Stefanie Becht
Katholische Universität Eichstätt-Ingolstadt
stefanie.becht@ku.de

Stefanie Becht

Preliminary Report on the Excavation of a Roman Bronze-Casting Workshop on the Lower Terrace of the Temple of Zeus (Jarash/Gerasa)

Introduction

Following an almost 40-year long tradition of excavations that began in October 1982, work was resumed in the *pseudokryptoporticus* on the lower terrace of the Temple of Zeus in Jarash in fall 2021. For that the author owes special thanks not only to Jacques Seigne, who allowed the team from the Katholische Universität Eichstätt (KUEI) to continue his work and supported us in every possible way, but also to Thomas Weber and Lutfi Khalil, who are most valuable partners and consultants in the project.

In the year 1993, Jacques Seigne and his team of the Mission français archéologique de Jerash (MFAJ) made an unexpected discovery during the excavation at the lower terrace of the Temple of Zeus. Behind the old temple, right in front of the northern entrance to the terrace, they found a big pit filled with strange pottery fragments. It soon became clear that said fragments were smashed casting moulds and the installation was part of a bronze-casting workshop. When the MFAJ stopped working on the temple area in 2014, it was clear that the workshop had still not been completely excavated, even though three campaigns had already unearthed more and more details of this unique testimony of Roman craftsmanship. To further investigate the area of the foundry, Gerhard Zimmer, an expert on ancient bronze casting, initiated a new project funded by the DFG (German Research Foundation), with the author of this article as the field director. With Gerhard Zimmer's profound expertise on Greek foundries and the new insights from the recent excavations, we hoped to understand the technological differences between Greek and Roman workshops, among other things.

In fall 2021, a small square was opened inside the porticus, directly

next to its entrance where the French campaign of 2014 had unearthed the hitherto last of the casting pits and another campaign took place in 2022. Though the main objective of the project was research on the bronze-casting workshop, it had also been planned from the beginning to document the later uses of the area as thoroughly as possible. The results of both excavation campaigns, regarding the Roman foundry as well as the later phases of occupation, will be presented in this article.

The Lower Terrace of the Temple of Zeus

To understand the archaeological record, it is crucial to first take a look at the history and topography of the sanctuary of Zeus in Gerasa, where the workshop was situated (FIG. 1). The nucleus of the first temple on what is now called the "lower terrace" goes back at least to the Iron Age, when the first settlement was still situated on the tell opposite the later sanctuary. The natural grotto near the top of a massive rock served as the original high place, as traces of incense and pottery that were deposited there show (Seigne 1997: 995). After the entrance to the grotto had been blocked, it seems that the summit of the rock itself became the place of cult, with at least two phases of an altar, the second of which corresponds with an enlargement of the artificial terrace around 100 BC (Seigne 1997: 996). Shortly thereafter, probably around 60 BC, the first temple, the Hellenistic Naos, was built on that same spot. In the following years, the terrace was banked up on a grand scale, resulting in a platform of about 40 x 60 m on the southern side of the temple, the construction of which can be dated to the middle of the first century AD. In the year AD 9/10, according to the inscriptions, the sanctuary was embellished with a vaulted corridor along the slope of the hill on the northwest side.

Soon afterwards, around AD 30, the architect Diodoros of Gerasa extended the vaulted corridor, as a *pseudocryptoporticus*, to all four sides of the terrace that was enlarged to a size of 50 x 100 m, with the *cryptoporticus* on the southeastern side as a substruction, the way it is still preserved. The area now had three entrances, the main one being the *propylon* that led to the courtyard from the southeast, with the staircase leading to the depression where the famous "oval plaza" was yet to be constructed. It is still not clear if the two side entrances were connected to the road system at that time, or if they had a mostly decorative function.

In 69/70 the Hellenistic Naos that had been destroyed, probably during the first Jewish war, was replaced. The new Roman-style podium temple was considerably larger than the old naos and aligned with the surrounding *pseudocryptoporticus*. In the new construction, called the Naos of Theon, after its donor, a small booth was included in the eastern anta, which could only be entered from a passageway inside the temple, running alongside the sacred rock. This unusual building element led the excavators to believe that from inside this small room, an oracle was practising divination for the visitors of the sanctuary.

When the temple was rebuilt—for the first time on a smaller scale—after the Bar Kochba revolt in AD 135, the small booth remained unchanged, though the passage leading to it no longer ran past the original sacred place. The podium of the temple had been closed completely, sealing off the sacred rock as well as the nucleus of the Hellenistic Naos which had both still been accessible, though underground, in the Naos of Theon. By this time, it seems, the rock as a nucleus

of the sanctuary had more or less lost its religious significance. It was invisible and inaccessible for both the worshippers and the temple staff, but the sanctuary with its oracle kept on working as usual.

During all that time, a bronze-casting workshop, which can be messy, smelly, and potentially dangerous during busy periods, could hardly be imagined right behind one of the most important temple buildings of the ancient city. This probably changed fundamentally when the construction of a big *peripteros* on top of the hill was decided upon. Suddenly, bronze objects were needed on a large scale to equip and embellish the new temple. The lower terrace with the old naos, on the other hand, would now above all be a public space with a large staircase leading to the future temple building. Yet the lower terrace was, of course, still part of the sanctuary and thus first choice for putting up a workshop that had to comply with a number of criteria. Since the place was still under the administration of the temple, it could be made available without problems. The vaulted corridor provided shade during the summer and shelter during the rainy winters, and it was well ventilated due to the large openings. It was not only very close to the place where the goods produced would be set up later, but also close to the old temple. The workshop was hidden behind it, not directly in view of the visitors to the sanctuary. Under these circumstances, the area around the northwestern entrance proved to be the best spot possible for a bronze-casting workshop.

