An Iron Age Metal Workshop at Gabii, Latium

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To Stefano Musco (†), with my gratitude

Topography

The ancient site of Gabii was a settlement of the Latins, who formed a part of the larger group of the Italic peoples. It is located in the immediate vicinity of Rome on a coastal plain in central Italy which extends from the Tyrrhenian Sea in the west to the Apennine Mountains in the east. The earliest archaeological evidence of the Latin culture (civilità laziale) dates back to the turn of the 1st millennium BC.[1] Amongst researchers, Gabii is most well-known for its Iron Age necropolis which is located at today's Osteria dell'Osa. The finds of the necropolis have been analysed and published by A. M. Bietti Sestieri and A. De Santis.[2]

The Evolution of the Settlement

The main source of every urban study of Gabii has to be the work of M. Guaitoli, for which he analysed aerial photographs and the general topography as well as known stray and surface finds.[3] His results are now to be substantiated or possibly corrected by the ongoing research projects.[4] According to Guaitoli's studies, the rim of the crater lake was already populated during the middle Bronze Age. The analysis of the tombs at Osteria dell'Osa suggests that Gabii had become an important location by the 9th century BC (according to traditional chronology).[5] Little is known about this settlement. The concentration and distribution of the surface pottery paint a picture of several pre-urban nuclei spread irregularly over the tuff plateau, the slopes and the edge of the lake (fig. 1). In the early Iron Age, the inhabitants of the area retreated to the southern part of the plateau where a proto-urban settlement was established over the course of the 8th century BC. During the 7th and 6th century BC, the site evolved into an urban centre with sanctuaries[6] and governmental institutions.[7] The city prospered during the Archaic period, but ultimately began to decline in importance, power and inhabitants with the onset of the mid-Republican period (4th/3rd century BC).[8]

Location of the Workshop

The fortifications of Gabii and their historical context were the main objectives of our archaeological explorations.[9] During our excavations, conducted between 2008 and

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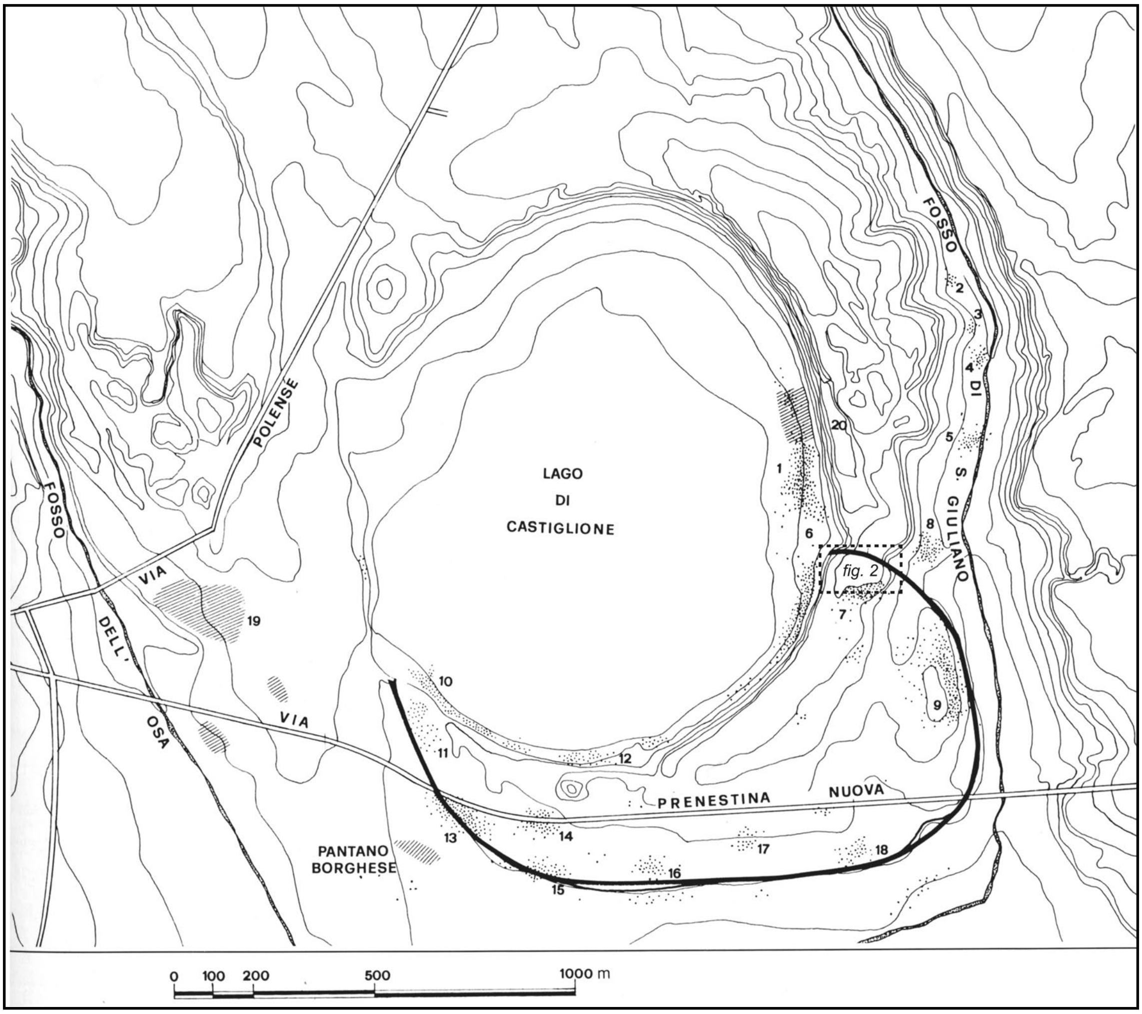

Fig. 1: Gabii in the Early Iron Age, with the later city wall (black), pre-urban nuclei (dotted) and necropoleis (hatched). The dotted line marks our excavation areas A and B.

2014, a group of structures was discovered in the eastern part of the ancient *arx*, which we interpret as a metal workshop and copper-alloy foundry. At present, the *arx* of Gabii is less prominent than it was in ancient times, mostly due to extensive quarrying of tuff stone to its south that began in the mid-Republican period. Very obvious even today is the depression to the north of the northern edge of the *arx* (fig. 2). Originally most likely a natural landform, its defensive properties were reinforced by further chiselling away the sides, most likely during the Archaic period. To the south of this moat, up on the northern edge of the settled *arx*, our two main trenches A and B are located. In area B, the workshop that is to be the subject of this paper was excavated between 2010 and 2014.[10]

