Serial Production in Classical Greece: Attic Figural Vases

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The mass production of pottery is well known at least through the production of Megarian bowls and Terra Sigillata. Much earlier, though, the Athenian pottery workshops of the 6th and 5th centuries tried to produce series of nearly identical vases using moulds (negative forms). We can consider these vases to be early examples of mass production.

Concerning the Greek pottery of Archaic and Classical times, we usually analyse the individual hand of a potter or a painter. Concerning the figural or plastic vases, the individual craftsman and his skills do not stand out – with the only exception being the initiator(s) of the series. The vases from the workshop of Sotades, with their often exotic iconography, are probably the most famous objects of figural pottery in Attic production.[1] More often, the Attic figural vases are shaped more simply, in the shape of heads of animals and humans. The Athenians did not invent the use of moulds for plastic vases, however, they only modified it for their special purpose of creating distinctive ceramic vessels.[2]

Attic Production of Figural Vases

Initially, the Athenian plastic vases were small and mostly used as containers for scented oil, comparable to their predecessors from Corinthian and East Greek productions. As they became larger, the vessels were usually converted into drinking and serving vessels.[3]

The represented shapes of vessels are the *kantharos, aryballos,* mug, single or double faced, rhyton, and *oinochoe.* In this article we focus on the production of pouring vases, *oinochoai,* dating back to the late Archaic and early Classical times. The bodies of the vases are shaped as a human head, mostly female. This shape represents the biggest group. Besides the female heads, heads of male and female blacks also are documented, and there are rare examples with the heads of Heracles and Dionysos.[4]

The vast majority of the Attic pottery was thrown on the potter's wheel. For producing head vases, the potters used the same technique only for the upper part of the vessel, the vase's "neck". The body of the vessel, the head, was made using two moulds, one for the face and a second for the rear. The handle was hand-made. All components were glued together with slip.[5] Finally, some details like eyes, eyebrows, or a wreath of leaves were painted by hand.[6] After the final decoration the vase was fired in the kiln.

The production process relates the head vases to terracotta figurines. Theoretically, the aim was a series of almost identical objects. However, minor deformations could occur during the drying or firing process, and in the reworking process of the still-wet surface. Minor differences in the manually applied painting of the face may also lead to deviations.

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Overall, the use of a mould enables mass production on a homogenous level and of similar dimensions.

Attic Figural Vases – Classification

In Athens, the production of plastic vases in the form of human heads dates back to the late 6th century. We owe their classification to the fundamental paper of Sir John Beazley, written in 1929.[7] Since then, numerous vessels have been published, but Beazley's groups are still relevant.[8] Based on an art historical methodology, Beazley categorized the head vases into twenty groups, so-called classes, according to the stylistic development of the face.

This paper will focus on two classes defined by Beazley (fig. 1): Class N, called the Cook Class[9], and the Vienna Class, Class Q; two replica vases stored in the Kunsthis-

Fig. 1: A vase grouped in the Cook Class (Vienna, Kunsthistorisches Museum IV 998) and one of the name-vases of the Vienna Class (Vienna, Kunsthistorisches Museum IV 1039).

torisches Museum Wien are the name-vases for this class.[10] The number of preserved vases in the diverse classes varies from only a few objects to more than 230 in the biggest group of all, the Cook Class. The small Vienna Class is represented by only 14 samples so far.

As the use of moulds aims at almost identical products, Beazley's stylistic grouping of vase painting is less suitable for moulded objects. Therefore, he himself compared the head vases to sculpture and used their chronology.[11]

We pursue a different approach that seems more suitable for defining the coherence of a given class of moulded objects.

Quantifiable Approach Based on 3D Models

The key question is: Are the vases grouped in the same class *similar* vases, or are they more or less *identical* in terms of geometry? If their geometry is identical, they were made using the same mould or at least using the same master model.[12]

Therefore, we documented each vessel using a 3D scanner[13] and generated 3D models from this data. So far, we possess 3D models of head vases stored in Berlin, Bologna, Budapest, Ferrara, Florence, Munich, Tübingen, and Vienna.[14] All data will be stored in a repository which is being set up currently at the Austrian Academy of Sciences in Vienna.[15]

The digital comparison enables a quantifiable comparison of objects stored in different places based on 3D models. Generally, it is possible to compare all features of the entire vase. To examine our main question, we disregarded the texture. As we were most interested in the handling of the mould, we focussed on the heads.