The sanctuary of Zeus remained active until Christianity began to spread in Jarash. Bishop Placcus ordered the use of marble ornaments from several temples, including that of Zeus, in new buildings, such as the baths of Placcus (Seigne 2014). When it had lost its original religious function, the area of the sanctuary of Zeus was repurposed. In Byzantine times there was a monastery in the eastern hallway, whose simple mosaics have partially been conserved and are still *in situ*. Clusters of Ayyubid pottery discovered in different spots on the lower terrace also suggest that the area was inhabited well into medieval times, though there is little evidence as to what the structures might have looked like (Rasson-Seigne, Seigne, and Tholbecq 2018).

The Excavation Campaigns

1993 Excavation (MAFJ)

As already stated above, the first discovery connected to the workshop was made by the French mission in 1993. At that time, the archaeologists were removing the debris between the back of the youngest temple and the northwestern hallway of the *pseudokryptoporticus*. While in the rest of the square the pavement, consisting of rectangular stone slabs, was nearly intact, it seems that here the floor had not been paved at all. After the destruction of the Vespasianic temple, which had reached up to the hallway, the area was levelled around AD 135–140 for the construction of the new, smaller temple.

In this area not covered by the later building, there were no slabs, but instead the excavators found a large, round pit, about 1.65 m in width and 1.40 m in depth (FIG. 2). It was cut into the backfill from the years AD 135–140 and covered by what was interpreted as the AD 180–200 floor level. The pit was filled mainly with slag and pieces of technical pottery, namely crucibles and mould fragments, while at the bottom, the lower part of a big circular casting mould was uncovered. It had a diameter of roughly 1.10 m and consisted of a ring

of well-levigated reddish-brown clay about 8 cm wide that sat on a foundation of thick, yellowish clay that was used to level the bottom of the pit (Rasson-Seigne and Seigne 2013: 14–15). Since the main objective of the mission was to study the stratigraphy and history of the temple, there was no expert for bronze casting on the team at that time. Yet it soon became clear that it was a bronze-casting pit that had been discovered here and that the feature was of extraordinary importance. The smaller mould fragments from the pit were cleaned and partly put together by the team's pottery specialist, Mr. Gabriel Humbert, and are still in storage on site, available for further research. The circular lower part of the casting mould, however, is now lost and all statements concerning it must be made from the documentation of the excavation only. The mould shows the imprint of a large, circular bronze object with a diameter of about 1.35 m that was hollow inside. According to Jacques Seigne, neither the pit nor the lower part of the mould showed any traces of firing.

2012 Excavation and Restoration (MAFJ, GJU, and University of Mainz)

It was only in 2012 that the work in this part of the sanctuary of Zeus continued in a joint excavation and restoration project. The restoration work that started in summer 2012 included professional cleaning and joining of the mould fragments, resulting in the reconstruction of several nearly complete moulds. At the same time, all the fragments were photographed and registered in a database, and ceramological as well as metallographic analyses could be carried out (Khalil and Al Naddaf 2013: 25–32).

During the following excavation campaign in fall 2012, another casting pit was discovered right in front of the northwestern entrance to the lower terrace. The pit itself differed from the one discovered in 1993 in so far as it was not circular but rather pear-shaped, measuring 3.10 m in length, with a bulge of about 1.30 m, and about 1.90 m in width. Thus, it was also a bit bigger than the one discovered before, but the depth was the same (1.40 m) and at the bottom there was another circular clay shape, this time surrounded by a ring of reused fragments of tuyères as well as tiles and pottery sherds, covered in yellowish clay. It was separated from the debris of AD 135–140 by a thin layer of well-levigated dark earth (Rasson-Seigne and Wolf 2013: 38–41). The whole bottom of the pit was laboriously removed as a block recovery. (For a detailed report see Eckmann *et al.* 2013: 42–45). It is still kept in the Jordan Museum in 'Amman, awaiting further research.

2014 Excavation (MAFJ)

The last campaign led by Jacques Seigne took place in 2014. Its main objective was to test the theory that there had been installations of the workshop inside the northwestern *pseudokryptoporticus* as well as in front of it. For this purpose, the hallway, which had been filled to the top with modern and ancient debris, had to be emptied out, a time-consuming enterprise. The work was further delayed by the discovery of the unique pending keystone of the northeastern entrance, that required the full attention of the researchers (Seigne 2018, especially 306–312). This is why the level of the workshop was only reached in part of the excavated area, yet it was enough to discover another casting pit that had obviously been used for two casting processes by the same workshop.

At the bottom of a pit shallower than

the ones in the courtyard, the traces of the lower part of a rectangular casting mould were found, measuring 1.20m x 1.10m. It is disturbed by a second square object, measuring 60 cm, so about half the size of the first that was cast in that same pit, on a slightly lower level. The pit contained pieces of furnaces, bellow pipes, a few mould fragments, large amounts of bronze slag and, unusually, pieces of moulded plaster fragments. The latter are thought to be parts of models for the sculptors, which are usually not preserved (Seigne 2018: 314).

2021 Excavation 2021 (KUEI)

During the ongoing Coronavirus crisis, the excavation at the lower terrace of the Temple of Zeus could finally be resumed in 2021, thanks in no small part to the help of Lutfi A. Khalil and Thomas M. Weber. The work concentrated on the hallway directly to the northwest of the 2014 excavation. Just like our French colleagues before us, we had to deal with a large amount of debris that lay on top of the big stone blocks from the collapsed vault.

Below that, we found traces of the two phases of squatter houses that had been set up in the *pseudokryptoportic*us (FIG. 3). In the younger phase, a square room and an adjacent corridor covered an area almost identical to that season's excavation site. The western wall of the room could be seen in the western section of the excavation. The room itself had a mud-brick floor with a stone substruction. The corridor that led there from the *porticus* entrance seems not to have been paved and the floor level was a bit lower here. The small amount of pottery we found in this area lets us date this phase of occupation to the Ummayyad period.

Underneath this level, to the west, there was an earlier wall running north-south, forming one big room that could also be entered from the northern entrance to the terrace, with a doorstep close to its centre. The second wall of the room was not within the excavated area. It probably lay on the other side of an arch that led from the *porticus* to the terrace in Roman times and had been closed off later.