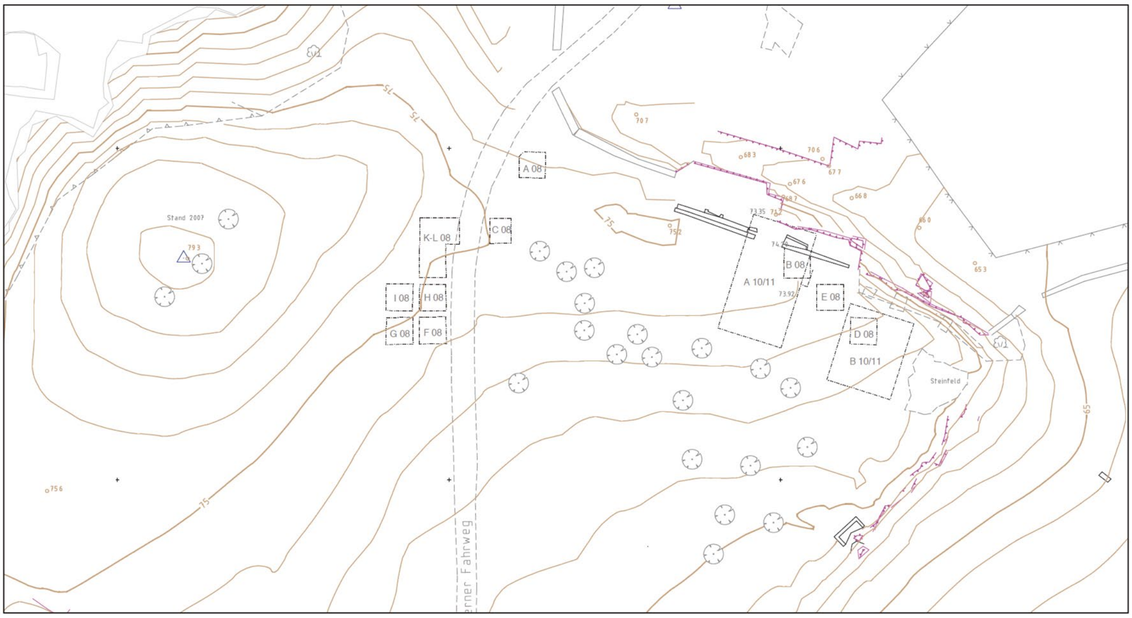

Fig. 2: The northern arx of Gabii with the areas excavated by the German Archaeological Institute (2008) and the University of Bonn (2010–14).

The Structures

Structure 1: The Kiln Used to Manufacture Terracotta Casting Moulds

Structure 1, of which only the foundations remain, is located directly below the crest of the slope. After discovering and identifying the light-red soil as the fill of a kiln and determining its extents, we[11] decided to cut it lengthwise from east to west and excavate only its southern part (figs. 3. 5. 6). We were able to distinguish two building phases. In this paper, only the main phase (Phase 2) shall be discussed in detail.[12]

Phase 1: The Circular Kiln – Latial Period IIB or earlier

The first kiln consists of a platform made of roughly set stones, forming a circular structure with an external diameter of 3,40 m. This was most likely a substructure for a dome-shaped kiln made of clay and wattle and daub, of which no traces remain.

Phase 2: The Kiln on a Rectangular Platform – Latial Period IIB

After the fortifications had been built up against the northern side of the kiln, it received a new frame. For this purpose a short wall was constructed on its eastern side, connecting the platform and the city wall (figs. 3–5). On its northern side, the narrow gap between the fortification and the circular platform was also filled in, and the southern side was similarly closed off. With this frame, the kiln received a new, rectangular form.

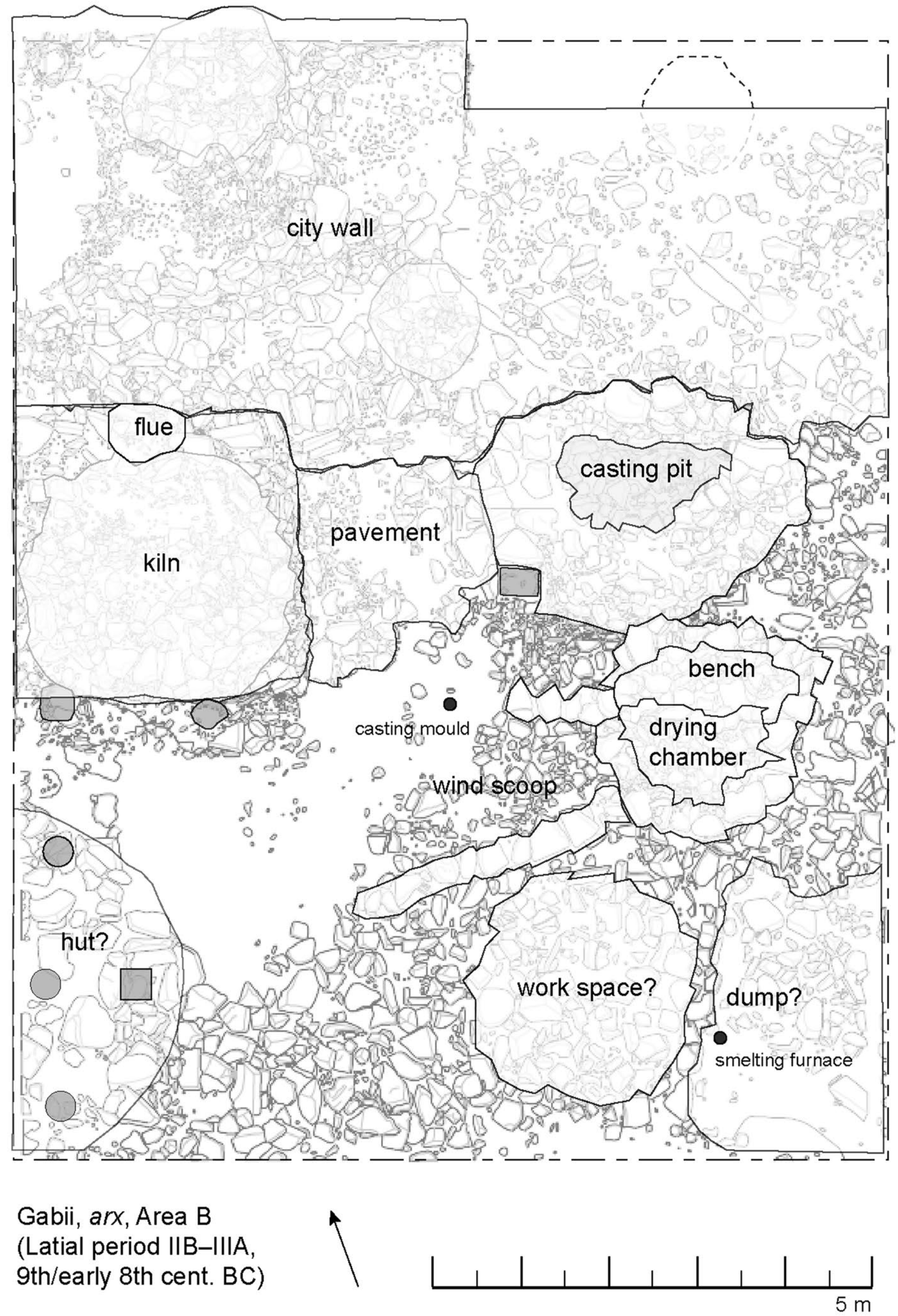

Fig. 3: Drawing of area B with Structures 1–3 (structure 1: kiln, structure 2: casting pit, structure 3: drying chamber).

Two post-holes and remains of loamy material point to the existence of a dome-shaped structure made of clay and wood. The centre of the kiln's platform was now hollowed out, creating a shallow pit lined with small stones. The opening forming the entrance to the kiln reached far into the dome, leading us to reconstruct a tunnel-like stoking chamber.