Based on 3D information, OptoCat software was used to align the selected common areas of two objects. A special implementation of the iterative closest point (ICP) algorithm was employed to achieve the best fit alignment of the two 3D surfaces. During the ICP alignment, the position of the reference object was fixed in space while the second object's position was translated and rotated in space, thus minimizing the distance between the two objects. After the alignment, calculation and display of the offset between reference and search model were carried out. The distance value was displayed on the 3D model in a false colour image. If the deviation was less than 1 mm, we regarded two objects as so similar in shape that it was likely to come from the same mould.[16]

Analysis Based on 3D Models

Comparing vases of the Vienna Class following the approach described above, it became obvious that the vases are closely connected. The compared faces mostly have a deviation of less than 1 mm (visualised in green). Only in a few areas is the deviation

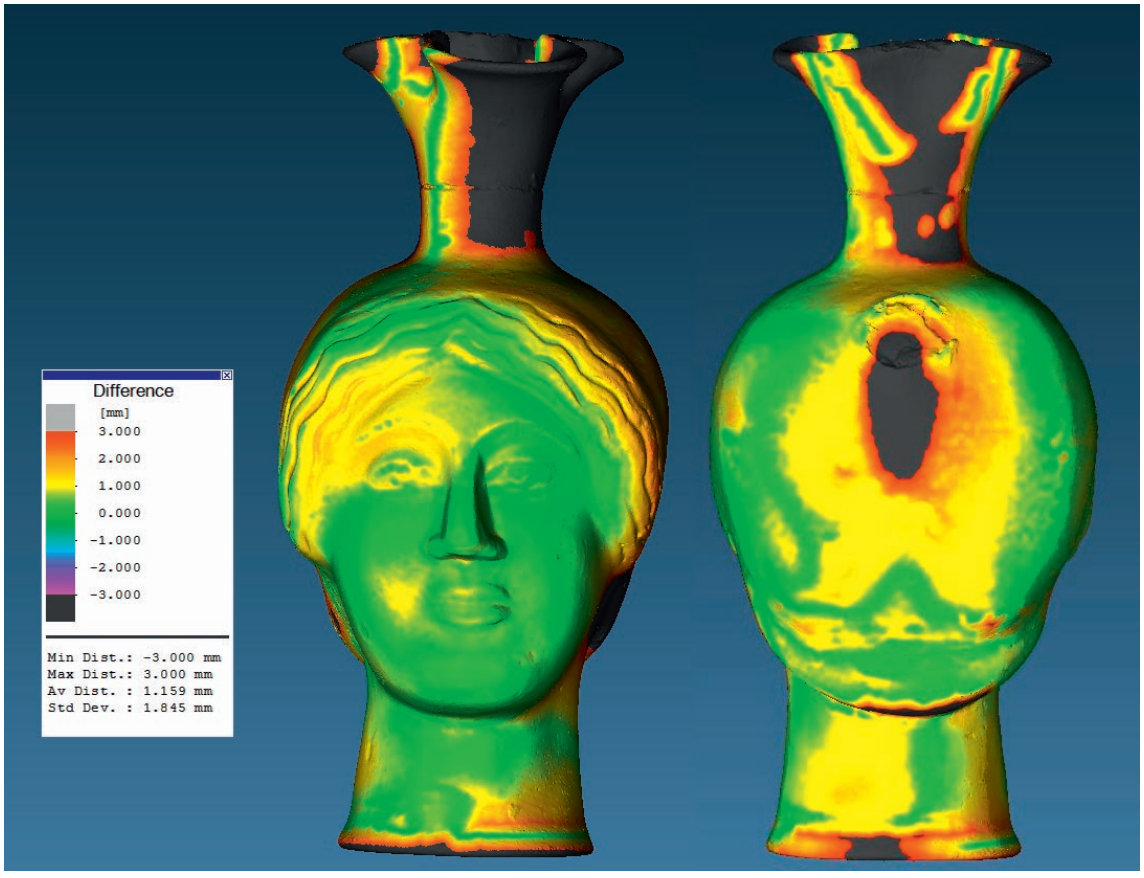

Fig. 2: The comparison of the two name-vases of the Vienna Class (Vienna, Kunsthistorisches Museum IV 998 and IV1039).

between 1 mm and 2 mm (visualised in yellow), but it never exceeds 2 mm. Comparing the back of the vases produced similar results (fig. 2).

