

THESES OF Ph.D.

NIKOLETTA SEY

**ISSUES OF THE BRONZE WORKING WORKSHOPS IN THE ROMAN AGE IN
PANNONIA**

Budapest

2013

Eötvös Loránd University
Faculty of Humanities

Nikoletta Sey

**ISSUES OF THE BRONZE WORKING WORKSHOPS IN THE ROMAN AGE IN
PANNONIA**

Thesises of Ph.D.

Supervisor: Dr. László Borhy

Ph.D. School of History

Senior master: Gábor Székely DSc., professor

Ph.D. Programme of Archeology

Senior master: László Borhy DSc, professor

Budapest, 2013

The Subjects and Objectives of Dissertation

The objective of the dissertation, after collecting the evidences of bronze working in Pannonia, is to size up the functioning of the bronze workshops in the roman age as detailed as possible. Since bronze was used in crafting of the most of the objects of everyday use, it is important to research the issues of fabrication and the economic background as well. However, the examination of bronze working cannot be fully separated from other metal working and economic activities. Namely, the known facts of other lead and iron processing workshops can serve valuable pieces of information. In many cases these workshops operated together, and in certain types of settlements they gathered with other economic units, forming an industrial quarter. In this dissertation, considering these points and the evaluation of the bronze working artifacts in Pannonia, I tried to give an as comprehensive view about the labor of bronze workers, as possible. The different tools and the technical specialties that were found in the workshops can give an insight into the local customs and methods of bronze working.

The collection of artifacts of Pannonia is an important objective of the dissertation, even by itself, because several new artifacts turned up since the previous writings had been published, based on earlier excavations. However, the significant part of the artifacts is sparse, and can give only an insight inspecting the site, they are indispensable in creating the comprehensive view. During the essential collecting process of this dissertation, the perishing and inaccessibility of certain artifacts became obvious, hence being based on some of the earlier publications was unavoidable. The reason of the possible deficiencies of the collecting process could be the fact that certain objects were stocked with wrong definitions due to the incompleteness of the recognition, and could not be observed. Despite of all these complicating circumstances, the catalog contains a large number of artifacts.

The comparison of the domestic artifacts and the ones known from other provinces clearly shows the regional similarities and differences. In the case of bronze workshops, the type, size and nature of the settlement cannot be left out of consideration during the evaluation.

One of the most important objectives of the dissertation is answering the questions of the crafting technics and the reconsideration of the earlier terminology, and sizing up the functioning of the workshops by setting the methods applied in Pannonia against the ones

those were used in the other provinces. Thus, the discussion about the issues of bronze working workshops in Pannonia is the summary of gathering the artifacts, the earlier publications, and the outlook to other provinces.

I. The Method and Build of the Dissertation

The first chapter of the dissertation is the Introduction, which has two subsections: the first part contains the objectives and the general introduction (1.1), and in the second part there is a survey of the previous researches about the bronze working in Pannonia and other provinces, and about other metallurgical researches (1.2).

The second chapter analyses the antecedents of roman bronze working, and the pictorial and written sources (2.). The adaptability of the different tools to several professions complicates further their identification based on pictures. The written sources might serve valuable pieces of information about the contemporary bronze working customs, and the attitude of people towards the bronze workers and their profession. These documentations might be prejudiced of course, thus they need to be handled by source-criticism. On the grounds of the sources we can figure out how those bronze workers and their works were estimated.

An important part of the dissertation is the third chapter, where I examined the raw materials and the issues of crafting technics. Within this chapter, the first subsection examines the significance of the raw materials' inspection and composition (3.1), and the second one analyses the issues of crafting technics (3.2), based on the different tentative archeological methods, and the noticeable marks on the excavated artifacts. Accordingly, during the collection of crafting technics, the founding and the sheet-working processes can be separated. Despite of the sporadic nature of the artifacts in Pannonia, and the difficulties of their identification, several crafting processes' marks can be detected during their inspection. At the founding technics it can be clearly seen what kind of processes were in use in Pannonia. Examining these methods, some of them can be paralleled with the ones originated from the other provinces, but some of them lack proof in local destinations. The regional differences can originate from the variance of demands in quantity and quality. Also in the case of sheet-working we have plenty information about the various repair- and crafting technics, based on the artifacts from Pannonia.

The most important chapter of the dissertation is the enumeration of the sites of artifacts; those refer to the bronze workshops in Pannonia (4), in which all the known data and details are introduced that related to metal working in the province. The already known, published objects will be introduced together with the newly excavated artifacts at the description of each site. Examining those settlements in Pannonia, where bronze working-related artifacts turned up, we can see, that bronze working existed in some form at any type of settlement. It is logical, since a major part of the tools and objects were made of bronze. Considering that only minor partition of the proofs of bronze working survived, we can assume that much more settlements had bronze workshops. Of course, this is only an assumption without proofs, but after the examination of the sites, we can see, that the bronze workshops in Pannonia developed depending on the type, size and demand of the certain settlement.

