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Data Management for Moulded Ceramics and Digital Image Comparison: a Case Study of Roman Terra Cotta Figurines

Abstract: Using a technique of image comparison on the one hand and data management on the other, we have developed a system that takes into account the singularity of moulded ceramics and allows us to approach the figurines from various points of view such as iconography, archaeological contexts, fabric and painting. The system is receptive to products of different economical regions and guarantees the objectivity of the dating process. A total of 3200 figurines have been described, measured and photographed to allow comparison of the digital images. The analysis enabled us to establish a relative chronology, to recognise iconographical evolution and to redefine the relationships between the coroplasts and the workshops. The major result of the study is the establishment of a chronological system that will make the figurines an important dating instrument for Roman provincial archaeology. Furthermore, we succeeded in defining the economic interaction between Eastern and Central Gaul.

Introduction

As is the case in modern industrial practice, in antiquity third parties often copied original creations. The antique industrial moulding techniques caused shrinkage of the dimensions or change of details. The reconstruction of this reproduction process gives moulded ceramics a tremendous advantage over other ceramic productions, since it is able to give us far more information on important topics such as economy and chronology. Thanks to modern computer technology, we can fully exploit its possibilities. The extraordinary value of moulded ceramics can be validated by using a technique of digital image comparison combined with efficient data management, a method that has been applied to figurines, but could equally be used for Samian ware or decorated lamps.

Image Comparison

Mass production results in series of objects with the same shape. Therefore, the basic category of the classification needs to be the series. Each series consists of a range of uniform moulded figurines deriving from a common model. Accumulation of moulding defaults, retouching or adding new details can give birth to a new series. In order to visualise the relationships between different series, a new concept was needed: the genealogical tree. Just as genealogy explains the descent of members of a family, the

genealogical tree shows the relationships between series that are related by the moulding process. Thanks to these descent schemes, it is possible to establish a relative chronology, to recognise the iconographical evolution and to redefine the relationships between the coroplasts and the workshops.

In order to reach that goal, we compared the images of several thousands of figurines. Photographs of four sides of the objects have been digitised and scaled. The images of comparable objects were assembled on large documents in different layers.

A picture in one layer was superimposed onto

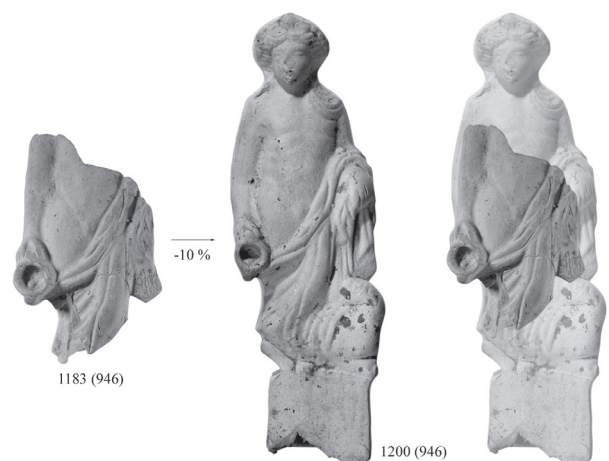


Fig. 1. Objects that belong to the same series. On the left a fragment of Bacchus from Braives (Belgium. Excavation CRAN Louvain-la-Neuve). In the centre a complete figurine from Tienen (Belgium. Excavation VIOE Tienen). On the composite image at the right, the fragment from Braives has been reduced by 10%. Scale $\frac{1}{2}$.

a second picture in another layer. By changing the transparency, the similarities or differences become clearly visible. Shrinkage of the dimensions due to the moulding process can be measured exactly by resizing the largest picture with retained proportions. This way we can determine which figurines or fragments belong to the same series. Additionally, we can determine which objects are closer to the original model and are therefore presumably older.

The example in *Fig. 1* shows the relationship between a fragment of Bacchus and a complete figurine of the same series, produced in Cologne in the second half of the second century AD. The first number beneath the figurines refers to the number of the catalogue, whereas the second number between brackets refers to the number of the series (DE BEENHOUWER 2005).

Once the series have been analysed, a more complicated search begins: the search for the mechanical relationships between the series.