The back side of the vases is difficult to calculate by conventional means due to the lack of reference points. Only the 3D models allow for this evaluation.[17] So far, we have carried out the calculations for seven[18] of the 14 known samples in the Vienna Class. No significant deviation was observed, only minor differences. Hence, it is most plausible that all vases in the Vienna Class come from the same pair of moulds. Only the final decoration made by hand shows minor differences, with the wreath having pointed or heart shaped leaves.

For the Cook Class, the situation is slightly more complex. At first glance, the only difference again is the shape of the leaves of the wreath, being pointed or heart-shaped.[19] Upon closer examination, the number of existing vases is far greater, and the dimensions also differ significantly. The difference in the maximum height can be seen clearly, especially without texture (fig. 3). In line with the maximum height, the height of the faces themselves also differs. Comparing the vases by aligning the 3D models as before

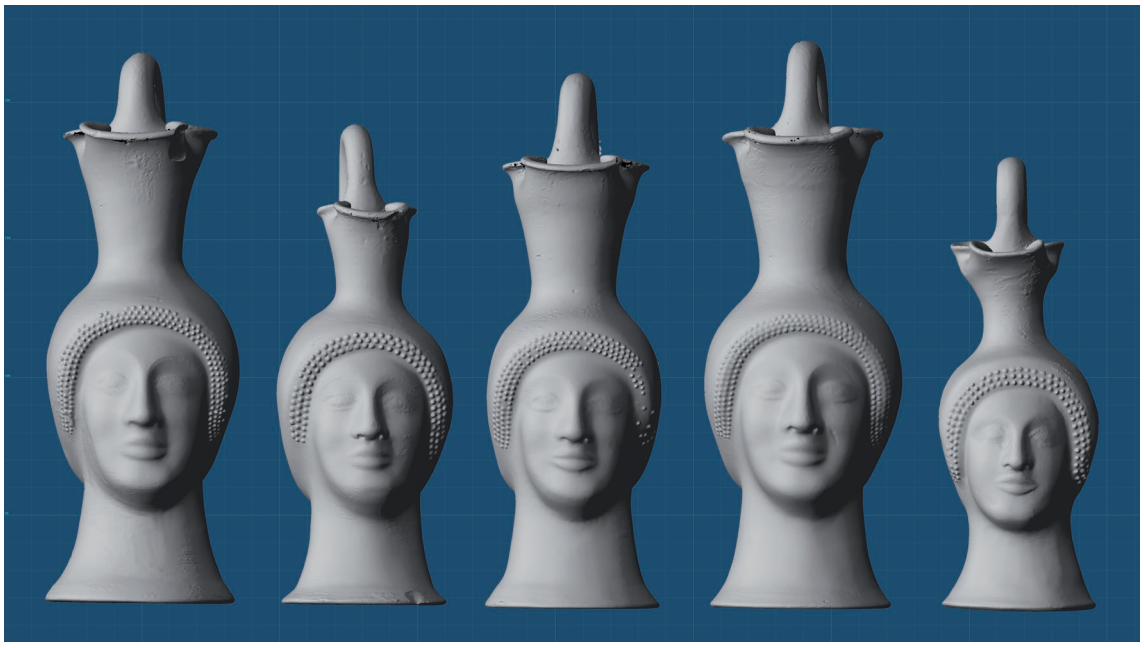

Fig. 3: 3D models without texture of five vases belonging to the Cook Class stored in Berlin; Berlin, Antikensammlung F 2191, F 2192, F 2193, F 2194, F 2195.

does not make sense. Although there is the typical similarity, the use of the same mould can be excluded for these faces.