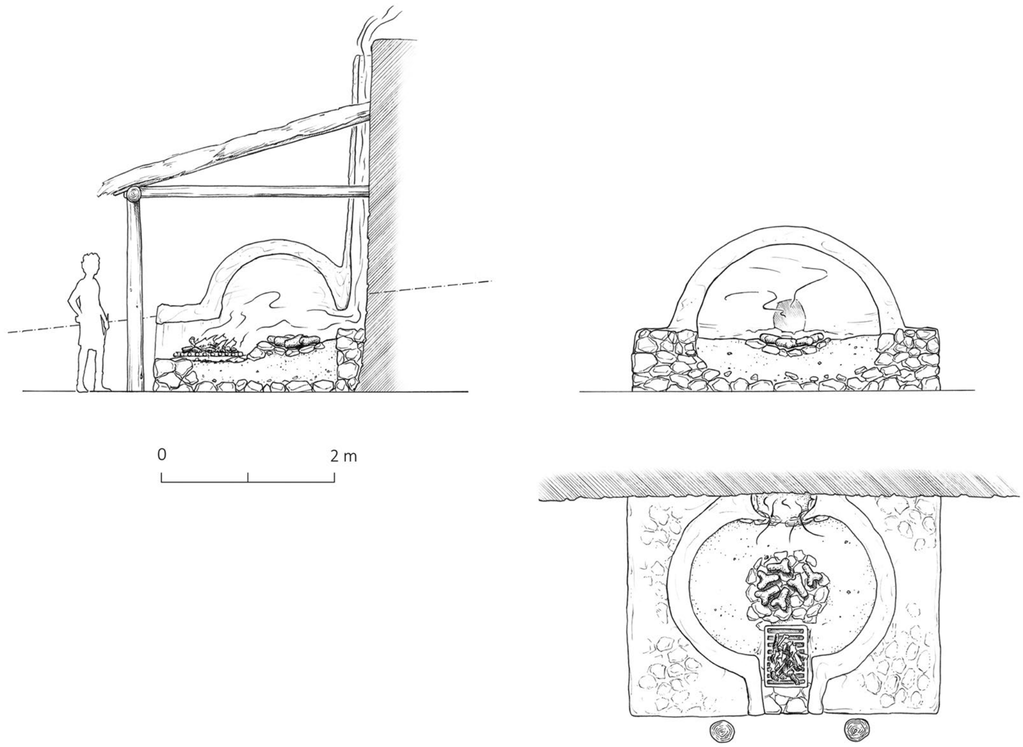

Fig. 4: Isometric reconstruction of the kiln used to manufacture terracotta moulds (the dotted line marks the surface level of 2010).

The specific arrangement of a number of stones directly opposite of the stoking chamber leads us to assume that there might have been a chimney or air flue in this spot. The kiln was protected by a roof, as evidenced by the two post-holes flanking the stoking chamber. The other side of this roof was most likely supported by the city wall built up against the kiln, with the wooden beams inserted into the fortification proper.

Interpretation as a Kiln used for the Manufacture of Casting Moulds

Fundamental for the interpretation of the structure as a ceramic kiln are a number of factors that point to the fact that the interior of the kiln was exposed to very high temperatures. Even during the excavation of the structure, the difference between the surrounding soil and the light, reddish material inside the kiln was evident at first glance. The material recovered from this fill also featured many pieces of charcoal and fragments of calcified bones. Small, burnt, dark-grey pieces of travertine and limestone were also frequently encountered.

Vital clues were provided by our colleagues of the University of Basel. The archaeobotanical and archaeozoological analysis of the material, conducted by Ö. Akeret and S. Deschler-Erb respectively, as well as geological information provided by Ch. Pümpin led us to the unambiguous conclusion that the inside of the domed chamber must have seen temperatures of over 600° Celsius.

Fig. 5: Overview of area B, view to east, with prevailing wind directions (Rome, annual average).

This precludes the interpretation of the structure as an oven used for culinary purposes. The reconstruction as a kiln was not immediately apparent, however, since it lacks the perforated floor characteristically found in ancient ceramic kilns encountered in the wider Mediterranean region. Also not found were specific small finds often associated with the production of ceramics, like wasters and misfired material, test-pieces, kiln props and other kiln furniture and significant amounts of ceramics. An important role in identifying the structure in area B as a kiln used for manufacturing ceramic moulds played the recently-published study of Nepalese foundries and metal workshops by A. Furger.[13] His description of the traditional procedures and working processes utilised for casting metal figurines underlines the central importance of a kiln that could produce the necessary terracotta moulds.[14] Theorising that our structure was not used to manufacture ceramics, but rather ceramic moulds used for metalwork would account for all the different observations made during its excavation and during the analysis of the materials found. It therefore seems that structure 1 was designed as a horizontal kiln (see below).

A brief Typology of Ancient Ceramic Kilns

Ancient ceramic kilns known from archaeological research are usually divided by their specific form and design into two broad categories. These kilns evolved from more simple methods of manufacturing ceramics,[15] which used open fires[16] or covered pits[17] to fire pottery. The use of open fires or fire pits was generally discontinued with the development of more complex, permanent structures that could be used more than once. One major improvement was the separation of the to-be-fired pottery from the fuel, which led to improved control over the firing process. Generally speaking, pottery and fuel could be arranged in two ways: Either vertically, by placing the ceramics above the fuel, or horizontally, by placing the ceramics behind the fuel. This influenced the layout of the kiln and the way in which the airflow and heat of the flames were directed inside of it. The vertical or updraught kiln[18] consists of two chambers arranged on top of each other, separated by a perforated floor. The heated air travels vertically, from the lower combustion chamber through the pierced floor, past the load and out of the kiln through the chimney placed at its highest point. In a horizontal or downdraught kiln,[19] on the other hand, the firing chamber is placed in front of the pottery chamber, with the latter eventually being located slightly higher than the furnace. Here, the hot gases move through the kiln in a horizontal direction until they escape through a flue or exit at the back of the pottery chamber, generally[20] located at about its floor level.[21]

Interpretation as Horizontal Kiln

We would therefore argue that this structure discovered in area B (fig. 3) was a horizontal kiln, since combustion and pottery chamber are arranged in a row and not on top of each other. In addition, no hints of the existence of a perforated floor could be found, which is a prerequisite for an updraught or vertical kiln. The furnace was therefore located in the tunnel-like installation in the south, a hypothesis supported by the fact that a noticeably higher amount of ash, calcified bone fragments and charcoal was found here compared to the rest of the structure. The pottery chamber was equipped with a shallow pit that must have held the load of the kiln, as can also be theorised by the fact that we found more ash surrounding the depression than within it. In the back of the dome, in the area where the kiln meets the city wall, there was probably a flue through which the hot gases could escape, which is characteristic for and the most practical solution in a horizontal kiln.

Chronology

Only a few finds can be clearly attributed to the first phase of the structure (e.g. Cat. 1, 2).[22] The remains of the collapsed, rectangular kiln, on the other hand, yielded far more material (e.g. Cat. 3–6).[23] These ceramic finds (fig. 8, Cat. 1–6) allow us to conclude that this kiln was in use until Latial period IIB–III and point to a construction date in Latial period IIB. Latial period IIB is traditionally dated to 830–770 BC. In light of the 14C-derived date ranges proposed by A. Njiboer,[24] Latial period IIB should receive a slightly ›higher‹ date of about 900–850/825 BC. This matches our own 14C results, for which we analysed two charcoal samples taken from the within the post-holes of the kiln's small porch. They, too, date the structure to the 9th century BC.[25]

Structure 2: The Casting Pit

Remains of this structure were found east of structure 1 adjacent to the city wall. Only 30 cm below the topsoil the first elements of this installation began to emerge, consisting of the fill of the casting pit and its stone-lined walls (figs. 3. 5–6).

The Remains

The semicircular structure was built up directly against the city wall using quarry and fieldstones, thus forming a kind of vat- or basin-like pit. The walls of this basin are made up of the straight segment of the city wall in the north and the rounded southern part set against it. The stones of the surface of the inner wall and the floor of this structure were noticeably discoloured, turning the originally light-grey material a light yellow-red. The pit, 65 cm deep at its lowest point, was filled with a fine, sandy layer of soil that contained a large number of bone fragments and ash, which were disproportionately found directly at the surface.

