slightly thicker at its lower edge, is corroded to such an extent that it can only be vaguely determined how far it protruded into the open mouth. However, it was not much bigger than the largest preserved part on the left. Inside, the width of the strip extends beyond the corners of the mouth. White particles are hidden in the internal gaps between the corners of the mouth and the strip. The particles are somewhat discoloured by green copper corrosion and inter-



Fig. 17. Installation of teeth in large bronzes. Variant 4: teeth installed with pins in front of a tooth backplate made of bronze, 1 – upper lip, 2 – lower lip, 3 – row of teeth made of bone or ivory, 4 – mounting pins, 5 – tooth backplate (D. Greinert, Staatliche Museen zu Berlin, Museum für Vor- und Frühgeschichte).

62 HOUSER 1987, 199. P. C. Bol published in 1978 about teeth that can be seen “flashing out of the slightly opened mouth” (BOL 1978, 91). About the marble teeth again see HAYNES 1992, 110, note 30.

63 HOUSER 1987, 199, 215–216. About the ivory teeth again see HAYNES 1992, 110, note 30.

64 HOUSER 1987, 245.

65 For the assumption without further conclusion that the Athena as well as the Artemis statues have marble teeth see DAFAS 2019a, 107.

66 PELTZ – SCHALLES 2011.



Fig. 18. Trapezophori from Xanten (Collection of Classical Antiquities, National Museums in Berlin, Inv. Sk 4). a – current appearance, b – slightly opened lips with inner backplate and two pins in front to fix the upper incisors (J. Laurentius, Staatliche Museen zu Berlin, Antikensammlung).

Portrait in the Getty Museum (Fig. 16.a) is said to have been cast in the 1st century BC. And the discussed female portrait with the corkscrew curls was created at approximately the same time. The question arises: Is it possible that the invention of the hooks cast above corners of the mouth with the head had an impact on the dating of the two statues in Rome? And a decade ago, a number of technical characteristics were listed for the Xanten Trapezophori, which suggested that this statue

dispersed with fine craquelure. Their very low UV-Fluorescence indicates bone rather than ivory.⁶⁷ This information leads to the conclusion, that the bronze strip was cast together with the head and was used as an inner tooth backplate. In front of the backplate was the row of upper incisors held by pins. Variant 4 is therefore a mixed technique from Variants 2 and 3. From the second type we find the veneered tooth backplate and from the third the choice of the material for the row of teeth. Their mounting with drilled pins however is the characteristic feature of Variant 4.

Time for teeth

The temporal horizon, in which red lips, inserted eyebrows or even the inset eyes each gave a natural appearance to the ancient large bronzes, has already been discussed.⁶⁸ Therefore, certain polychrome highlights are helpful indicators to even more precisely determine the time period of a statue's creation. Another feature could be the inserted teeth. As became clear, we can consider the inserted white teeth on the large bronzes as an achievement of the late archaic or early classical period. A comparatively large number of large bronzes illustrates that from the beginnings to the Hellenistic period teeth are typical for very high-quality statues. With the decline of the late Hellenistic foundry art, the teeth in the large bronzes disappeared and were not continued by the roman workshops. For them, just the silvery-white teeth on large and small statuettes, anthropomorphic attachments and appliqués can be observed.

Tracking back to the statues discussed here, the view falls once again on the bronzes of the Quirinal. Their dating varies between the late 4th and the middle of the 1st century BC. Now, the aforementioned Male

67 Many thanks to I. Hertel (Berlin) for the UV-Fluorescence-Analysis. The fluorescence of the particles by the UV-Light rules out the possibility that they are inorganic substances from the find context. The reason for the low UV-Fluorescence is the considerable degradation of collagen, which occurs more rapidly in archaeological bone than in ivory.

68 See page 52.

was created in a foundry that was still in the late hellenistic tradition of craftsmanship.⁶⁹ Now even the teeth in his mildly smiling mouth point to the casting in the course of the 1st century BC.

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