

LEAD MODELS OF 10TH CENTURY STRAP ENDS APPLIQUES FROM METALWORK CENTERS NEAR PRES LAV

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Cuvinte-cheie: modele din plumb, aplice capăt de curea, metalurgie, producția pieselor turnate.

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Rezumat: Acest articol analizează câteva modele din plumb descoperite în timpul cercetărilor desfășurate în centre de prelucrare a metalului. Am ales să prezentăm 12 modele din plumb reprezentând cele mai populare forme și modele specifice pentru fiecare centru metalurgic. Acestea diferă nu numai prin formă și decor, ci și prin modul în care au fost produse.

Una dintre practicile principale folosite de bijutierii bulgari era utilizarea modelelor din materiale durabile, precum cele din plumb. Acestea erau forma intermediară între conceptul artistic original făcut din ceară și produsul final turnat în bronz.

Abstract: This article describes some lead models found during the excavations in metalwork centres. We chose to present 12 lead models from each of the in complexes representing the most popular shapes and patterns for the particular metalwork center. The lead models differ not only in shape and decoration but also in the method of production.

A main practice among Bulgarian jewelers was the use of durable models such as the models made of lead. They were the intermediate form between the original artistic concept made of wax and the final product cast from bronze.

The place of the lead model in the process of production of artistic metalwork in early medieval Bulgaria was highlighted after the study of the first known complexes of metal art in the vicinity of Preslav - those in Novosel, Zlatar and Nadarevo¹. The models, and in some cases finished pieces, were used as a

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¹ BONEV & DONCHEVA 2011; DONCHEVA 2007, p. 639-643; DONCHEVA 2008, p. 688-690; DONCHEVA 2010, p. 523-251.

base in the process of bronze and precious metal casting. Among these, lead models have several advantages: they were easily manufactured of metal with low melting point, they could be easily reshaped or processed, and they could be easily removed from the molding sand².

This article describes some lead models found during the excavations in metalwork centres mentioned above. We chose to present 12 lead models from each of the complexes representing the most popular shapes and patterns for the particular metalwork center.

In the first center, that near Novosel, the heart-shaped (**Fig. 1:1, 3-5**) and shield-shaped (**Fig. 1:2, 6, 8-9**) models prevail. Respectively, heart-shaped models subdivide into narrow (**Fig. 1:4-5, 7**), wide (**Fig. 1:3, 10**), with engraved (**Fig. 1:1-3**) or embossed (**Fig. 1:4, 9**) decoration of three-leaves (**Fig. 1:3-6**) or five-leaves palmette (**Fig. 1: 7-9**). On those with engraved decoration, there are three (**Fig. 1.1**) up to five buds on the outline of the shape (**Fig. 1:2**), but on those with embossed decoration – there is a bud at the top (**Fig. 1:4-5, 8-9**) and also in the middle of the base (**Fig. 1:11**).

The shield-shaped lead models have a bud at the base and another one on the top. Embossed decoration consists of a five-leaves palmette with straight stylized leaves at the base and a split middle leaf pointed to the top (**Fig. 1:8-9**). An embossed frame links the base and the top. We also present three tracery works having heart and plant shapes but in reduced size (**Fig. 1:10-12**).

In the complex near Zlatar, the heart-shaped (**Fig. 2:14-16, 20-23**) and the leaves-shaped forms (**Fig. 2:17-19**) dominate. They are available in both versions: narrow (**Fig. 2:13, 18-19, 20-21**) and wide (**Fig. 2:14-17, 22**). Basically, the decoration is of five-leaves palmette (**Fig. 2:13, 15-17, 21-22**), but there are models with three-leaves palmette, as well as with a seven-leaves palmette with a bud on the top (**Fig. 2:18**). The Zlatar artefacts demonstrate also more sophisticated plant decoration, combined with additional elements such as a grained ornament (**Fig. 2:17**), details with double outlining (**Fig. 2:23-24**) and palmette leaves protruding from the artifact shape (**Fig. 2: 24**).