In the next chapter the build-up and functioning of the excavated workshops and the bronze workshops based on the international archeological literature is introduced (5). Within this, the analysis and refinement of the functions of different types of smelters (5.1.1), the crafting tools (5.1.2), and the casting models and negatives (5.1.3) are discussed. It is evident from the artifacts, that not all the tools can be reconstructed on the base of the excavated sites; at times the ethnic parallels of same working technics must be invoked. Defining the equipment of the workshops often conflicts obscureness. Surveying the artifacts, the workshops equipped with the tools mentioned in the chapter could function. These tools and objects might have varied from workshop to workshop, but in basics they were developed to the same pattern.

The next aspect of the examination of workshops is the incidental specialization, which is discussed in the next chapter (5.2). Within this, the workshops, which specialized to different objects (5.2.1), separate to crafting military equipment (5.2.1.1), brooch (5.2.1.2), sculpture (5.2.1.3), pots (5.2.1.4), email objects (5.2.1.5), and the workshops using different technics (5.2.2). Technically three categories can be separated, the workshops dealing with sheet-working (5.2.2.1), casting (5.2.2.2) and repairing (5.2.2.3).

In the case of the specialized workshops, regularity cannot be noticed neither on era, size, location, nor on settlement type. Probably the demand of the area controlled the specialization of workshops in the certain era. This affected the objects crafted there, and the crafted technics as well. The separation of the workshops based on the crafting technics comes from the different crafting methods of certain objects and tools, and the specific demand for a certain era. In the first centuries of the emperor era, the supply of raw materials

was probably trouble free, while in the III-IV. centuries the recycling and repairing came to forefront due to the decadence of commerce. Though the in the earlier eras workshops dealt with repairing, this method became popular in the late roman age, beside with the less raw material demanding sheet-working.

In the next chapter, the sequences of objects, and the survey of their controversies (5.3), and the difficulties in the identification of the bronze workers and the objects, tools that are marked by the bronze workers in Pannonia (5.4) are being analyzed. In the case of the unmarked objects and tools, especially the ones that have certain figures on them, the possibility occurs, that they can be connected to workshops or bronze workers stylistically. This method is not possible in many cases, but cannot be left out of consideration.

II. The Major Achievements of the Dissertation

In the chapter of crafting technics, foremost, the process of the preparation of bronze itself is necessary to be introduced. The first step is the extraction of copper from the ore, which takes place in a furnace, and can last 5-20 hours while the rock and the slag is removed.

After the extraction of the copper, a distinction must be made between the preparation processes of the brass and the bronze. Brass is made by so-called cementation, where the zinc, vapored from the zinc ore, diffuses with the copper. In the case of the bronze preparation, the copper was put into a closed pot with calamine and charcoal, and was heated at 1000 °C for 2 hours. The heating is very important in this process, since the zinc turns into gas at 918 °C, and the clean copper melts at 1083 °C, which temperature must not be reached before the zinc combines with the metal. Afterwards the temperature rises, and the alloy becomes unitary, and the bronze will contain about 30% zinc.

One method of melting metals is when mineral copper (Cu₂O) and charcoal (CO) is heated to about 1100 °C in a pot, and we get copper (Cu) and carbon-dioxide (CO₂) from them.

Several methods of bronze elaboration are known from the roman age. In the case of casting technics, lost wax process was in use in the antiquity. At the casting processes, the preparations of the larger sized plastics and the smaller sized articles of personal use must be distinguished. The larger sized statues in the antiquity were made by jointing the separately casted smaller parts together. We do not have any data about these large sized statues from

Pannonia. However the proofs of manufacturing of small plastics and personal articles are revealed from several settlements in Pannonia.

The necessary temperature for casting was reached by heating the charcoal in the furnace with a windbag. At that certain temperature, the metal was put into the pot in smaller doses and at equal time intervals, to prevent the overheating, which would cause hydrogen gas in the alloy. At the smelting of copper the added iron enables the oxidation, and helps the clotting of slug, making it easily removable through the upper, open part of the pot. With this technic the iron content can be reduced below 0,5 %, which was enough to keep the metal tractable in cold and in hot state as well.

After the casting, certain post-works were necessary to be made on the objects. The smaller seams were corrected by rasp and emery, and they used leather and granulated materials for polishing. The smaller failures, bubbles and flashes were not corrected in every case, only when a work of high standard was required. In these cases they made a tetragonal cutting on the surface of the object, especially on the sculptures, and hammered a bronze annex into it, or sometimes they heated it and worked into the cutting. At posterior correctional processes these annexes were connected to the statue by studs, or in certain cases with feral or vegetal glues.