Interpretation as a Casting Pit

Three factors point to the interpretation of structure 2 as a casting pit. Firstly, the discolouration of the stones making up the walls of the basin and which points to them having been exposed to intense heat could only be found on the interior walls and the floor and not the exterior walls of the structure. Secondly, calcified bones were found mainly in the upper layers of the reddish filling and were clearly concentrated in the western part of the pit. This leads us to theorise that, for one, the entire pit must have been exposed to high temperatures. Also, the concentration of the bones – many of them heavily charred –, ash and charcoal in this area of the pit could be evidence of a fireplace located in this upper western part of the installation. Thirdly, the calcified bones strewn throughout the fill point to them having come into contact with a fire burning over a temperature of 600° Celsius.[26]

If this structure is interpreted as a casting pit used for the manufacture of metal objects,[27] all three factors can be traced back to the same source. When casting objects using the lost-wax or lost-mould technique, hot metal is poured into terracotta moulds. During that process, the molten metal displaces the air inside the moulds, very rapidly

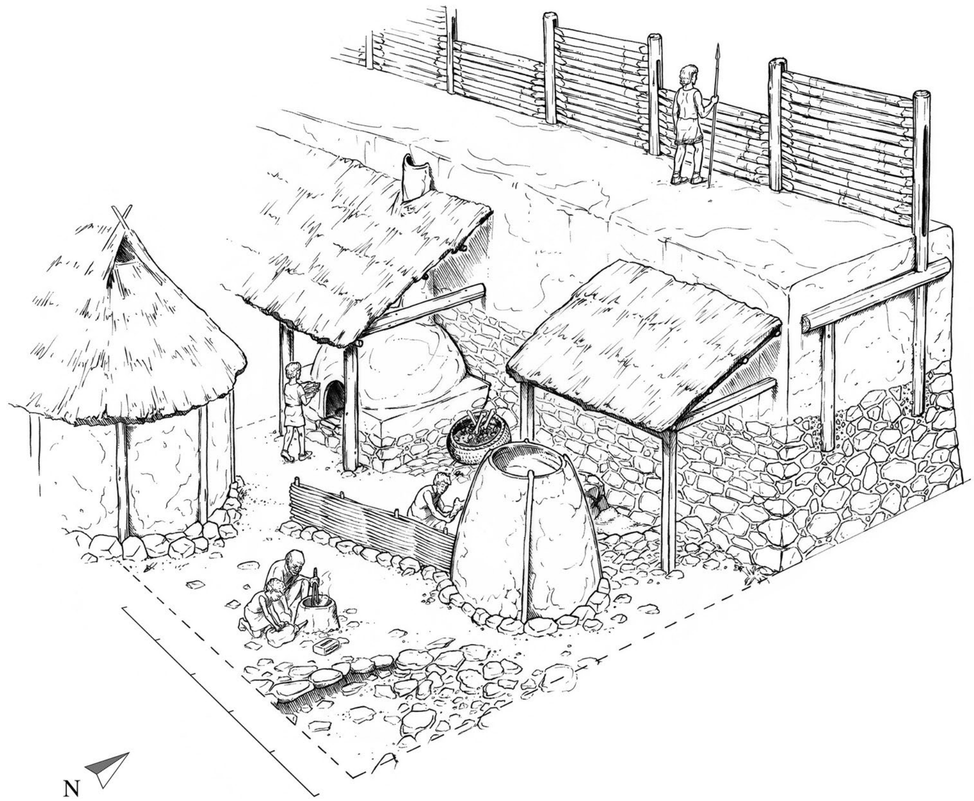

Fig. 6: Isometric reconstruction of the workshop and its surroundings.

cools off and begins to set.[28] This transition from a liquid to a solid state is accompanied by very high temperature levels, also known as heat of crystallisation or enthalpy. This thermal process is most likely responsible for the discolouration detected on the interior walls of the pit, where terracotta moulds would have been placed directly in the soft fill. Before the casting process could begin, both the metal and the moulds had to reach specific temperatures in order to guarantee the successful outcome of the casting and to protect the terracotta moulds, which would otherwise have shattered due to the temperature difference.[29] This would explain why only the interior of the pit seems to have been exposed to high temperatures.

We would therefore like to suggest that the moulds were heated in another part of the workshop[30] and then transferred to the casting pit with the feeder tubes pointing up. The gaps between the moulds were filled in with the sandy soil. They were thus surrounded on all sides by sand, a material, which could serve as a conductor that distributed the heat evenly throughout the pit. By interpreting the structure as a casting pit, the discolouration found on the inner walls and floor of the structure, the powdery fill containing very few finds and inclusions as well as the existence of a top layer consisting of ash and calcified bones could therefore all be explained in a satisfying manner.

Chronology

The casting pit was built up against the city wall, which in this period took the form of a wall made of rammed earth and wood, placed on a massive foundation of field and quarry stones.[31] This wall therefore predates both structure 2 and the reconstruction of the kiln (Structure 1, second phase), which seem to have been constructed contemporaneously.

As was the case with structure 1 (the kiln), no useful material for establishing a date of construction for this structure could be found. Some clearly dated sherds (e.g. Cat. 7–9) can be attributed to its last phase, however, dating its abandonment phase rather generally to Latial period IIB–III (fig. 8, Cat. 7–9). This allows us to conclude that the pit was constructed in Latial period IIB and therefore in the 9th or early 8th century BC (revised chronology).[32]

Structure 3: The drying chamber

Already during the spring campaign of 2011 we discovered a cluster of large stones in the eastern part of area B, directly to the south of structure 2. Only two years later we were able to identify it as the remains of a single structure, which was subsequently excavated and documented.

The Remains

The installation consists of two separate elements (figs. 3. 5): First, a roughly circular substructure taking the form of a low platform, and second, two long rows of stones set against its western side. Together with the western face of the platform, these two roughly parallel walls form a corner at a slightly obtuse angle. We suggest that an opening might have existed in the western wall of the structure built on top of the platform.

Interpretation as a Drying Chamber

The interpretation of the poorly preserved structure as a kind of drying cabinet (see below) can neither be substantiated by specific finds nor by parallels with similar constructions found at comparable sites. While we therefore move in a distinct grey area, our hypothesis is supported by a detailed analysis of the workshop's contexts. Within the circular part of the structure, we could detect no traces of fire or the presence of high temperatures, which precludes the use as an oven or kiln. This was therefore a small, circular room, possibly with a low bench on its northern side, which was accessible from the west. It can hardly be interpreted as a living space or small hut, possessing an external diameter of only 2,5 m.

The two stone walls built up against the western part of the circular platform and reaching into the open space between structure 1–3 and the city wall do not seem to belong to any other structure and are clearly connected to structure 3. The length of the southern wall, which exceeds that of its northern counterpart and might have been even more substantial in antiquity, led us to interpret these walls as a means to channel air into the small circular room and therefore as a kind of ventilation channel or scoop. Then as today, the Latin plains generally experience westerly winds during the summer months, as modern computer programs used by sailors and aviators to determine wind direction and wind speed confirm (fig. 5). If the walls were meant to channel naturally occurring breezes, the layout with a shorter northern and longer southern wall, arranged in a slight V-form and oriented towards southwest, would have served that purpose perfectly.