A huge number of lead models were found in workshops near Nadarevo, which have not been fully studied yet. Most of them are kept in various museum and private collections and have not been displayed to the wide public. The current group of lead models demonstrates a rich variety of motifs and decorations in the workshop's finished products. These include predominantly heart-shaped (**Fig. 3:25, 29, 31-32**) and shield-shaped models (**Fig. 3:26-28, 30, 33-35**) in both versions: wide (**Fig. 3:25, 31-33**) and narrow (**Fig. 3:26-30**). The decoration is either engraved and usually contains five-leaves (**Fig. 3:25-26**) or seven-leaf palmette (**Fig. 3:27**) or embossed, with a three-leaves (**Fig. 3:30-31**) or five-leaves palmette (**Fig. 3. 32**). One can encounter other plant forms as well (**Fig. 3:36**).

The numerous artifacts from the three production centers demonstrate more or less the same basic shapes and decorative patterns, with some differences. The differences come from the fact that some models were obviously more popular

² GEORGIEVA & BUCHINSKI 1959, p. 40; SOTIROV 2001, p. 185.

than others, which highly depended on the requirements and demands of the workshop clients. We could even talk about some specialization in the workshops belonging to the different centers, as well as within the same center. This conclusion is supported by the artifacts found during the archaeological excavations. The firm expression of such conclusion however is hindered by the substantial destruction of the metalwork shops in all three centers and the dispersion of the material from them across the fields. The destruction of the production facilities was caused by the agricultural work in the surrounding fields of all three centers for many long centuries. Thus the artifacts produced in a particular workshop may be found in a completely different location, in most cases, quite distant from the place of its production. Nevertheless, the abundance of artifacts allows us to at least to make an attempt for classification.

The lead models differ not only in shape and decoration but also in the method of production. Casting is one of the most highly spread methods from ancient times to the present day, because it makes it possible to make blanks and details with extremely complex external shape, with internal holes and a specific internal contour³. Its essence of the production process lies in pouring molten metal into a special casting mould, in which the metal cures in a piece with particular shape (**Fig. 4:1-2**). The metalwork thus obtained is called casting. The casting process involves several steps - metal melting, moulding and curing. Each of these steps is accompanied by series of physicochemical processes determining the quality of an article. The aesthetic characteristics of the cast metalwork depend both on the composition of the metal and on the quality of the mould.

Compared to the other methods, such as forging, welding, stamping and rolling, casting makes it possible to obtain a work piece with a complex shape and good mechanical properties⁴. The capabilities of the method, both in terms of size, weight and work piece complexity, are practically unlimited. The weight of a cast object can range from a few grams to hundreds of tons. The shape complexity may be such that producing the work piece by use of other methods may turn to be difficult and, in some cases, even practically impossible.

The production of castings by use of moulds, such as „cire perdue“ or „lost-wax“ casting, is among the oldest production methods at all (**Fig. 5**). The „lost wax“ casting method was the most popular bronze casting technique in the Antiquity, which was practiced in the Ancient East since the 4th millennium BC⁵. The use of wax to make casting models occurred in several places simultaneously. While the earliest evidence of this method originates from the Middle East, near the Tigris and Euphrates rivers, the process was also known in quite distant places that did not communicate with these regions. Such artefacts were found in Israel (4000-3500 BC) and China (2000-500 BC). The technique was very well-known to Egyptians as well (**Fig. 6**)⁶.

³ DZIDZEVA *et al.* 1981, p. 74-76; PENCHEVA *et al.*, p. 56; *Bulgarian Medieval Town. Technologies* 1997, p. 29-42.

⁴ FLEROV 1968, p. 111; MURAVIOV 1984, p. 99.

⁵ SIAS 2005, p. 2-3; BONAGIES 1994, p. 75-84.

⁶ LUKAS 1958, p. 348.