The excavation shed new light on the later usage of the hallway, but it also became clear through traces of fire on the wall, as well as the remains of a "workspace floor" seen in the sections from the previous excavations, that there was more to discover. The workshop floor especially—a thin layer of clay on top of the second-century floor level that could only be explained by the muddy boots of the workmen spreading the clay from the casting pits all over the working area—had never been documented in this form before. It was still sealed under a Byzantine floor level, or so it seemed. It also became clear to what extent the 2014 excavation had left this same Byzantine level untouched right in the centre of the entrance (cf. FIG. 2), so it was decided to uncover the workshop floor level in the next campaign.

2022 Excavation (KUEI)

The most recent excavation campaign concentrated on the area inside the northern entrance to the sanctuary already partly uncovered during the campaigns of 2014 and 2021, respectively.

There were at least two fireplaces in the northeastern entrance, one right in the centre and the other one directly on the entrance step to the courtyard. It is still hard to say whether they fit with our workshop. After all, the furnaces were smashed and thrown into the casting pits after the workshop had finished its job, as we know. We cannot expect

a big installation *in situ* for that reason. Hence, there are only traces of something hot having stood in both places. In the centre of the entrance there was an imprint of something round, roughly 60 cm wide and on the entrance step, a double pit with a thin layer of vitrified material on the bottom was discovered. "Sweileh-sand", a sterile sand used for building purposes nowadays, was banked up below the pit, probably for insulation purposes. The fact that those traces could still be found would mean that they were not completely removed after the workshop had closed, even though they rose above floor level. It is also possible that the area was used for working with fire in later times, too, maybe as a matter of habit. Hopefully, in the future this question can be answered by analysis of the charcoal samples taken from that feature.

The workshop floor was partly discoverable as specks of clay on top of the material banked up for the substruction of the terrace in the middle of the first century AD. There was no trace of a first-century floor level inside the entrance to the hallway, a situation that had already been described during the previous excavations. There was one exception, however: underneath one of the earlier walls discovered in 2021, probably belonging to an early Ummayad squatter house, some remains of a simple plaster floor were documented. Here, another pit had been preserved as well, which was much smaller than the previous ones, only about 1 m wide, and nearly circular. To its north, a very shallow bulge was observed, only barely cutting the plaster floor. It certainly did not serve as a step, as was the case with the bulges in the big casting pits. The bottom of the pit itself was marked by a layer of burnt charcoal, with some square mud bricks on top; no mould parts were found. The filling consisted mostly of sandy soil and unburnt clay of the kind that was used for the casting moulds as well as small splutters of bronze that occur when handling liquid metal. The most significant find was a fragment of a bronze garment fold, the first specimen of large bronze statuary from Jarash. Whether it is a failed cast or a piece of an old sculpture prepared for recycling will hopefully become clear after restoration. Judging by the massive layer of charcoal on the bottom, the pit was used for firing. A heap of ashy material on the southwestern wall of the hallway, close to the newly discovered pit, supports this theory since it might be the spot where the burnt charcoal was disposed. The presence of unburnt clay on top of the charcoal is a bit of a puzzle, though. The pit might have been just filled with the unused material when the work was finished, but there might also have been some additional step of work connected to the casting process that was executed in this area. Shallow pits filled with sand and ash are used for casting very small objects, for example (Zimmer 2003: 40). It is possible that the former firing pit was used in this way in a phase when it was no longer necessary to melt large amounts of bronze.

The Bronze-Casting Workshop

Ancient Bronze-Casting Technology

To cast any object in bronze, a cavity has to be formed in which to pour the liquid metal. This can be achieved by different means, with the so-called lost-wax casting method being most common for statuary bronzes. It was used in our workshop in Jarash, as the findings there show, which is why this particular technology will be described here, using a large bronze statue as an example.

As ancient art was usually contract work, a workshop would probably have

a "catalogue" of some sort, describing the different statues for the customer to choose from. After the details of how the statue should look were fixed, the artists would usually start with a life-sized model made of clay or plaster from which the negatives for the casting could be taken.

For those negatives, clay was applied in several layers to the positive, which had to be coated in some kind of mould-release agent such as talcum powder first. The inner layer of the negative, which had to reproduce all the details of the model as clearly as possible, would consist of a very fine, almost liquid clay that could be applied thinly with a brush. After it had dried completely, the next layers, made of a more coarse, heavily grogged clay, were added one after the other, always leaving enough time for them to dry slowly, so that no cracks would occur. When everything had dried up, this "coat" of clay could be carefully removed from the model and the pieces serve as negatives.

Then, a layer of wax corresponding in thickness to the later bronze would be put inside those negatives, using wax plates or panning liquid wax inside the negative to form an even result. The resulting wax model could then be revised before beginning with the casting itself.

The casting for the head, the torso, the legs and arms, as well as all the undercut parts was usually done separately. The bigger cast components, such as the torso, had to be installed on a pedestal inside the casting pit at this point; the smaller, more moveable parts, such as protruding folds of garments or single fingers, could also be worked within other parts of the workshop. All parts that were to be hollow later had to be filled with a core, again made of clay. Organic material such as straw or the hair of animals was usually added to this mixture to minimize shrinkage and allow for some ventilation. Another preparation step was the construction of a gating system, with funnels and air vents for filling in and distributing the liquid bronze. For this purpose, rods of wax were fixed to the model. The correct positioning of those rods was crucial, as mistakes could lead to an uneven distribution of the metal inside the form, leading to lacunas and other casting mistakes.

When the gating system was ready, the whole wax model was covered with several layers of clay, similar to the building of the negative. Again, at first a thin layer of very fine clay was applied, making sure that all the details would be traced. The next layer had to be more solid and would be grogged with organic material and small stones to allow for even drying without cracks. At this point, if the cast object was hollow, the so-called distance holders had to be inserted, to prevent the mould and the core from shifting when the wax was melted out. Iron nails with flat heads were normally used for this purpose. They could be pushed through the first layers of the mould, the wax, and part of the core. In a final step, another layer of clay was applied, covering the heads of the distance holder and giving more stability to the mould.