If the walls of the superstructure on the circular platform – our so-called drying chamber – were slightly inclined inwards and the roof featured an opening, the air could have travelled from the entranceway to the west, though the interior of the chamber and up and out through the opening in the roof (fig. 6). Because the (generally thin) walls of drying structures – as for example in oast houses used to dry cereals[33] – are designed to be easily heated by the sun, the temperance difference between the outside and the inside of the structure would have caused convection and therefore facilitated the movement of air from colder, low-pressure areas to warmer, high-pressure areas. Because of this phenomenon we reconstruct the installation with a centrally placed upper opening,[34] which of course is pure conjecture. This thermal effect, however, would have been intensified by the walls constructed to the west of the room, which channelled the southwesterly winds into the structure.

The combination of these two architectural elements – the circular platform and the two walls built up against its western outer wall – lead us to propose the interpretation as a kind of small drying cabinet or chamber. This interpretation is made more likely by the structure's proximity to the metal workshop. When using terracotta moulds in the lost-wax technique, it is imperative that the freshly shaped moulds are dried very slowly and carefully. It is inadvisable to lay them out in the direct sunlight and storing them in the shade is much to be preferred, lest the moisture trapped in the clay evaporates too quickly, thus leading to cracks within the structure of the mould and/or deformation during the burnout or firing process.

The inside of our drying cabinet would have been shady, and the wind flow would have helped to slowly dry out the clay shells waiting to be fired. The low bench or platform found along the northern wall could have served as a shelf or pedestal on which the moulds could have been placed.[35]

Chronology

The northern wall of the scoop used to channel air into the direction of the small drying chamber is built into its western wall, meaning that the two structures must have been built at the same time. Additionally, the northern part of the drying chamber (structure 3) overlaps the southern wall of the casting pit (structure 2), which again points to a contemporary or very slightly later date of construction (fig. 5). This allows us to interpret the wind scoop, drying chamber and casting pit as a single architectural and functional unit.

Ceramic material useful for establishing a more precise date for structure 3 could once again only be found in the collapsed remains of its substructure. The few datable sherds (e.g. Cat. 10) date the last period of utilisation to Latial period IIB–III, according to R. P. Krämer's analysis (fig. 8, Cat. 10). Consequently, this structure – just like structure 1 (second phase) and 2 – was constructed and used in the 9th and early 8th century BC.

Finds

Object 1: Fragment of a Melting Furnace (Cat. 12)

This terracotta object made of grit-tempered clay was found south of structure 3, the so-called drying chamber (fig. 3). It is fractured on at least three sides (fig. 7). The sherd, about 3 cm thick, is curved in both directions. The original diameter of the terracotta object can unfortunately no longer be reconstructed. Said object was hand-formed out of clay and its surface then sealed by direct contact with fire, meaning it was placed in the flames directly as opposed to properly fired in a kiln. This is documented by the specific, differently patterned colouring found on the in- and outside of the sherd. It also features a hole (diameter: 1,5 cm) with a raised, irregular edge surrounding it on the fragment's inner side. The area around this hole is of a reddish colour, which points to the fact that here a higher level of oxygen came into contact and reacted with the iron particles in the clay. It therefore seems possible that the nozzle of a bellows may have been inserted into the object through this hole.

The precise delivery of additional air to the fuel via a bellows is especially important during the melting process of crude metals or metal scraps, since it raises the rate of combustion and therefore the heat output of the furnace and thus helps reach the necessary melting temperatures.[36] Similar crucible furnaces, in which the fuel was placed and heated inside the installations and refractory crucibles were employed to heat the metal charge, are known from a multitude of Iron Age sites, for example from Heuneburg, a fortified hillside settlement by the upper Danube.[37] We believe that the fragment found at Gabii belonged to a low, circular furnace used to melt metals (fig. 6). This crucible furnace would have taken the form of a round clay structure at least 10 cm tall, with one wall featuring a hole through which the nozzle of a bellows could be inserted in order to add additional air to the fuel inside of it.

Object 2: The Casting Mould (Cat. 11)

This object (fig. 7) was found in the top layers southeast of structure 1 (the kiln) (fig. 3). It is made of porous sandstone, and only three of the six outer surfaces are preserved.

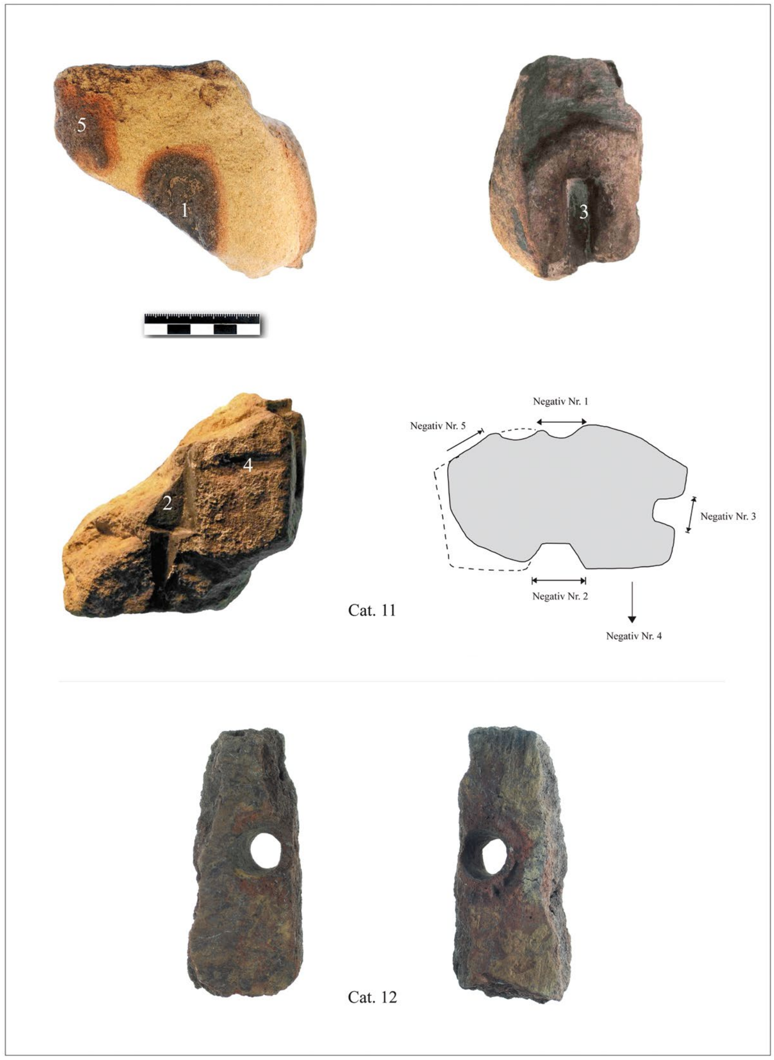

Fig. 7: A fragmentary sandstone casting mould (Cat. 11) and a fragment of a melting furnace with opening for bellows (Cat. 12).

The stone object features casting moulds for four, perhaps five different objects. Right next to the main fracture the object's surface is damaged, with the upper part having chipped off. It seems logical to assume that this surface, with the moulds for objects 1 and 5, was originally as regular and smooth as the reverse surface with the moulds for objects 2 and 4. The (restored) dimensions of the roughly rectangular stone object are about 10,5 cm (width) by 6,5 cm (height) by at least 12 cm (length).

The object exhibits clear, reddish-yellow traces attributable to the application of great heat, especially in and around the individual moulds. This leads us to propose an interpretation as a stone mould for different non-ferrous metal objects (cfr. fig. 6).

Since at least four different moulds can be counted, the object was used over a longer period of time. The individual shapes show differing stages of wear, which suggests that they weren't carved at the same time but rather subsequently, and were each used more than once.