The use of wax casting is the simplest way to produce quality castings and to obtain articles of complex shape that are impossible to cast in any other way. For the medieval jewelers, it was one of the key methods to produce models and high-quality products⁷ (Fig. 7). In this method, the mould was in the form of a coating on an easy-melting model. The use of a wax model simplifies the molding process and improves the casting surface quality. Quite correctly, the researchers of casting history note that one could hardly find more suitable material for production of models throughout the ages than beeswax⁸. The wax allows the craftsman to work freely and the original design in the process of work, to correct his mistakes and gradually shape the object to a completely finished look. A number of decorative elements can be placed on the surface of the model, which subsequently serve as guidelines to the engravers when finishing the metal surface. This enables depiction of small objects of complex shape, with and great accuracy of detail and dimensions (Fig. 8). The traces of wax model processing are best seen on the reverse side of the metal castings as a series of traces resulting from the model smoothing and surface modelling⁹. In practice, however, only a small part of the products found in the metalworking complexes have a negative printout on the backside.

The „cire perdue” method with additional wax removal required a lot of effort, precision and time, so it was not among the lead methods used by the medieval masters of the time. Basically, this method was used primarily in the production of lead and bronze models. Most of the lead and bronze models, however, were cast into molding sands, which is evident from the flat and smooth back and the unclean sprues (Fig. 9:1-2).

A main practice among Bulgarian jewelers was use of durable models such as the models made of lead. They were the intermediate form between the original artistic concept made of wax and the final product cast from bronze. Lead models were first printed in double boxes with casting sand, and then the molten metal was poured into the negative printout. There are some appliques that were made directly from a wax model, but they are an exception rather than common practice. Their group is not that big and mostly comprises articles with elaborate ornamentation. They also demonstrate negative decoration on the back.

In practice, the craftsmen preferred the more efficient, economical and easy way to achieve the desired result. Their choice was largely determined by the volume and intensity of the production process. The production of a large number of identical objects requires the use of a faster and more effortless method that could ensure simultaneously quality and speed. Such method was the mold casting by using durable lead model, which turned into basic and preferred method in the jewelry manufacture centers around Preslav.

This method was known as sand-casting and written 6th century Chinese sources show that it was used in the cast coins production¹⁰. The archaeological evidence for „sand casting” practice are scarce, but this does not prevent its

⁷ CHERY 1992, p. 30; SELIMHANOV 1970, p. 76; SZENTHE 2013, p. 2-6.

⁸ VASILEV 1988, p. 22; HODGES 1989, p. 69-72.

⁹ SHMONEVSKI 2006, p. 47-49; MINASJAN & SHABLAVIDA 2016, p. 105-111.

¹⁰ SZENTHE 2013, p. 1.

widespread use throughout the historical ages. One reason for the lack of visible remains is that the sand passes through several procedures such as sieving, drying and subsequent use, where it is lost, replaced or just enters the soil, leaving practically no visible traces. Single evidence from the middle Ages was recorded during the studies of a 9th century workshop in Mikulčice, Moravia, where three types of sands were found in one of the workshops corners¹¹.

The most reliable source proving the method application are the finished articles and waste products found. The major evidence are the casting metal fins formed along the dividing line between the two halves of the sand forms, if it was still retained on the casting. This excess material has so far been seriously neglected, since it is generally accepted that fins are resulting from the use of two-parts moulds. However, there is a significant difference between the fins resulting from the use of stone moulds and sand casting. One of them is the width of fins. The fins resulting from the use of stone moldings are thicker, whereas the fins resulting from the use of sand molds placed in metal boxes/frames filled with sand are thinner. Recently, some Russian researchers even concluded that stone moulds were used primarily for casting of easily molten alloys such as lead¹². The continuous casting of bronze objects, and of copper alloys in general, featuring high melting temperature (above 1100° C) in stone moulds, results in rapid wear and subsequent destruction of moulds.

Medieval craftsmen used all methods mentioned above, and the selection of a particular method depended to a large extent on their skills and the type and quality of the manufactured articles. The more efficient and secure method of „sand casting” was preferred for mass production, as was the case with the workshops around Preslav. The casting process was as follows (**Fig. 10**)¹³: by using the model, a casting mould was prepared of sand by means of various molding tools. The molten metal was then poured into the mould to fill it. Then the mould was left to cool down, which resulted in casting of the desired shape. That was the way of casting not only bronze articles but also articles of other metals. Once the model of a product was created by the „cire perdue” method, the serial production of articles started in metal box filled with casting sands (**Fig. 11**). According to K. Kluge, the artist's model was just a preliminary work that did not directly affect the metalwork itself, but solely the casting shape¹⁴.