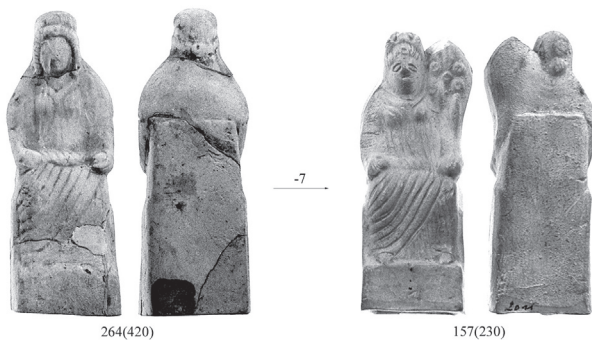


Fig. 2. Series of different themes, related by the moulding process. On the left a seated woman with fruits in her hands from Arlon (Belgium. Musée Luxembourgeois Arlon). On the right a Fortuna from Tongeren (Belgium. Provinciaal Gallo-Romeins Museum Tongeren). Fortuna 157 (230) is 7% smaller than the seated woman 264 (420). Scale $\frac{1}{2}$.

In the example shown in *Fig. 2* we can see how the modeller created related series of different themes, such as a woman with fruits and Fortuna, simply by changing the attributes. The round fruit in the right hand remains, but a cornucopia has been added in the left arm. The simple bonnet of the goddess with the fruits has been changed into uncovered hair, crowned with a lunala-shaped diadem above the forehead of Fortuna. A second dentate diadem has been put in front of the first one. The descent tree from which the example was drawn contains 13 figurines that belong to two series of Fortuna and two series of the woman with fruits. Each of these figurines has its own archaeological context, dating

evidence and technical characteristics. Their position in the descent scheme enables us to disentangle their chronological and technical relations. In this case the entire evolution takes place in Eastern Gaul. Although no workshop finds are known, at least two different production sites have been recognised. One of them has been localised in Cologne based on petrographical evidence, the other one in Frankfurt or Trier based on chemical analysis. The iconographical evolution took place between 115 and 150 AD, although some examples still occur in the second half of the second century.

The relationship between the series is not always obvious. Sometimes the change of detail is very thorough and hard to discover. It is perfectly possible that only a part of the figurine is mechanically related to another series. Some Central Gaulish series representing a seated mother suckling one or two infants share only the posterior half-mould, depicting the back of the seat. In other cases, only the head is common. In this way, image comparison teaches us about the attitude of the coroplast towards copying and how he dealt with the technical problems of the moulding process. We can see for instance how he used the same moulds for the back, removed the signature of a competitor, restored the loss of detail and compensated the loss of height by raising the plinth or by lengthening the body.

Gradually a gigantic web of relationships unfolds, which is visualised in the descent trees. In all, we analysed 3200 figurines, which have been ascribed to 990 different series and 133 descent schemes. Obviously, managing the data is essential to harvest the fruits of these relationships.

Data Management

A catalogue of the individual objects is the core of an interactive data bank. It groups all individual characteristics of each figurine. The information that goes beyond the individual object is grouped into satellite banks, around pillars such as typology, find circumstances and workshop study.

Typology

The system respects the proper character of moulded ceramics. A traditional typological classification consists of some basic categories such as theme, type and variant. In the case of moulded ceramics, this classification is insufficient and needs to be

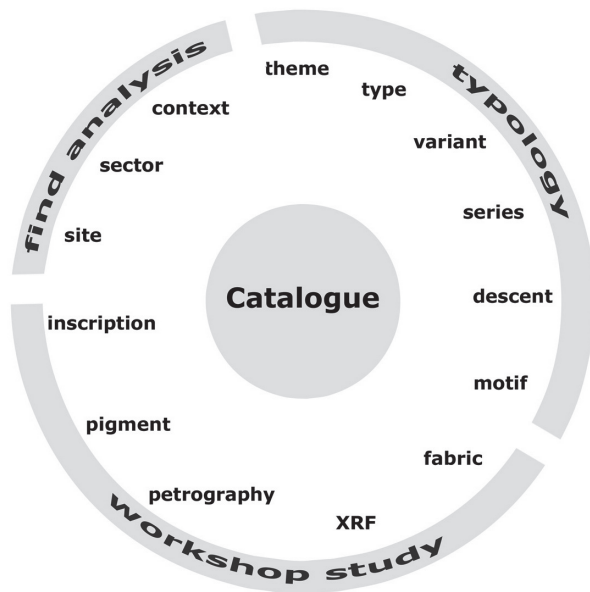


Fig. 3: Structure of the database.