Nevertheless, we can also find perfect matches in the Cook Class, as seen in the Vienna Class; in these cases, the deviation of the whole face is less than 1 mm (fig. 4 a; 4 b). These vessels were obviously made using an identical mould.

In a digital environment, we can change the dimensions and scale the data of the 3D models. A scaling factor was applied to one model before aligning it to the reference model for comparison, and the same factor was applied along the X, Y, and Z axes. Different factors between 0% and 20% were tested, as such differences may be explained by material shrinking and/or re-moulding from an existing model.[20]

We started by comparing three vases of different heights stored in Vienna, all attributed to the Cook Class. The calculation shows an interdependency between the three vases (big, medium, small): the biggest is ca. 10% higher than the medium vase (fig. 5), and the smallest vase is ca. 10% smaller than the medium vase.[21] Further vases stored in Munich and Berlin fit into the same scheme. Nevertheless, the Cook Class is less homogeneous than the 'smaller' classes; we have proven that at least three subgroups exist in the Cook Class.[22] The use of digital 3D models also enabled us to evaluate fragmented objects, which is hardly possible by conventional means.[23]

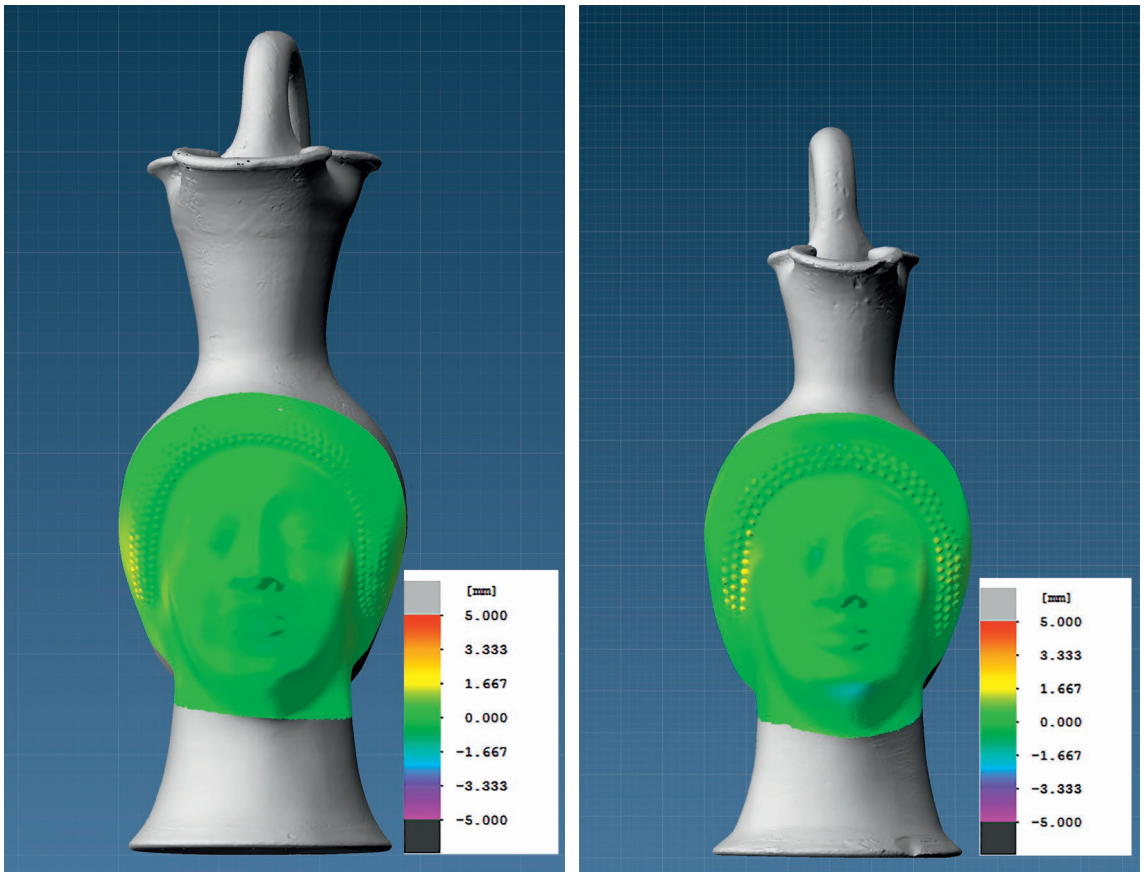

Fig. 4: Comparison of two vases in the Cook Class: Berlin, Antikensammlung F 2191 compared to F 2194; Berlin, Antikensammlung F 2192 compared to F 2193.