After the clay had dried, the firing of the mould could begin. The casting pit was filled with wood or charcoal and a fire was kindled that had to burn until steam no longer rose from the form. The main purpose of this was to heat the wax inside, but it would also make sure that all the water had evaporated from the clay. The liquid wax itself would not burn completely but be retrieved through an opening at the bottom of the mould or, for smaller moulds, just poured out.

Once the mould was ready for casting, the pit had to be cleared of the remains of the fire and be filled with sand that provided backpressure for when the liquid bronze was poured into the now empty form. Then the casting itself could begin, for which a sometimes-large amount of metal had to be melted. Usually, furnaces with moveable crucibles were used for this purpose. The molten mass from one or more crucibles had to be poured into the form quickly to gain an even result. Since to fill the bigger moulds more than one crucible would often be necessary, and also because the different parts of the statue were cast separately to be joined later, it was crucial to guarantee an even quality of the alloy. Fluctuating proportions of copper, tin, and lead could lead to differences in colour and behaviour of the alloy, so they had to be avoided at all costs. It is highly likely that every workshop had its own "recipe" for bronze and the percentages of the different metals were weighed out carefully to ensure a constant quality.

From the bronze rising in the gating system the casters could judge whether the form was filled completely. After the metal had solidified and cooled down, the mould was smashed to reveal the casting. The work was not done now, though, since the gating system had yet to be removed and the single parts of the statue had to be welded together, the surface polished, and any small flaws in the casting corrected. Only after this time-consuming work was the statue finally ready.

Characteristics of the Gerasa Foundry

Every workshop probably had its own characteristic mode of operation, depending on the knowledge and skill of the artists and bronze-casting masters. Different craftsmen may have found different solutions for the same problem. There is, for example, the question of which material the models used in the workshop would be made of. It is generally assumed that in Classical times clay was used for this purpose and there might have been Roman foundries that made their models from clay, too. In the case of the workshop at the Temple of Zeus, however, moulded plaster fragments have been found that clearly should be interpreted as parts of sculpture models (Seigne 2018: 306).

Another common problem is the stabilization of the casting moulds against its own weight and the pressure of the core material. To keep big moulds in place, sticks would sometimes be used, and in some of the Greek workshops evidence was found that a grid of metal bands was used to reduce the pressure, to prevent cracks in the investment mould. It has been presumed before that ropes could also serve the same purpose. For the Gerasa foundry this can now be proven, because there are imprints of thin ropes and even traces of the carbonized fibres below the outer layer on some of the fragments (FIG. 4). They were obviously wrapped around the mould before the last layer was applied, most probably at a delicate point that was prone to develop cracks easily or had already shown signs of deformation. Unfortunately, the fragments discovered up to now are too small to tell what characteristics led to the necessity of additional stabilization.

The spoon-shaped funnels (FIG. 5) are a characteristic feature of the Gerasa foundry as well. They make sense if the moulds were laid out relatively, but of course not completely, flat. The angle would allow the bronze to flow into the mould at a slower pace while at the same time letting out some air. This is not normally necessary, if the gating system

is functioning well, but it reduces the risk of air inclusions from pouring in the material too fast. While moulds with a regular, cone-shaped funnel have to be placed upright, usually by sticking them into the ground, the moulds with the spoon-shaped funnel were probably just leant somewhere, which made it easier to align more of them in order to make the casting process as efficient as possible.

Some aspects probably must be taken into account for most, if not all, bronze-casting workshops but cannot be observed everywhere. There is the question of the oven and the crucibles. Of course, a huge amount of bronze is needed for the main body of a statue, for architectural ornaments, or other large decorations. Huge crucibles are necessary to provide this, and they need to be heated accordingly. But for other steps in the process, such as welding or casting smaller details, less bronze needs to be prepared and smaller crucibles would be used.[1] In Gerasa we have evidence that, apart from the different sizes of crucibles, different forms of heating might have been used, as well.

The excavations of the French mission brought to light many fragments of what was interpreted as at least four furnace basins (FIG. 6). They were about 62 cm wide, with a bottom that was flat on the outside and round on the inside. On the rim there are markings that show where the bellow pipes were fixed. From the construction of the furnace-basins it is clear that they were not moveable. If they were used to melt the metal without the use of an additional crucible, as Jacques Seigne proposes, the liquid bronze would have had to have been let out through a hole at the bottom and led into the form through a channel, giving us a construction much like a shaft furnace. The furnace would have been placed above ground level, close to the casting pits, to use the gravity to fill the moulds (Seigne 2018: 307–308). Unfortunately, none of the fragments of the basins shows a hole at or near the bottom and there are no traces of a channel that connected the furnace to the pits, so this theory cannot be verified for sure, but it seems very likely. In a foundry from the second to third century AD in Paris, remains of such a channel have been found, so it is clear that this technology was known at the time (El Morr, Thomas, Pernot, and Cantin *et al.* 2017: 49). The question of heating poses another problem. The heavily vitrified tips of the bellow pipes testify to a very high temperature having been reached, so the heating must have been very effective. Judging from the surface of the inside of the basins, with traces of bronze and vitrification, as well as traces of firing on the outside, they were used for melting the alloy directly (Hindawi and Weber 2013: 21). They could have been placed in the centre of the entrance and on the doorstep, two places at which traces suggest that hot and heavy objects once stood there. The fireplace in the centre of the entrance closely resembles one found in Berytus that is said to have produced a temperature of about 800° (El Morr 2017: 8–39, 40 fig. 6). That would not be enough to melt bronze on its own, but we have to keep in mind that it would have been combined with additional heat from above.