completed by the category of the series grouping all objects of an equal shape. By navigating to the file of the series, we can evaluate the surplus value of moulded ceramics. Information about chronology, origin, decoration and coroplasts is multiplied by the number of individuals belonging to the series. A relative chronology is stated by the internal ranking of the individuals of the series and an external ranking compared to the individuals of other series that are mechanically related and therefore figure in the same genealogical tree. These descent trees visualise the relation between the series that are related by the moulding process. At this point the information gathered in the series becomes a story: a story about iconographical evolution, about coroplasts adopting creations of other workshops and about the confrontation of the economical interests of Eastern and Central Gaul. Of course this is not the result of a pure typological approach. None of these stories would be possible without the archaeological data, which brings us to the second pillar, the pillar of the find circumstances.

Context Analysis

Where possible, the finds are linked to their archaeological context, situated in their find sector and finally in the site as a whole. This system allows us to recognise the chronology and functionality of a certain sector of the site. This is the basis of the archaeological dating and of the study of the use of the figurines. The data bank contains 387 sites, 690 find

sectors and 923 contexts. The context file shows the description of the context, summarising fields with their characteristics and a list of the figurines. One can navigate to the files of the individual figurines, the find sector or the site.

Based on the contexts we created a dating system, using the relations in the interactive data bank. The archaeological level is the basis. On a second level the archaeological dating is corrected by our knowledge about the coroplasts and on a third level by our iconographical knowledge. These three levels are strictly separated to avoid running around in circles. Insofar as archaeological, epigraphical and iconographical data are available, the dating system has been applied to the 990 series and the 133 genealogical schemes. One of the assets of the data bank is that anyone who consults it can judge at all times all dating arguments on each separate level. It often comes to light how initial mistakes with regard to the dating of a member of the series have been corrected by the dating information of the other members of the same series and of the related series in the genealogical tree.

Setting the context to the broader scale of the find sector or of the site makes it possible to recognise the individual profile of the context in terms of the degree of Romanisation of the site and the characteristics of the find sector. Countless speculations have been raised about the use of the figurines, but until now no systematical study of the contexts has been carried out. Nonetheless, these contexts are the primary sources for the interpretation of the regional use of figurines. One of the most spectacular conclusions in this respect is the relationship between figurines and artisans. This could clearly be demonstrated for antique agglomerations that have been subject to intensive archaeological campaigns, such as Tongeren and Tienen.

Workshop Study

One last group of files concerns the workshop study. Most of the figurines in north-western Europe have been imported from the Allier, Rhine or Mosel area. One of the goals of our study is to develop a method to inform us about the economical process. The information can be given by the figurine itself. By analysing the assembly technique we can deduce the region of production. This analysis enables us to draw the map that shows the relations between Central and Eastern Gaulish import.

Another source of information on the workshops

are the names of the coroplasts that are often inscribed on the moulds as a property sign, or on the figurines as a quality label. Paint that often remains on the surface of the figurines is a third way to analyse the relations between workshops.

A fourth technique that informs us about the origin of the figurines is the analysis of the chemical and crystallographic characteristics of the clay. Nineteen samples have been studied by XRF. Furthermore, we analysed 550 petrographical samples. The petrographical analysis in particular is promising. The strength of the method lies in determining differences and resemblances within each series. This way it was possible to prove that most exported thorn pullers originated from the same Allier workshop. Again this proves how organised data management can lead to the connection of different relevant sources, in this case the results of fabric analysis and the information from image analysis.

Conclusion

Linking all aspects related to the subject offers a great opportunity for the study of the figurines and for the archaeologist, who enters his finds into a database in which every aspect of the object can be fully described and queried. This process does not stand alone. Through context, different kinds of artefacts such as pottery, glass, bone or metal are linked. Linking databases of different materials could open new perspectives to gain more information about chronology and the use of the objects.

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