Conclusion

Serial analysis is well established in the research on figurines. Given the comparable production process it can also be applied on head vases.[24] The common element is the mould. The advantage of using a mould is that the resulting product is predictable and that limited skills are necessary to shape the figurine/vase.

Similar head vases preserved only in small quantities ('small classes'), such as the Vienna Class, are likely to be the output of one workshop which wanted to produce more or less identical vases. For this reason, they prepared a single pair of moulds, which may have been used until it broke or was worn to a high degree. The final treatment of the individual piece is less homogenous, and differs in the depiction of the wreath. Nevertheless, a series of standardized vases was produced using moulds; it aimed in some way at a 'mass production', despite the 'limited output' of the workshop.

Considering productivity, another question arises: Does the use of the moulds increase the productivity and raise the workshop's profit? We may doubt this, for reasons

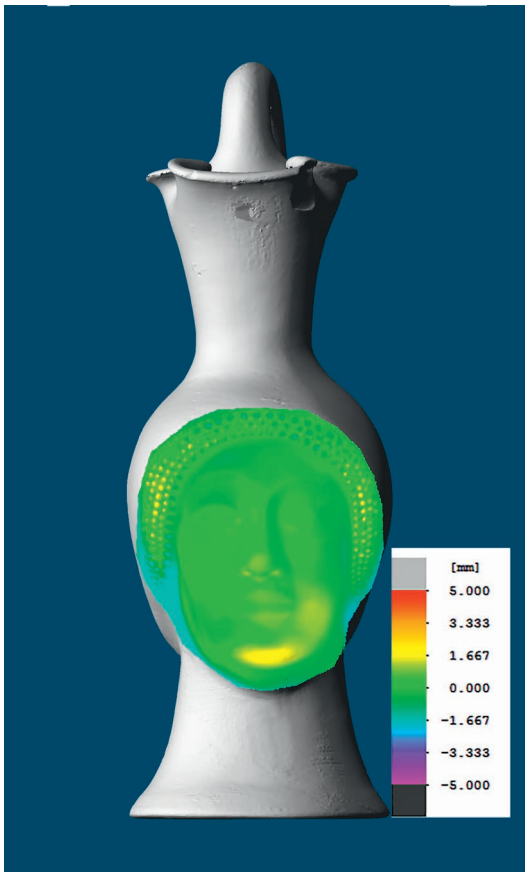

Fig. 5: Two vases in the Cook Class, one in original height (Berlin, Antikensammlung F 2191), the other calculated by 110% (Berlin, Antikensammlung F 2192).

of the "time" parameter. Only a leather-hard vase can be removed from the mould, and this may take considerable time, depending on environment, infrastructure, and weather. Afterwards, the mould itself must dry before it can be re-used. The drying period also needs to be taken into account. This leads to my assumption that especially the vases produced in small series did broaden the workshop's product range. However, although they were produced serially, I doubt that they were more profitable than vases thrown on the potter's wheel.

Concerning the Cook Class, the situation is slightly different: the head vases in the typical shape of this class were obviously more popular than other types of head vases. This is the conclusion drawn from the larger number of surviving items of this class.

In general, the number of copies from the same mould is always limited due to material wear and to the risks of damage or breakage. Sooner or later a new mould or a new pair of moulds becomes necessary. In the case of the Cook Class it was made from an already existing vase. The analyses proved that similar head vases from the Cook Class can be attributed to one of three interdependent groups. This fact has further

implications, especially regarding the date of the vases belonging to the Cook Class. Further 3D models and comparisons in connection with secure excavation finds[25] may reveal more information in this respect. Both will be the subject of future research.

Notes

[1] The exotic vessel type is often accompanied by exotic subjects, and most of them have a representative character; Guy 1981; Hoffmann 1997; Williams 2004; True 2006.