It is unclear if our object formed an open mould, in which the molten metal was simply poured in the hollows and left to cool, or a closed mould, which contained a delivery system for the metal to reach the mould cavity and usually took the form of a covered open mould or two halves forming a single unit. The deliberately smoothed surface on the side containing the mould for object 2 could strengthen the interpretation as a closed mould. In this case, mould 4 would have formed the sprue leading towards the cast for object 2. Below that sprue could have been a venting channel.[38] The mould might therefore have been covered with a smooth, flat stone that left the channels accessible. The cast objects were all of an elongated form. The sides of the moulds for objects 2 and 3 taper off slightly, so that these resemble small metal bars, which could more easily be released from the moulds. Similar casting moulds have been found at the late Bronze Age settlement of Sabucina (Sicily). They each feature multiple moulds on three sides.[39]

Interpretation of the Archaeological Contexts

A Site for Secondary Metal Production

The three structures and two finds presented here lead us to propose that, in this area of the *arx* of Gabii, there was a workshop of a metalworker using mainly non-ferrous metals. Ores do not occur naturally in the immediate vicinity of the city,[40] and we did not find any indicators that metals had been smelted on-site, e.g. in the form of slag, pieces of ore or remains of fires in which the broken-up ore would have been roasted prior to the smelting process in order to remove any moisture still remaining within (so-called primary metal production). Instead, crude metals seem to have been processed here, i.e. melted, cast and forged (so-called secondary metal production).[41]

Non-Expendable Mould Casting

After the analysis of the archaeological contexts and finds we conclude that two separate casting methods were used for processing the crude metals. On the one hand, non-expendable mould casting was practised, using reusable moulds. This is suggested by the discovery of the stone mould, which produced several kinds of small, thin metal ingots. It is probable that these unwrought pieces of metal were then turned into small tools, objects or pieces of jewellery, which were forged somewhere close-by or in another part of the city. An indicator for the production of fibulae on-site or at least in the closer vicinity could be the discovery of several copper-alloy pins, needles and rings in different parts of area B. The possible use of the small thin ingots as a kind of proto-money must not be discounted either.

Expendable Mould Casting

On the other hand, non-ferrous metal objects were produced using the so-called lost-wax casting technique. Since no remains of shattered terracotta moulds or spoiled castings were found, we have no information as to what kinds of objects were produced in this manner.[42] The depth of the casting pit (structure 2) would have allowed for the production of metal objects up to about 50 cm in height. As would be expected, no traces of the wax models have been preserved. Structure 3 seems to possess the most important elements of a drying cabinet or drying chamber, where the models, covered in a mantle of clay slurry, could be dried slowly and carefully. Where these shells were then heated to allow the wax to melt and run out is unknown. Instead of a simple fire, small and portable terracotta ovens (so-called cooking pot stands) could also have been used for this purpose, since the remains of several have been found in area B.

We suggest that the burned-out shells – now no longer containing their wax models – were then fired in the kiln discovered in the western part of area B (structure 1). Once that was done, the finished terracotta moulds were placed either directly in the casting pit or, if stored for a period of time, reheated and then placed within this basin-like structure (structure 2). They were surrounded with soft, sandy soil well suited to conducting the necessary heat. In the upper western part of the pit a furnace was then lit, the crude metal melted in a crucible and, once it had reached the melting point, poured into the prepared terracotta moulds. Based on the large number of calcified bone fragments found in the area, we assume that here as well as in the kiln animal bones served as the main source of fuel.[43] After the moulds had cooled off, they were uncovered and the rough castings released by shattering the shells. The cast objects would then have been further processed (sprues cut off, surface polished etc.), most likely somewhere close-by. We have found no trace of these next steps.[44]

A. M. Bietti Sestieri had already hypothesised in 1980 – during her exploration of the necropolis at Osteria dell'Osa[45] – that metal workshops producing copper-alloy objects existed at Gabii as early as the early Iron Age. Amongst the grave goods she found a substantial number of such objects, e.g. jewellery (especially in women's tombs), tools and other instruments that seem to have been locally manufactured. The discovery of the metal workshop on Gabii's *arx* has, as we would like to suggest, corroborated this hypothesis.[46]

Translation: Eva-Maria Träder

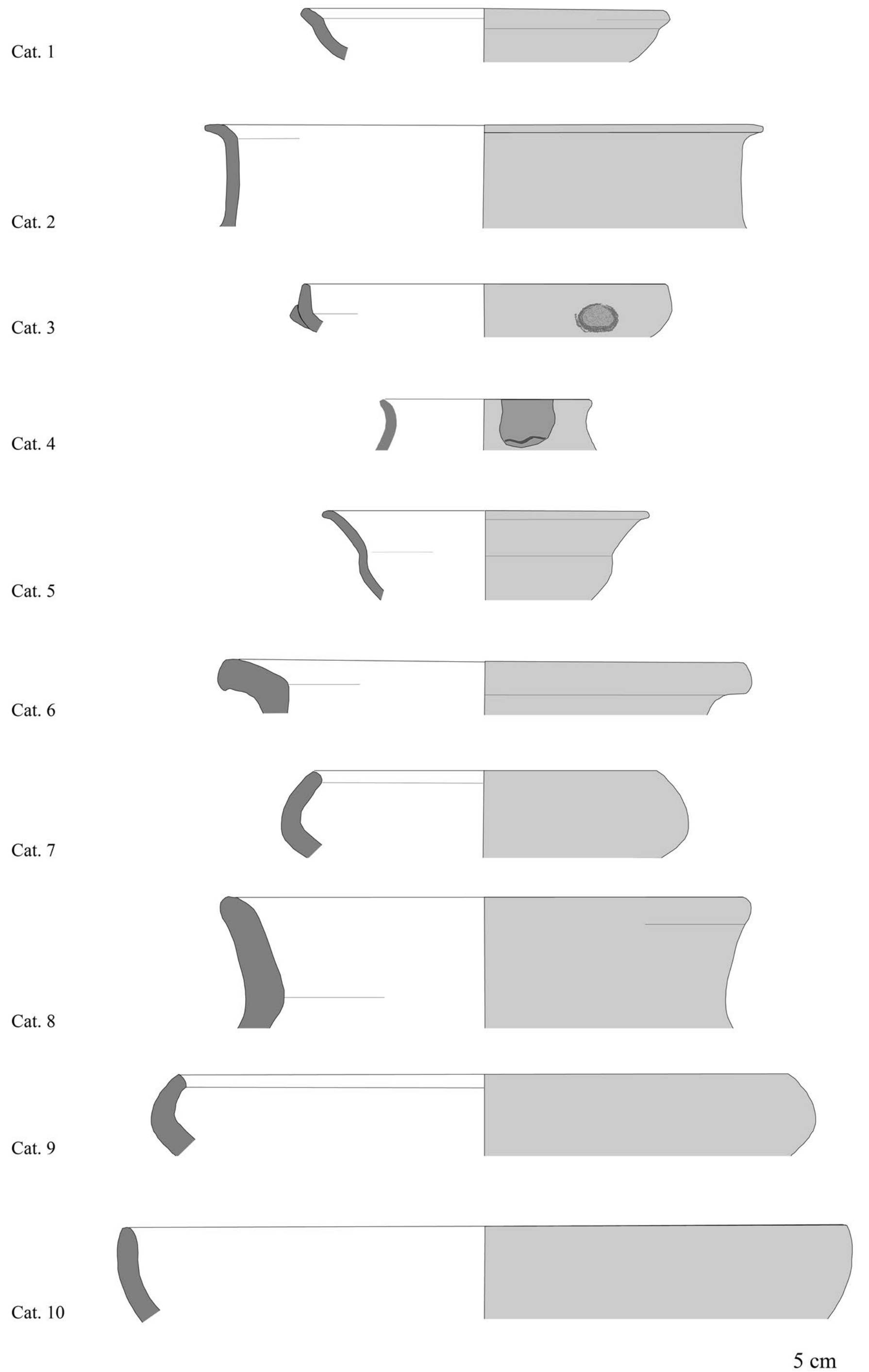

Fig. 8: Area B, ceramics selection (Cat. 1–10).