The fact that the non-moveable basins had to be kept above ground level, in order to make it possible to use gravity for pouring the metal, rules out their use in the pit filled with charcoal like the one found during the 2022 campaign, despite the measurements

[1] This has already been remarked upon by Zimmer (forthcoming).

of the pit being suitable for a basin this size and the amount of charcoal needed for heating it to be put inside, because this feature cuts what we interpreted as the original floor of the *porticus*. On the other hand, it is too big for the basin to be placed on top of it. That the pit was used for melting bronze seems clear, though. Inside it we found not only huge amounts of coal, but also splutters of bronze typical for the casting process. They occur when handling liquid bronze and may be seen as another hint that what we have here was a firing pit. Here, a moveable crucible would be surrounded and covered by burning charcoal, and the fire would be blasted with air using bellows that surround the pit.[2] This would neatly explain the shallow bulge beside the main pit as the place where one of the bellows was put. The mud bricks that were found on top of the charcoal were probably laid out to form a more stable foundation for the crucible. After the bronze had melted completely, the crucible would have to be lifted out of the pit. The position of an oven right next to the pit with the two square mould bases discovered in 2014 makes sense from a practical point of view, as the crucible would not have to be carried very far.

At present, no suggestion can be made as to why the walls of the casting pits are not insulated with clay as seen in most other workshops and why there are no traces of fire within. It can only be guessed that perhaps the burnt material was removed completely when retrieving the cast object, even though it is not clear why this would have happened here but not in other workshops. One must keep in mind that the pit had to be emptied two times during the casting process: once after the mould had been baked, to remove the ashes and the collected wax and fill it with sand for the casting itself, and a second time after the cast, to remove the sand, break the investment mould and retrieve the cast object. While it might be argued that mud bricks were used for insulation purposes and were taken out and reused afterwards, the space between the casting mould and the wall seems to be too small for that solution. In its excavated state, the room between the wall and the mould was about 20–30 cm, so if one were to add surrounding mud bricks, the workers would probably not have been able to walk around the mould inside the pit any longer. What is more, the moulds at the bottom of the pit, unlike the smaller moulds from the filling, seemed to be uncooked: only the inside was burnt from contact with the liquid bronze (Seigne 2018: 307–308). It is clear that the moulds had to be heated to remove the wax, otherwise bronze casting would not have been possible; but how was this achieved, and why did it not affect the bottom of the mould? Could it be possible that the walls and the bottom of the pit were lined with mud bricks that were removed and that in this way the top of the mould was baked completely but the bottom was not? This could be a solution if we assume that the cast object was wider at the bottom than at the top. With the object and the wall being coated with mud, the bottom would be inaccessible for further work, but the rest of the pit would not. This is, however, hard to prove.

The bronze casters in Gerasa surely had their own way of doing things. Some of the solutions found there probably were quite common and have been suspected but rarely documented before due to the delicate nature of the evidence, for example, the ropes to stabilize the

[2] The principle is described in detail in Zimmer 2006.

moulds or the plaster models. The spoon-shaped funnels seem unusual and the fact that they are not usually described among the material of workshops, even though funnels belong to the parts of the moulds that are preserved quite often, suggests that the use of them was not so widespread. Both the use of a pit filled with charcoal and a furnace for melting the bronze have been documented before and using two systems at one site probably made sense, yet further research is needed on the exact way the furnace worked.

The Cast Objects

Four lower parts of casting moulds—two round ones and two square ones—and a huge amount of fragments of casting moulds have been found during the excavations. All of them have been thoroughly examined and catalogued, and many pieces could already be joined together during the restoration project. All this effort was made in order to try and find out what kinds of objects had been cast in the workshop.

The mould bases at the bottom of the pits themselves allow some assumptions about the cast objects. The two circular ones are so regular that they probably belonged to perfectly round objects. Big basins, which could have been put up in the sanctuary, have been proposed (Seigne 2018: 306). Another possibility that has not been taken into account yet are claddings of columns, round bases, or altars. Bronze-clad public monuments or architectural ornaments are a quite common yet often overlooked phenomenon in Roman times (Becht, in press). Keeping in mind that the maximum height of the object would correspond to the depth of the pit, which is about 1.40 m in our case, columns are more or less ruled out, but statue bases and altars would certainly be possible, even if it would be unusual to cast them in one piece, leaving the basins as the most likely alternative. In any case it can be stated that the objects cast inside the two pits in front of the *pseudokrypt-porticus* were large-scale non-statuary bronzes that can be connected to the decoration of the temple.

For square moulds similar to the ones found at the Temple of Zeus, monumental door frames have been proposed (El Morr, Thomas, Pernot, and Choueiry 2017: 191). While it is entirely possible that such ornaments were produced in the workshop, since temple doors are often made of or at least clad in bronze, they do not completely fit the measurements of the pit and the mould. A bronze-clad door normally consists of several rectangular or square panels that are framed with more or less ornamented profiles (FIG. 7). The panels and the frames were usually cast separately and welded together, with the profiled strips bordering the panel spanning only a few centimetres, much like a modern-day picture frame. The panels themselves are just about 5 mm thick, while the frames could add a few centimetres if they were not cast separately but together with the panels, as was sometimes done. Yet a pit that is 40 cm deep, such as the one for the bigger rectangular object, would not be needed, let alone one that was 70 cm deep, as was dug out for the second, smaller square object. The shapes of the mould-bases correspond well with the socles of bases or altars of different sizes, but up to now no such monument has been found to be cast in one piece, either. That does not exclude the possibility that either door-frames or bases were cast in those pits, as the solutions for the construction of bronze monuments were highly indi-

vidual.[3] The regular, non-organic form of the mould bases suggests that the objects cast in those pits, just as was the case with the round moulds, were not statues but architectural ornaments of some kind.

The mould fragments found within the pits speak a different language, however. They can almost exclusively be attributed to the folds of garments, so we can be sure that at least one statue was cast in the workshop. The close connection of the foundry and the sanctuary leads us to believe it could have been the cultic image for the temple.