[2] Schlotzhauer 2006; Böhm 2014.

[3] Cf. the introduction to the chapters dealing with head vases and rhyta in Schöne-Denkinger 2018, 44 f. 60 f.; Ebbinghaus 2008.

[4] The identification of the depicted persons is subject to debate, but is not our topic here; cf. Lissarrague 1995; Reeder 1995, 212–215 No. 47 f.

[5] Schreiber 1999, 236–241; cf. also the video "Making a Molded Attic Vase" produced by the Getty Museum. Sometimes the seams are still visible on the surface. By using imaging techniques (e.g. X-rays, CT) the joining parts are clearly identifiable; Schöne-Denkinger 2018, 51–55; Boss et al. 2010, 39 fig. 7–9.

[6] Many heads wear a wreath of leaves, but some have a *stephane.*

[7] Beazley 1929.

[8] Beazley ignored vessels with full-height figures and also the productions of the 4th century. He focused on vases in the form of human heads.

[9] The Cook Class is named after the famous religious historian Arthur B. Cook in Oxford. Cook was the former owner of the name-vase of this class, a double-sided aryballos with the faces of Heracles and a woman, today stored in New Zealand; Dunedin, Otago Museum E48.236: BAPD 218434.

[10] Trinkl 2011, pl. 27.

[11] Very often he refers to the *korai* of the Athenian Acropolis; Beazley 1929.

[12] Schöne-Denkinger 2016 demonstrates the difficulty in making these comparisons using conventional methods of measurement. Although she produced nice results and proved relations between vases stored in Berlin, the measurements taken by hand always remain slightly tentative. The marked contrasts and especially the perfect Attic glaze also represent challenges for the measurement devices.

[13] We used a fringe projection scanner.

[14] I would like to thank all of the curators who showed interest in our method and generously granted access to their collection.

[15] Spelitz et al. (2020).

[16] For a more detailed explanation of the method and additional results dealing especially with the head vases stored in Berlin, cf. Trinkl – Rieke-Zapp 2018.

[17] The back is often not even shown in publications.

[18] Berlin F2200: BAPD 218628; Bologna G143: BAPD 218632; Ferrara 1900: BAPD 218636; Florence 73695: BAPD 218633; Munich SH2746: BAPD 218629; Vienna IV 999: BAPD 218631; Vienna IV 1039: BAPD 218630.

[19] The characteristic depiction of the hair as dots of clay attached by hand is also heterogeneous, since three and four rows of dots appear. This difference can even be observed on vases which were made by the same mould.
[20] Nicholls 1952; Muller 1997a; Muller 1997b.
[21] Vienna IV 998: BAPD 218491; Vienna IV 1038: BAPD 9031306; Vienna IV 997: BAPD 218490; Trinkl 2011, pl. 25 f. We suggest that Vienna IV 1038 was made from a mould that was taken from Vienna IV 998, and that Vienna IV 997 had a mould that was taken from a vase similar to Vienna IV 1038; cf. Trinkl et al. 2018.
[22] Subgroup of greatest height: Berlin F 2191; Berlin F 2194: BAPD 218477; Schöne-Denkinger 2018, pl. 44 f.; subgroup of medium height: Munich SH 2743: BAPD 218479; Berlin F 2192: BAPD 218475; Berlin F 2193: BAPD 218476; Schöne-Denkinger 2018, pl. 46; subgroup of smallest height: Munich SH 2745: BAPD 218480; Berlin 2195: BAPD 218478; Schöne-Denkinger 2018, pl. 48. In general, cf. Trinkl – Rieke-Zapp 2018.
[23] The fragment Berlin F 2199 is attributed to the subgroup of medium-height vases belonging to the Cook Class; Schöne-Denkinger 2018, pl. 47, 5 f.; Trinkl – Rieke-Zapp 2018, 71. The fragments Tübingen, University 1564: BAPD 16879, and Tübingen, University 1563: BAPD 16878 were attributed the largest and the smallest subgroup of the Cook Class respectively.
[24] Jastrow 1941; Hornung-Bertemes 1997; Muller 1997b; Beenhouwer 2008; Mathieux 2015.
[25] E.g. Guggisberg 2015.

Image Credits

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