In practice, models were prepared by using:

- an existing finished product;
- a model made of easily molten alloy, most of all lead;
- a model made of copper alloy (mainly bronze).

Metal models, compared to those made of wax, had a number of advantages: they do not break apart, preserved their shape, had a clean surface and considerable durability. The lead models were widely spread due to the low melting point of the lead and the lack of necessity to completely isolate oxygen from the process. The finished lead model was carefully inspected and retouched,

¹¹ POLACHEK 2008, p. 8-9.

¹² MURASHEVA 2000, p. 8-14.

¹³ BREPOL 1982, p. 106.

¹⁴ VASILEV 1988, p. 22; MAGNICKY & PIRAJNEN 1996, p. 78.

where necessary. The soft base allowed for making some improvements, such as deepening the engraved sections, sharpening of contours, and smoothing of the transitional sections. After these procedures, the lead model was ready to perform its primary role - printing of a negative image in the molding sand (Fig. 9:1). Metal models ensured long-lasting preservation of the original artwork embodied in them. The good surface treatment also preserved its quality after extensive use. In the molding process the sand did not adhere to the surface of the model. The models were easily taken out of the mould, leaving a clean and sharp printout. When using a finished product as a model, copying was done mechanically.

Used artifacts were also frequently used as model¹⁵. In many cases, the casting took place without the use of intermediate shapes and models, which is evident from the size of the castings and the quality of their ornaments. The surface is smooth, and sometimes the fastening pins are also visible. Such a multi-stage and sophisticated system allows for the production of extremely high quality castings¹⁶.

As for the semantics of the depicted motifs, there are plenty of observations made so far. It can only be mentioned that the decoration of the belt sets are based on the most common themes used in the East during the Middle Ages. They include interpretations of fruit and petal motifs as symbols of the tree of life and the universal life circle. Compositions are built of repetitive elements incorporated into a linear system of ornamentation in free and unrestrained pattern. Byzantium used to be the main source, which brought Eastern traditions to the Bulgarian art. Byzantium itself was influenced by the art of the East in various periods of its development¹⁷.

Constantinople, being the center of artistic crafts, helped spreading of the artistic practices, models and specific ornamental motifs far beyond the boundaries of the Roman Empire. Some of them found expression in the objects of small metal art, among which are the belt sets - popular and widely spread in Bulgaria during the 10th -11th centuries. The presented lead models for mountings complement and enrich the big group of such articles and prove the presence of organized and intensive belt sets manufacturing activity during that period.

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¹⁵ JANSON 1985, p. 90-91; ENIOSOVA 2001, p. 83-92.

¹⁶ MURASHEVA 1999, p. 25-34; LAMAN 1989.

¹⁷ GRABAR 1951; BANK 1988, p. 262-271.

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Fig. 1 - Lead models found in the center of metal art in Novosel, Shumen district. 10th century.



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Fig. 2. Lead models found in the center of metal art in Zlatar, Preslav district.
10th century.



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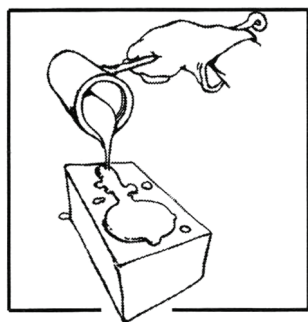
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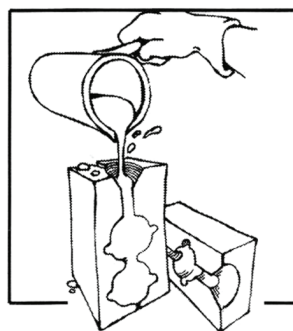
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Fig. 3 - Lead models found in the center of metal art in Nadarevo, Preslav district. 10th century.



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Fig. 4 - 1. Casting in a one-sided mould. A reconstruction (after *Bulgarian Medieval Town. Technologies* 1997); 2. Casting in a two-sided mould. A reconstruction (after *Bulgarian Medieval Town. Technologies* 1997).