If a statue of Zeus was to be cast for the temple, one can but wonder today what it might have looked like. From inscriptions from inside the sanctuary we know that the god was worshipped as Zeus Olympios specifically (Lichtenberger 2003: 209–210), so the image of Zeus seated on his throne comes to mind, which is a very common depiction of this deity on coins as well as in sculpture. For the Decapolis region, several coins depicting the Zeus Olympios sitting on his throne were minted in Capitolias, Gadara, and Skythopolis (Riedl 2003: 83, 85). The presence of Zeus Olympios in Gadara is additionally attested through a well-preserved less-than-lifesize statue that is now kept in the museum there (FIG. 8). A coin from Gerasa shows only the bust of a bearded Zeus wearing a wreath, though (Lichtenberger 2003: 199). Unfortunately, we could not identify any fragments of the statue itself, nor the pedestal on which it stood. The following thoughts are therefore speculative. They are based on the ideas of Wolfgang Thiel who is planning to do further research on the topic of monumental acrolith statues in the Decapolis region in the near future.

It has already been noted that all the mould fragments that can be attributed to a statuary bronze can be identified as folds of garments. Of course, this could be a coincidence, as the protruding details of the drapery are among the last things to be finished and welded on when producing a statue. It seems logical that the waste from the last steps of production was dumped into the casting pits that had to be filled instead of using the material for, say, grogging clay for new moulds or other recycling purposes. Nevertheless, it seems strange that there are no traces whatsoever of body parts, hair, or other elements of the statue apart from its clothes. In the Hellenistic workshop inside the so-called Anaktoron in Demetrias, for example, far fewer fragments of moulds were found, yet they were of a much more diverse nature, containing imprints of various different parts of the statue.[4]

If we keep in mind that the most popular prototype for the seated Zeus was probably Phidias' chryselephantine statue at the temple in Olympia, it is plausible that later artists tried to achieve a similar effect when creating cultic statues of Zeus, even more so if the god is worshipped with the epithet of Olympios. They would not have been made of ivory and gold, but white marble and polished or gilded bronze to give a look that was comparable. That being said, our Zeus could very well have been an acrolith, which would neatly explain the fact that there are no traces of cast body parts.

This seems even more likely since there is an example of a monumental acrolith in another Decapolis city nearby. A huge hand (FIG. 9) and part of an arm with elbow were found in the

[3] For the construction of such monuments see Becht 2017, especially 135, and Becht in press.

[4] For a catalogue of all the moulds, see Zimmer 2003: 50–63.

surroundings of the so-called Temple of Heracles on the citadel hill of Philadelphia/'Amman and are now kept there in the garden in front of the Archaeological Museum. The arm ends above the bent elbow; a dowel hole proves that it was fixed to the rest of the body. The left hand held a rod-shaped object. The two fragments barely give enough hints as to the statue type, except for the fact that the muscular arm and heavily veined hand probably belonged to a male statue and that the sheer size of it makes it highly probable that it was a cult image (Lichtenberger 2021: 464). Yet suggestions have been made and the fact that such a monumental statue could only have fit inside the *cella* of the temple on the citadel hill if it was seated can hardly be denied. Since it is far from clear which deity the so-called Temple of Heracles really belonged to, it could well have been Zeus Olympios, but there is really no clear evidence (Lichtenberger 2003: 274).

In Gerasa, on the other hand, we know the god that was worshipped in the temple, but the statue itself is lost today, even though parts of it might still be resting in one of the storage rooms of the Department of Antiquities in Jarash. During excavations in the *cella* of the peripteral temple, fragments of a statue made of fine white marble seem to have come to light that might have belonged to the cultic image, but unfortunately there is no further information on its appearance or size, nor on the number of fragments.[5] The marble was described as scratched and it seems unlikely that the statue was complete, but it cannot be stated for sure whether it was destroyed when the *cella* collapsed and buried it or if it had already been smashed before. The latter seems more plausible, however.

It is a well-known fact that bronze could easily be, and therefore often was, recycled during and after antiquity. The same goes for marble, which could be burnt to produce lime. We know that the Temple of Zeus, like other monuments in Gerasa, was plundered by Bishop Placcus to use the spolia in his new bath. Furthermore, there are the examples of marble statues depicting Greek deities collected in a basin in the eastern baths, probably in order to recycle them. The fact that most of the heads and genitalia had been chopped off makes it plausible that they were damaged in a deliberate act aimed at the destruction of the Graeco-Roman gods. This is supported by the carbon-14 dating of a piece of wood that was found among the statue fragments, which points to the years AD 620–650 as the time of deposit. The statues seem to have been gathered from all over the city of Gerasa, since the larger-than-life image of Aphrodite at least was probably the cultic image from a temple of that goddess which unfortunately has not yet been located. (Weber-Karyotakis and Al-Bashaireh 2021: 263–264). What is more, one of the statues discovered was that of a very fragmented yet nearly complete life-sized standing Zeus. According to Thomas Weber-Karyotakis the statue could well be associated with the new peripteral temple built in the middle-Antonine period, since it shows characteristics that allow a dating in that epoch. In any case, it did not belong to the decoration of the bath, which it

[5] According to Jacques Seigne, who saw some of the fragments shortly after the excavation, it seems that the bigger, more significant pieces were kept at the DoA office at that time, but they could not be found during T. Weber-Karyotakis' survey of the marble fragments from Gerasa in 2012. Cf. also Weber-Karyotakis 2021: 413–414.

predates.[6] (Weber-Karyotakis and Al-Bashaireh 2021: 265–266). It stands to reason that the cultic image of Zeus, coming from a temple that we know was robbed for reuse of its decorative elements, was also a victim of the iconoclasm that led to the collection of the statues in the eastern baths.

If we keep in mind that all that remains of two other monumental statues in the Decapolis region are a hand and an elbow in Philadelphia/ʿAmman and a finger and a toe in Skythopolis we cannot exclude the possibility that an entire monumental statue has vanished from Gerasa.