Appendix: Catalogue of Selected Finds from the Iron Age Metal Workshop at Gabii, Latium

R. P. Krämer

Structure 1:	First phase of round kiln: Cat. 1–2.
	Abandonment phase of rectangular kiln: Cat. 3–6.
Structure 2:	Last phase: Cat. 7–9.
Structure 3:	Last phase: Cat. 10.

Cat. 1 (inv. no. GB12MNB49I-1)
Rim fragment of a cup in impasto bruno
Hard-fired, dark-grey clay with some fine inclusions. Exterior black and polished.
H 2,6 cm; W 1,8 cm; wall Dm 0,5–0,6 cm; Dm 14 cm.
Maaskant-Kleibrink 1987, nos. 390. 392. 393. 674. 675; Bietti Sestieri 1992a, nos. 19a. 19c; 20a–20d. 22a–20c; Attema et al. 2001/2002, 343 no. VII-2.
Latial period IIB–IVA

Cat. 2 (inv. no. GB13MNB143I-2)
Rim fragment of an amphora in impasto bruno
Hard-fired dark-grey to black clay with a few very fine inclusions. Exterior black and very polished.
H 3,8 cm; W 6,2 cm; wall Dm 0,4 cm; Dm 20 cm.
Bietti Sestieri 1992a, nos. 7b. 7d (Latial period II).
Latial period II

Cat. 3 (inv. no. GB12MNB40I-2 – GeF156)
Rim fragment of a bowl in impasto with knob on shoulder
Medium-hard-fired reddish-brown clay (2,5 YR 4/4) with many very fine inclusions. Exterior reddish-brown (2,5 YR 4/4) and polished.
H 1,7 cm; W 4 cm; wall Dm 0,6 cm; Dm 14 cm.
Maaskant-Kleibrink 1987, nos. 364. 365. 367–369. 606–610; Bietti Sestieri 1992a, nos. 26c. 26d. 26h. 26m; Attema et al. 2001/2002, 337–340 no. V-3.
Latial period II–III, perhaps more likely Latial period IIB

Cat. 4 (inv. no. GB11MNB68I-1)
Rim fragment of an amphora in impasto bruno
Medium-hard-fired reddish clay (2,5 YR 4/8) with few fine inclusions. Exterior dark to black (2,5 YR 4/8) and polished.
H 1,8 cm; W 2,1 cm; wall Dm 0,4 cm; Dm 8 cm.
Maaskant-Kleibrink 1987, nos. 1086. 1214; Bietti Sestieri 1992a, nos. 11i. 11k. 11m. 13a. 13b var. III.
Latial period II–III, more likely Latial period II

Cat. 5 (inv. no. GB12MNB68I-1)
Rim fragment of a bowl in impasto bruno
Hard-fired clay with many very fine inclusions. Exterior almost black and polished.
H 4,2 cm; W 2,8 cm; wall Dm 0,4 cm; Dm 12,2 cm.
Maaskant-Kleibrink 1987, no. 1035; Bietti Sestieri 1992a, no. 24c; Attema et al. 2001/2002, 340 no. V-7.
Latial period III, perhaps Latial period IVA

Cat. 6 (inv. no. GB12MNB68I-4)
Rim fragment of an olla in impasto bruno
Medium-hard-fired reddish-brown clay (2,5 YR 4/4) with few fine inclusions. Exterior black and polished.
H 1,7 cm; W 2,9 cm; wall Dm 1,3 cm; Dm 20,4 cm.
Maaskant-Kleibrink 1987, no. 586; Bietti Sestieri 1992a, no. 11a; Attema et al. 2001/2002, 332 no. III-2.
Latial period IIB–III

Cat. 7 (inv. no. GB11MNB28II-1)
Rim fragment of a bowl in impasto bruno
Medium-fired brown clay (2,5 YR 4/4) with few fine inclusions. Exterior brown (2,5 YR 4/4) and coarsely smoothed.
H 3 cm; W 2,8 cm; wall Dm 0,7–0,9 cm; Dm 13 cm.
Maaskant-Kleibrink 1987, nos. 364. 365. 367–369. 606–610; Bietti Sestieri 1992a, nos. 26c. 26d. 26h. 26m; Attema et al. 2001/2002, 337–340 no. V-3; di Gennaro 2002, no. VIII.7.
Latial period II–III, perhaps more likely Latial period IIB

Cat. 8 (inv. no. GB11MNB28II-2)
Rim fragment of an olla in impasto
Medium-fired reddish-brown clay (10 R 4/4) with few fine inclusions and quartz. Exterior reddish and polished.
H 5 cm; W 5 cm; wall Dm 1,2–1,6 cm; Dm 20 cm
Maaskant-Kleibrink 1987, nos. 352. 585–588. 591. 592; Bietti Sestieri 1992a, nos. 11a. 11a var. II; Attema et al. 2001/2002, 332 no. III-2.
Late Latial period IIB–III

Cat. 9 (inv. no. GB13MNB35II-1)
Rim fragment of a bowl in impasto bruno
Hard-fired black clay with many fine inclusions. Exterior black and polished.
H 2,3 cm; W 4,5 cm; wall Dm 1 cm; Dm ca. 22 cm.
Maaskant-Kleibrink 1987, nos. 364. 365. 367–369. 606–610; Bietti Sestieri 1992a, nos. 26c. 26d. 26h. 26m; Attema et al. 2001/2002, 337–340 no. V-3; di Gennaro 2002, no. VIII.7.
Latial period II–III, perhaps more likely IIB

Cat. 10 (inv. no. GB13MNB137IV-1)
Rim fragment of a bowl in impasto bruno
Hard-fired grey clay with few fine inclusions and quartz. Exterior dark-brown to black and polished.
H 3,3 cm; W 4,8 cm; wall Dm 0,9 cm; Dm 26 cm.
Maaskant-Kleibrink 1987, nos. 625. 626; Bietti Sestieri 1992a, nos. 26a. 26f. 26i; Attema et al. 2001/2002, 337 no. V-2; di Gennaro – Schiappelli 2013, 87–89 no. 3; 89 no. 5.
Latial period II–III

Cat. 11 (inv. no. GB11MNB81III-5)
Fragment of a casting mould in porous sandstone. The surface features at least four moulds and yellow-reddish discolourations that may be attributed to intense heat.
H 6,5 cm; W 10,5 cm; L 12 cm.

Cat. 12 (inv. no. GB12MNB122IV-5)
Wall fragment of a melting furnace
Reddish Impasto (10 R 4/6) with many coarse and fine inclusions, exterior brown (7,5 YR 6/6). Curved wall fragment, fractured on three sides, featuring a round hole (Dm 1,5 cm).
H 4,8 cm; W 10,9 cm; wall Dm 2,8–3 cm.