The lost wax casting technic required special facilities in the workshops. During the excavations in Pannonia, the furnaces were revealed only in a very few cases, but so much the more used and unused casting pots were found in the sites. Furthermore, the semi-produced and flawed castings, and casting models also allude to casting activity of this area. During the investigation of the artifacts, several observations were made related to the issues of crafting technics. At some of the artifacts, which were specified as casting models, the question emerges, whether any bronze was ever casted into these negatives. Namely, these clay negatives do not carry any sign of heating. The tentative archaeological methods also prove that the dried negative was heated to 150 °C, before the 1080-1150 °C hot metal was casted into it. The lack of heating marks on these negatives supports the hypothesis, by which the wax model of the object was formed this way. A casting artifact from Brigetio also supports this hypotesis, where it is clearly visible, that the covering clay was not removed from the brooch. This piece is a good example of how the brooch was made by casting the bronze into the clay, which was put around the wax model previously, formed in the original negative. An other proof of this technic is an artifact from Szőny-Vásártér, where the clay covering was not totally removed from the casting either. The seams on the sides of the objects refer to the existence of the casting technic where more casting models were used to make one casted

object. This means that both technics might have been in use. Although both the negative and positive parts of a casting model never got revealed together in Pannonia, we know such cases from other provinces. Because of this technical problem, the negatives that cannot be proved to be used at casting will be named as auxiliary negatives, since it is less misleading in the terminology of crafting technics. Among the collected artifacts of Pannonia the leaden models can be found too, which were used later as the models of the objects made of bronze.

The collection of the bronze workshops of the roman age in Pannonia comes up against several difficulties. The artifacts from certain sites which unambiguously refer to workshops often occur as sporadic or single artifacts. These artifacts although prove the existence of workshops, they cannot determine their exact location and function. Only a few artifacts from Pannonia can be found in the museums, which were revealed together with a workshop. However the artifacts, the partly complete objects and the wastes that can be localized without any doubts can give an insight to the metal crafting habits and methods of that province.

In the dissertation, the workshops of certain sites are collected, considering the currently present artifacts of the museums, and the results and hypothesises of earlier researches. Here must be mentioned, that the incidental incompletions might be caused by the destruction and the inaccessibility of certain artifacts, and also some data seem unrealistic after the reconsideration of earlier researches using the up-to-date researching methods.

Apropos of the roman age bronze working, general economic questions emerge, whether the self-sufficiency or the usage of goods arriving from different manufacturing centres was the main supplying method in certain areas. The commerce – particularly the overland one – made the different goods more expensive considerably, so obvious, that beside the luxury goods, which were expensive anyway, the common people's everyday goods had to be manufactured locally. Thus signs of some kind of bronze working turn up widely in Pannonia. Apropos of the evaluation of these signs, new questions emerge at the processing of other provinces' artifacts.

One of the difficulties of metal elaboration's investigation is that archaeological artifacts, that prove bronze working clearly, rarely turn up from roman settlements. The reason of this is that the unfinished, defective, and disused samples were re-smelted; therefore they endured only in exceptional cases, and the clay casting moulds perished due to the quality of the soil, so it is difficult to size up the bronze working of a certain area. However it is evident, that some form of bronze processing existed even in the smaller settlements. It has several obvious reasons, on the one hand, the necessity of raw material is not bound to the

area, because by re-smelting the disused bronze objects workshops can exist anywhere, on the other hand, it does not need significant space, tools or devices, and furthermore it is an advantage if the goods are crafted locally and can act upon the demand and taste of the goodwill.

Within the same settlement the workshops might have existed with different facilities, and produced different types of goods in the different eras. In case the documentation of these workshops allows it, their location can provide important data. It is evident further on, that against the common method, the bronze working workshops settled not only outside the city wall, thus a common convention related to the area cannot be observed, furthermore an issue raises about the scales of functioning, since the workshops can be categorized according to their size, such as the small-sized 'family' workshops, the ones functioning with an employee or two, and the bigger ones, which consist of more rooms, employing several workers, using division of labour. The investigation of these workshops in Pannonia is uneasy because of the deficiency of the subject's research and the inaccurate documentation of the earlier excavations, but on the basis of the other provinces' examples the data can be inserted into these models.