Fig. 5 - Bronze casting in Ancient Egypt (1450 BC) (after LUKAS 1958).



Fig. 6 - A fragment of the bas-relief from the tomb of Memeruk, Egypt, 2300 BC (after LAMAN 1989).



Fig. 7 - Adam and Eve in metalworking workshop. Detail of an ivory casket. The end of the 10th - the beginning of the 11th century (The Cleveland Museum of Art).

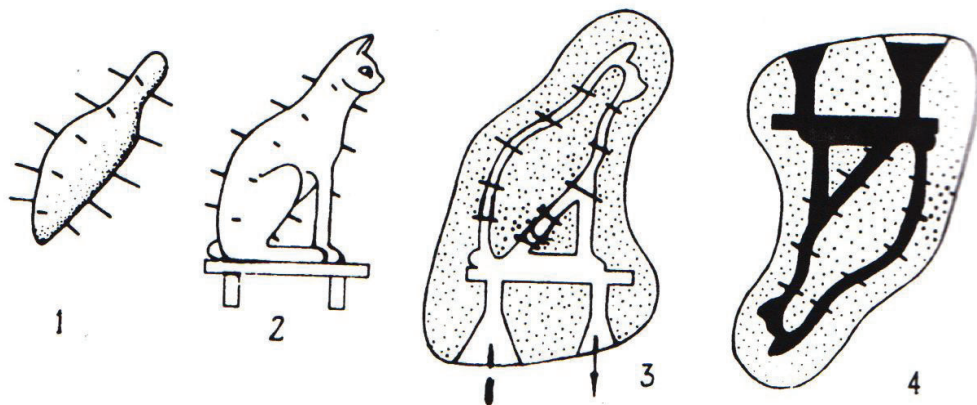
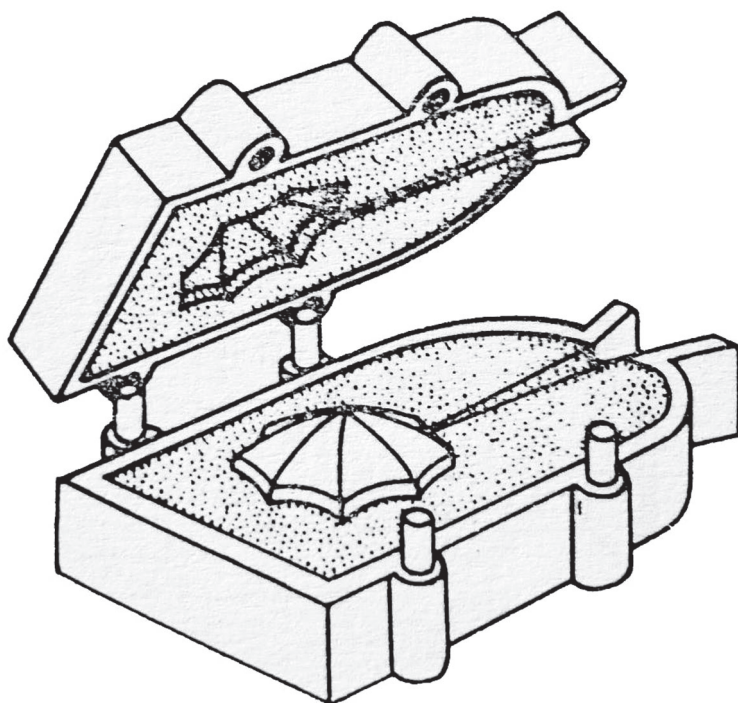
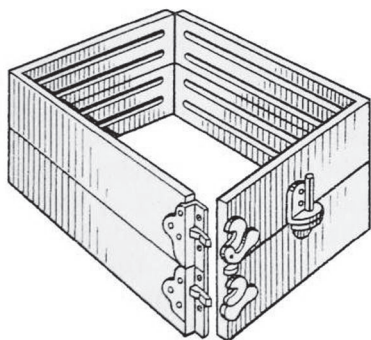


Fig. 8 - Lost wax casting. 1 – clay core with protruding chaplets; 2 – over this the wax figure is modelled; 3 – this is invested with clay and then heated to remove the wax and fired; 4 – bronze is cast into the space occupied originally by the wax; headers and chapels are later removed (after HODGES 1989).