The Later Uses of the Area

As has already been stated, the eastern hallway of the lower terrace was occupied by a Byzantine monastery. During the 2014 excavation a Byzantine wall was discovered directly to the east of the entrance. Behind it to the east, the Byzantine inhabitants of the area seem to have removed the Roman-period floor and even some of the soil forming the foundation of the terrace, as a trench excavated by Jacques Seigne and his team shows.

It was therefore surprising for us that no Byzantine structures apart from a very thin floor level could be found in the area inside the entrance and to the west of it, excavated in 2021 and 2022. It turned out that the earlier of the walls discovered in 2021 (see FIG. 3), which we had interpreted as being Byzantine at first, in fact had to be dated to the Ummayyad period by pottery evidence. Only the last layer of this wall survived; the rest was removed and probably repurposed when the new room was built and even though it looks massive enough, it does not have a deep foundation. The wall runs directly east of a former opening leading from the hallway to the terrace and it seems that this arch was closed at the same time the wall was constructed, changing a relatively open space into an enclosed room of unknown purpose that could only be entered from the east. The overall impression of the hallway must have changed a lot.

In the later Umayyad period, the earlier wall was destroyed and only the last layer of it survived. The area corresponding to the space excavated in 2021 (see FIG. 2) was further divided into a square room and an adjacent corridor which led to the northern entrance of the *porticus*. The room had a mud-brick floor with a stone substruction. The corridor seems not to have been paved and its floor level was a bit lower. Though the impromptu house was buried underneath the collapsed blocks from the vault, there were no signs of a widespread fire. All the stones of the vaulted ceiling are black from the kind of grime caused by the smoke from fireplaces on the inner side, but the ones from the corridor also show traces of colour that indicate a simple floral decoration. Most of those green, red, yellow, and orange marks are amorphous, with the exception of some circle shapes. Markings like this have been observed before, but not much attention was paid to them even though it is remarkable that the ceiling of the corridor seems to have been adorned with that very simple decoration.

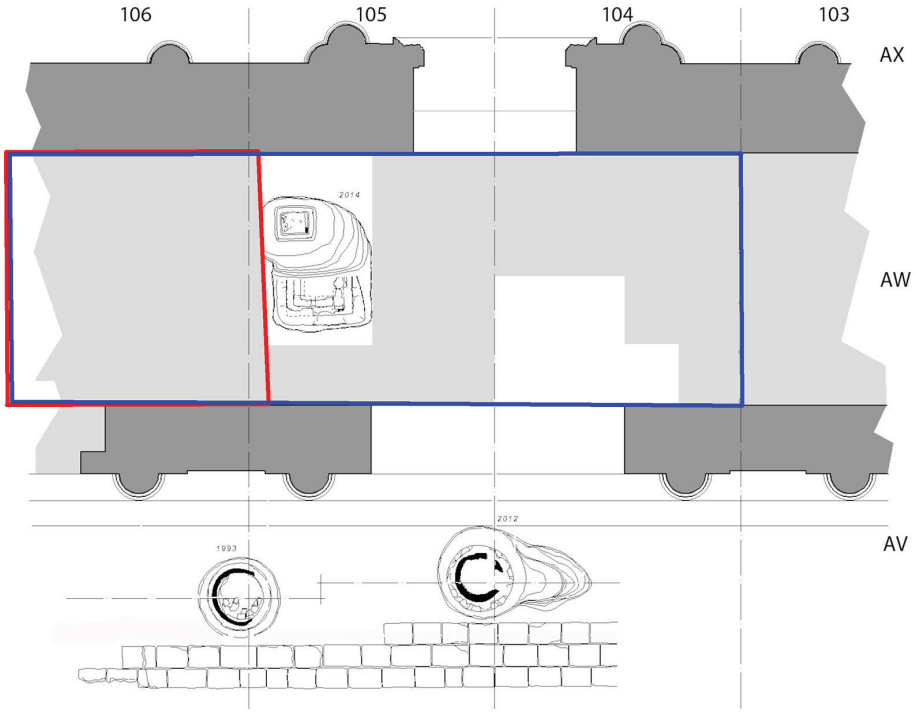
Due to the very small number of finds and the lack of destruction by fire inside the room, it is presumed that this part of the vault did not collapse directly during the earthquake of AD 749 but at a later time, leaving the inhabitants time to move out in an orderly fashion.

[6] Among the findings from the exedra of the bath there is a younger head of a bearded god, probably also Zeus, which might have been part of the statue program of the building.

There are nearly no pottery sherds from the Abbasid period found underneath or directly above the stones of the vault, either, leading us to believe that at that time the vault had already collapsed. There might have been activity in this area, in connection with a building complex in the northwestern corner of the lower terrace, however. It consisted of a small, roofed room and, probably, a sheepfold underneath the still intact western vault and an open court with space for working and cooking inside the courtyard of the sanctuary. This court could well have extended to the area inside the *pseudocryptoporticus*, as we know was the case for a very similar installation in the northeastern corner (Rasson-Seigne, Seigne, and Tholbecq 2018: 69–71).

It is, however, impossible to confirm for sure if this part of the *pseudocryptoporticus* was occupied during Abbasid times, as it was probably at least partly cleared by Harotoune Kalayan in the 1980s (Rasson-Seigne, Seigne, and Tholbecq 2018, esp. fig. 5.2). He seems to have removed the soil until he had reached the stones from the vault, at which point the clearing in preparation for the restoration work (Rasson-Seigne, Seigne, and Tholbecq 2018: 65) was stopped. The huge amount of debris that had to be removed during the 2021 excavation campaign was brought in on purpose afterwards to form the ramp allowing access to the terrace from the northwest corner, as is proven by the vast amount of modern material inside.

1. Aerial view of the sanctuary with the oval plaza and the southern theatre (from Stott, David, Rubina Raja, and Achim Lichtenberger, "Jerash Aerial Photos [2018]," https://doi.org/10.6084/m9.figshare.6073838.v2 [accessed 6 March 2023].)