The economic form of metal processing can be observed in several ways, which were on file by B. Gralfs among others. According to this it is important to consider certain factors during the observation of workshops in certain areas. Such a factor is for example the localization of the workshop, whether it was located in a countrified settlement, in a town, in a villa, or in a military camp or fortress. Namely, subject to the type of settlement, obviously different demands emerged on the basis of quality and quantity. Another thing is to be examined within this issue, whether the workshop was a part of an industrial quarter, or possibly a separate one, or a member of a group of other workshops. Such structural examination is possible only in the case of excavated workshops, but most of the sporadically found workshop artifacts do not enable it. Several possibilities emerge on geographical basis too, since there are known metal processing workshops in the central parts of the provinces, next to the road-systems, at bigger crossings, and next to raw material sites. Finally a further separation is possible and necessary on the basis of the workshops' size and the type of goods produced in them. The totality of the examinations considering these aspects can give a more complete view of bronze working. The pannonian context of research in many cases requires the known information from the better researched provinces to be used and compared during the examination of domestic material.

Therefore, because of the appearance of newer excavation methods, the spread of material tests, and the lack of their evaluation together with the older artifacts, a completion of an overall dissertation became necessary. In most cases of the Pannonian sites, the localization of the workshops is impossible, since only an object or two refer to the existence of the workshop functioning there. However the unfinished or failed objects, the moulding casts, the auxiliary negatives, the wastes, the moulding pots and the unsmelted metal stocks prove the existence of local bronze working. The exact localization of the workshop is possible only if the furnace could have been excavated as well. Though in the case of furnaces, only the smelting-furnaces can be considered as obvious proofs of metal processing. Of course, by taking notice of the site circumstances, the other furnaces can be connected to metal working too.

Observing the issues of the bronze working workshops, it is obvious, that the topic can be, and must be examined in several aspects. One of the aspects is by all means the functioning, positioning and structure of the workshop in a certain settlement. Furthermore, it is necessary to observe the different settlement types separately. The bronze processing workshops in towns, in military camps, in military towns, in vicuses and in villas might have been different in size, in facilities and in expertise too. Observing these factors, the different demands of certain settlement types are revealed as well. Workshop artifacts are known from each settlement type in Pannonia, even if not at an outstanding extent. Their significance is great, since only a few excavated workshops exist in Hungary.

Considering the fact, that the overall picture is not complete, is necessary because of the relatively small number of revealed artifacts. But the necessity of any form of bronze processing in the everyday life allows the conclusion that such activity existed in most parts of the populated areas. Depending on the size and significance of the settlement, after sufficing the local demand, the workshops could have produced goods for distant orders too in some cases. Also the existence of travelling artisans must be taken into consideration to a certain extent.

One of the main achievements of the research is that by examining the different settlement types, it can be stated, that craftsman supplying soldiers, and craftsmen supplying the civil population both existed. That is why a part of workshops specialized to certain goods or technics. The specialization to different goods was caused by the growth in demand in certain eras. These reasons could cause the usage of different technics too. The specialization to reparation can be separated the most unambiguously, since the possibility and necessity of repairing different goods came to the front because of the production's retrogression in the

late roman era. While the repairs were just side works for the craftsmen before, in the late roman era some workshops settled in for this express purpose. Of course proving this statement is difficult, but examining the artifacts from the different eras, this tendency is demonstrable.

Examining the bronze working workshops, it becomes evident, that they cannot be treated separately from other workshops. In most cases it is reasonable to examine complexly together with the other industrial activities. Bronze working primarily must be analysed together with the other metal processing workshops, namely with the smithy and plumber ones. As it is noticeable in case of several sites, these workshops were not separated, but functioned in the same building, possibly even under the same craftsman's control. This hypothesis seems logic in the aspect of the fact, that all three branches of metal processing used the same raw materials, tools and technical knowledge. Functionally, the bronze casting was not an everyday activity; hence the craftsman could perform other metal processing works between the casts.

The other significance of the dissertation is the exact definition of the tools and other devices used at bronze working that came up during the collection and evaluation of the workshop artifacts, and the review of the eventual terminological problems and the presentation of the possibilities of their solutions. The adaptation of the latest researches and the different experimental archaeological methods, and the consideration of the ethnographic parallelisms are indispensable for the latter one.

Thus, accordingly to the ambition, the dissertation sizes up the information about the bronze workshops of the roman age in Pannonia by collecting the sporadic artifacts from the earlier excavations and private collections, and the outcome of the latest excavations. The bronze working in Pannonia evidently fits into the image formed by the artifacts of the other provinces.

III. The publications of the author connected to the subject

’Brigetiói áttört bronzveretek a Sellye-hagyatékából’ *Komárom-Esztergom Megyei Múzeumok Közleményei* 16. Tata, 2010. 7-10.

’Római kori bronztárgyak a Szöny-Vásártéri ásatásról 2010-ből’ *Komárom-Esztergom Megyei Múzeumok Közleményei* (megjelenés alatt)

’Római kori viseleti tárgyak Scarbantiából’ (megjelenés alatt)

’Római kori bronztárgyak Budaörs területéről’ *Studia Comitatus* (megjelenés alatt)