Notes

[1] Bietti Sestieri 1979, 11–13; Bietti Sestieri 1992a; Bietti Sestieri 1992b; Bietti Sestieri 2014, 267–284; Zuchtriegel 2015.
[2] Bietti Sestieri 1992a.
[3] Guaitoli 1977, 17–20; Guaitoli 1981a, 157–161; Guaitoli 1981b; Guaitoli 1984; Guaitoli 2003.
[4] Terrenato et al. 2010; Terrenato et al. 2018.
[5] cf. Njiboer 2004; Nijboer – van der Plicht 2008.
[6] Zuchtriegel 2012.
[7] Fabbri 2010; Fabbri et al. 2012; Fabbri – Musco 2016.
[8] Guaitoli 2003.
[9] DFG Project No. 162143724: Gabii, Latium: The fortifications from the Archaic to the mid-Republican period. See also Helas 2018.
[10] Due to the particularly time-consuming documentation process necessarily applied in this area and the fact that our main focus was the study and excavation of the fortifications, the structures could unfortunately only be partially explored.
[11] I very consciously say ›we‹, since while I may have directed the project and authored this paper, the results presented here are the fruits and culmination of an intensive, lengthy discussion with all members of my team.
[12] For a more in-depth discussion I refer to the forthcoming main publication.

[13] Furger 2017.
[14] Furger 2017, 77 with figs. 90. 124.
[15] Cattani 1997, 508.
[16] Duhamel 1978/1979: "cuisson en meule"; Cuomo di Caprio 1985: "focolare all'aperto"; Köpke – Graf 1988: "Feldbrandanlagen"; Saracino 2005: "fornace a cielo aperto"; Heege 2007: "offener Feldbrand"; Rice 2015: "open firing".
[17] Duhamel 1978/1979: "cuisson en fosse"; Köpke – Graf 1988: "Brenngruben"; Saracino 2005: "fornace in conca"; Heege 2007: "Grubenbrand"; Rice 2015: "pit/trench firing".
[18] Köpke – Graf 1988: "stehender Ofen"; Saracino 2005: "struttura verticale"; Rice 2015: "updraft kiln".
[19] Köpke – Graf 1988: "liegender Ofen"; Saracino 2005: "struttura orizzontale"; Rice 2015: "downdraft kiln"; Cuomo di Caprio 2007: "fornace orizzontale/forno a fiamma rovesciata".
[20] Duhamel 1978/1979, 72 with fig. 42. Horizontal kilns can also be equipped with a chimney placed in the upper part of the kiln; a low-lying flue is therefore not always part of the design, cf. Heege 2005, 114.
[21] Cuomo di Caprio 1985, fig. 17b; Köpke – Graf 1988, fig. 9.
[22] The small number of datable sherds recovered do not contradict the date proposed below, but they are of particularly long-lived types that make a more detailed chronology impossible.
[23] A selection of the ceramics used for this chronology is presented by R. P. Krämer in the catalogue included in the appendix.
[24] Nijboer et al. 1999/2000, 163–176; Nijboer 2004, 527–556; Nijboer – van der Plicht 2008, 103–118.
[25] A charred wood sample (oak) gave an absolute date of 1125–912 calBC. The analysis of charred seed pointed to a slightly lower date (1071–843 calBC). The analysis was performed by our colleagues at the University of Cologne (CologneAMS, J. Rethemeyer).
[26] As pointed out by S. Deschler-Erb in her report. Ö. Akeret could not detect any carbonised floral material in the soil samples, since the high temperatures would have consumed such material without leaving perceptible traces. We refer the reader to the upcoming publication for details.
[27] This interpretation was suggested by S. Deschler-Erb, to whom I would like to extend my sincere gratitude for her generous help and advice.
[28] A brief summary can be found in Armbruster 2012, 308. 309 with fig. 421; see also Giardino 2010, chapter 5, esp. 66–70. Once again very helpful in general is Furger 2017.
[29] Ratka 1998, fig. 7.67.
[30] It seems unlikely that the moulds were heated in the pit itself, since no larger amount of charcoal was found in the soil filling its lower part.
[31] This phase of the city wall was erected in Latial period IIB. For more information we refer the reader to the forthcoming final publication (in preparation).
[32] cf. note 24 above.
[33] In our reconstruction we assume that the structure only possessed thin walls, maybe even made of ephemeral materials like leather, textile or wood.
[34] If the superstructure was tent-like, as we hypothesise, such an opening could have been covered up in the case of rain or very high temperatures.
[35] Following our proposed reconstruction, the entranceway and the upper exhaust opening could have been closed and opened at will in order to control the temperature, and wet cloths could have

been employed to control the humidity. This would have allowed the artisans to influence the drying process.

[36] Furger 2017, 77. 78.

[37] Drescher 2000, fig. 12. These kinds of crucible furnaces differ only slightly from the bloomeries used to smelt crude metals from ores, cf. Giardino 2010, 58–63, fig. 5. The fact that no slag has been found in Area B points to the interpretation as a crucible furnace, however.

[38] I thank A. Murgan for sharing his expertise on this subject.

[39] Albanese Procelli 2000, 75–90, cf. inv. no. 2637, fig. 4.1 and inv. no. 2647, fig. 4.2.

[40] Bietti Sestieri 1980, 111.

[41] Metallurgy is broadly divided into primary and secondary metal production operations, i.e. into the smelting of metals from ore and the further processing of melting the extracted, crude metals.

[42] We assume that all metal scraps were reused and melted down and that a hypothetical dump for material that was no longer usable is located somewhere in the wider area.

[43] Furger 2018, 234–237.

[44] The furnace used to heat the metal (Cat. 12) could comprehensively also have been used as a forge.

[45] Bietti Sestieri 1980, 110.

[46] I would like to thank many people for their generous help and their suggestions. Only a few of them can be mentioned here. First I would like to thank Area B supervisor A. von Helden and his assistants S. Holzem and A. Weirich. M. Zingaretti and R. Krämer analysed and documented the finds. Critical suggestions leading to a breakthrough in the study of the complex were offered by S. Deschler-Erb, Ö. Akeret and Ch. Pümpin from the Institute for Integrative Prehistory and Archaeological Science (IPAS) of the University of Basel. A. R. Furger conducted experiments to determine the suitability of animal bones as a fuel source. P. Fleischer and P. Thomas gave helpful (literary) references, and M. Jansen and D. Kirchner from the Bergbau-Museum in Bochum analysed numerous samples. I discussed many details of the interpretation with A. Murgan and A. Segbers, and S. Kiel (Magdeburg-Stendal University of Applied Sciences) took excellent aerial photographs and was a fount of meteorological information. I thank T. Scheffler as well as his colleagues M. Jakobi and J. Hoffmann for their various mapping and surveying services. O. Bruderer drew the reconstruction drawing and helped further the general discussion. E. Träder translated this text into English and had a few helpful suggestions. Last but not least I would like to thank the German Research Foundation (DFG), who financed this research project, and the Department of Classical Archaeology of the University of Bonn, which provided me with a workspace. Special thanks is also due to S. Musco of the Office for the Protection of the Archaeological Heritage in Rome, who invited us to Gabii and supported us on-site.

Image Credits

Fig. 1: Bietti Sestieri 1992a, fig. 4-1. After Guaitoli 1981a, fig. 1. – Fig. 2: M. Jakobi, Magdeburg. – Fig. 3: A. von Helden – P. Fleischer – S. Helas, Bonn. – Fig. 4: O. Bruderer, Zürich. – Fig. 5: S. Kiel, Magdeburg – Fig. 6: O. Bruderer, Zürich. – Fig. 7: S. Helas – S. Holzem – P. Fleischer (sketch), Bonn. – Fig. 8: S. Helas, Bonn, after original drawings by R. Da Vela, R. P. Krämer, E. Lunardon and M. Zingaretti.

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