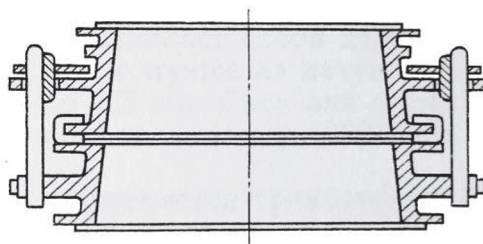


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Fig. 9 - 1. Halves of a molding box with a model (after BREPOL 1982);
2. Composite hinge molding box (after BREPOL 1982).

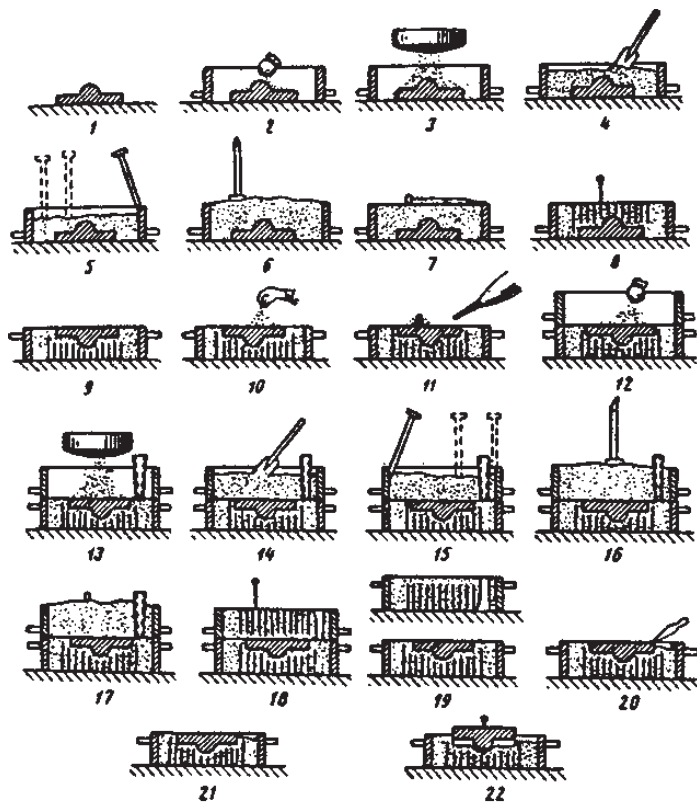


Fig. 10 - Stages of the hand molding (after MAGNICKY 1996).

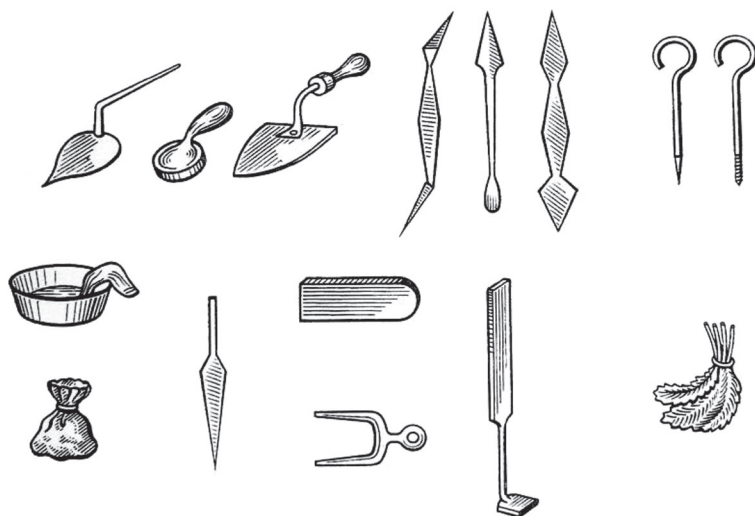


Fig. 11 - Molding tools (after BREPOL 1982).