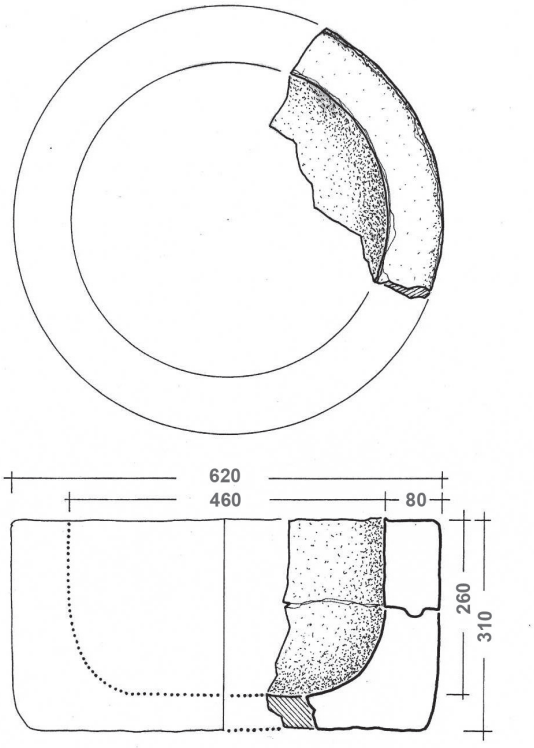


2. Plan of the porticus with the casting pits discovered by the French missions (the grey areas were not completely excavated during the campaigns 1993–2014). The areas excavated by the German missions are marked with a stroked (2021) and and a dotted (2023) line (image courtesy of the Mission français de Jerash; markings by the author.)

3. Two phases of "squatter houses" inside the Roman hallway (photo by Stefanie Becht).

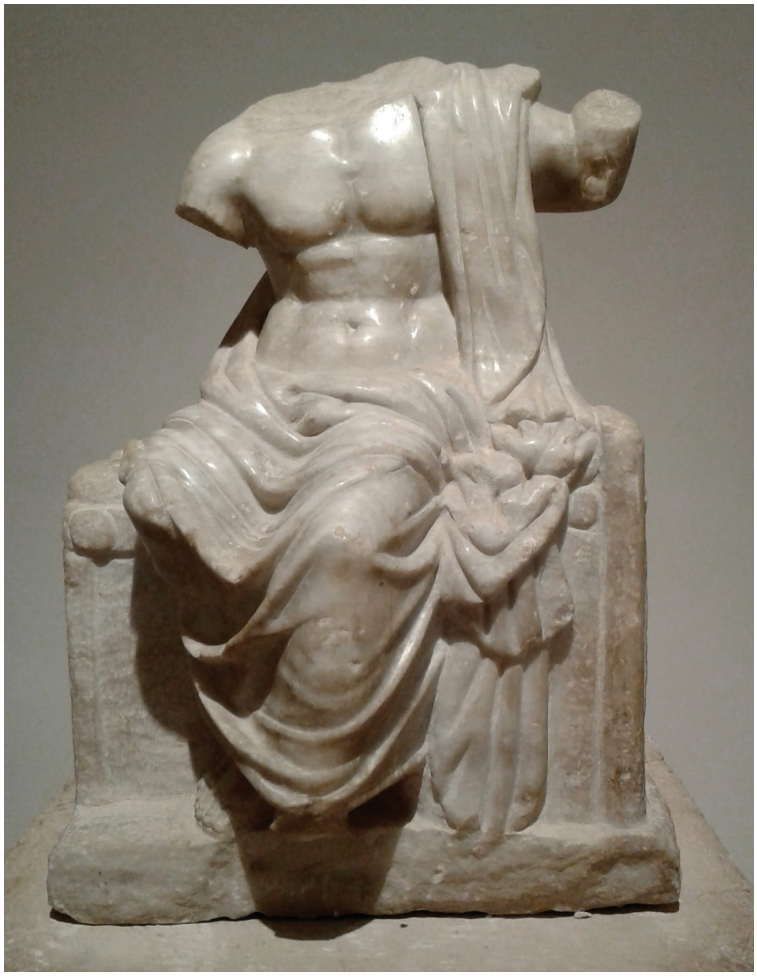
4. Fragment of a mould with imprints of ropes (photo by Stefanie Becht).

5. Spoon-shaped funnel (photo by Stefanie Becht).

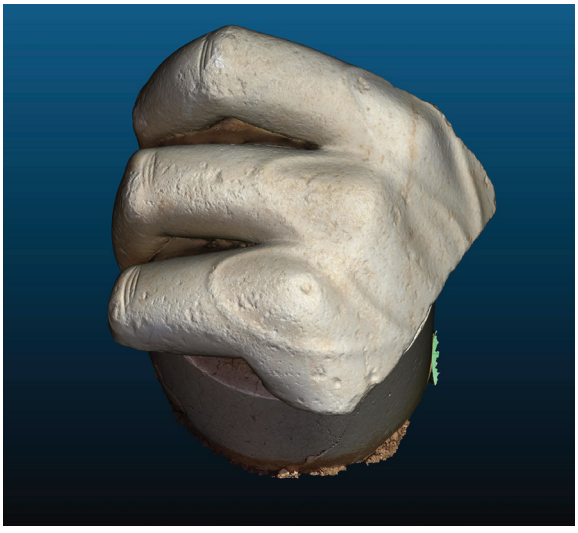


6. Reconstruction drawing of a furnace basin (image courtesy of the Mission français de Jerash).

7. Example of an ornamented bronze door with rectangular and square panels: Pantheon (Rome) (photo by Nora Garibotti, garibottiphotography.com).



8. A small statue of Zeus Olympios from Gadara (photo by Stefanie Becht).



9. Three-D scan of the monumental hand on the citadel in ʿAmman (image by Safa Judeh).

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