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Art metal production in early medieval Bulgaria (according to the findings)

ABSTRACT

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The dissertation consists of an Introduction, Two parts with a total of seven chapters, Conclusion, References, List of abbreviations, three Appendices, including illustrative material in the text; the tables and graphs from the typological and elemental analysis of the finds. Total - 548 pages of text and 365 pages of appliquess.

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Production culture is a multi-layered phenomenon related to the provision of the basic needs of society. The key role is played by the degree of development of the technological process, the knowledge and skills of the masters. Archaeological science deals mainly with the final product of the metallurgical process - with what is produced. Acording to characteristic of the socio-economic status of the community it is necessary to answer the question - how it is produced. The comparative analysis of a production makes it possible to ask the question about the model of technological development. The construction and research of models contributes to obtaining the best idea of the studied process or phenomenon. The model of technological development is the set of three interconnected components - the technical-technological stereotype, the production traditions and the influences from other cultures. Technological stereotype includes a certain set and ratio of the features, characterizing the material, composition and methods for the preparation of the products in the specific archeological culture. Its establishment and transmission from generation to generation over a long period of time has been at the heart of production.

Against the background of production traditions, there is an opportunity to trace the external cultural interactions, manifested in various forms. An example of a model of technological development in early medieval Bulgaria are the production centers for metal art, which functioned in the first half of the 10th century in the vicinity of Preslav. Each region of metalworking has a complex structure in which the individual production areas are often far apart. They function according to the developed system of exchange with the various metallurgical fields, where the connection between them is determined not so much by economic compliance as by the degree of culture and traditions. The regularly located complexes of workshops show the presence of proximity in the location of the individual production areas, which is influenced by the cultural development of the early medieval Bulgarian community and the synchronous time of functioning. Metalworking has considerable autonomy and this is especially evident in the various stages of the technological process. Its distinctiveness is expressed in the specialization of the blacksmith's trade, the special social and public status of the masters, the nature of

the productive and trade relations, etc. The production of artistic metal is characterized by its own traditions and its own path of development, reflected in the history of alloys, production technology, the typology of metal inventory and the system of concepts. Local traditions are refracted through the prism of general practice in the development of production. Often these are established principles in technology and the individual stages in it, which retain their stability over time and reach both the Middle Ages and the New Age, with minor changes as a result of technical progress.

In the Middle Ages, the artist was not accepted in the modern sense of a man creating a work of art, for which objects of artistic observation serve. During this era, art was not separated from the craft - the term artifex (artist, master) in the Middle Ages, denotes a person with a practical specialty. Thomas Aquinas, citing examples from the artist's practice, often uses this term to mean an artist or an architect, a blacksmith or a knife maker. His theory of creativity applies to both the artist and the craftsman of any profession. The creation of an object is the appliques of the finished form to matter. This also applies to handicraft production. The eminent scientist and theologian Hugo Saint-Victor wrote in the holy book The Teacher (Didascalicon): "Knowledge can be called art when it comes to objects that take shape in matter by processing this matter" (II , 1, 752 C)… "The art of making tools" comes from the material given. The material (materia) can be stone, wood, metal, sand, clay. Two types of art belong to the making of cannons (objects): construction and blacksmithing… The work of a blacksmith is divided into hammering, where the certain form (forma) is given initial matter (massa) by hammer blows, and casting, where the shape is given by melting '.

Certain personality traits, namely her knowledge (skills) turn out to be common to the whole group, for example to the master and his students. That is why the products of not only one master, but also of the whole team - the workshop are unique and differ from similar products, which came out of another workshop. At the same time objects created in the Middle Ages are very similar to each other, unlike those of modern times. Recipes are built according to the scheme: "if you want to know the nature of something, take it and do it. Medieval knowledge is knowledge of the skill. For medieval man,

the micro and macrocosm are similar perceptions. Man is identical with the world, but the world repeats in each of its components. The medieval man transfers the ideas about himself to everything around him, including the objects he creates. The diverse production of the studios for artistic metal, near the Bulgarian capital, is a vivid example of the interaction between the artist and his creation, found expression in the works of metal-plastic art. Therefore, the in-depth study of the production of artistic metal has its significance not only for the history of the development of the jewelry craft and its works in a given community but also for the imprint of the unique individuality of their creator on them.

The subject of research is the rich collection of belt sets, received from the archaeological excavations of the three centres for the production of metal art from the early Bulgarian Middle Ages near Preslav - near Novosel, Zlatar and Nadarevo. The finds of belt sets in the three centres are the most numerous and mass-produced products, the number of which so far exceeds 3000. Along with them, the finds from the production centres received in the museum collections before the excavations were examined. This applies primarily to the third production centre near Nadarevo, Targovishte region.

The study aims to investigate the production of artistic metal in early medieval Bulgaria on the basis of the numerous production of belt sets, collected as a result of 20 years of research of the first known specialized centres for metal plastics. As a result of archaeological excavations from 2004 to 2009, the first centre was studied - the one near Novosel, Shumen region. From 2007 to the present, the second production centre near Zlatar, Preslav region, is being studied with a short break. The centre near Nadarevo, Targovishte region was partially explored in the 1990s within one season. The number of finds in the National Museum in Sofia and the museum collections from all over Northeastern Bulgaria prove the existence of large-scale and organized production, in parallel with that of the other two complexes.

The aim of the research is also to present the typesetting belt as a single and strictly organized composition, composed of separate and

morphologically, technologically and stylistically related details (buckles, tips, appliquess) - elements of the decorated leather strap. A large number of items are a good basis in this regard. Added to this are the numerous finds from studies outside the country, found in synchronous cultures and proving the role of the decorated belt in the medieval costume at that time. Presented in connection with the other accessories to the belt set, as well as in view of the stylistic features of the constituent elements on it, the set belt marks an ethnocultural accessory. The dynamics of the Eurasian fashion of the decorated belt illustrates the gradual change of one compositional scheme with another, influenced by the traditions of the particular community and the popularity of the composite belt.

The set goals are related to solving the following **tasks**:

1. To present in a comparative plan the wide range of belt details found at the place of their production. To develop a general compositional scheme, uniting the species diversity of products, subordinated to the functional division between them, depending on the position in the belt set - buckles, belt tips, appliquess.

2. To make an attempt to reconstruct the belt set of finds from the production centres, subordinated to the ornamental style and parallels of dating sites in the country and abroad. To indicate and substantiate the possible variants within each reconstructive order and to illustrate graphically and on a scale their form.

3. To analyze the most important studies of the elemental composition of selected samples from the findings of the three production centres, the so-called PIXE-method conducted in the laboratory of the Institute for Nuclear Research Atomki, Debrecen, Hungary. To consider the specific features of metals and alloys that are part of them. The results should be presented in tabular and graphical form and the main highlights in them should be highlighted.

4. To establish the origin and the way of the raw material to the production centres on the basis of a comparative analysis of the results of the research of the elemental composition in ore sources and finds from the workshops. To present the historical and archaeological data on the existence of raw materials and their metallurgical development, based on the information about the largest and longest existing region

for copper ore mining, which is the Burgas-Strandzha region - a major source of the metal from prehistory to modern times. time for the region.

5. To present the whole set of jewelry tools found in the production of artistic metal, clarifying its practical appliques with an analysis of the technical parameters that each group of tools carries and similar examples with similar objects from related cultures. To look for parallels among the modern set of jewelry and forging tools and to analyze their use.

6. To study the technology and the individual stages in the production of artistic metal according to data from the most numerous group of finds, such as the belt details, which make up 80% of the total items of the production centres. The individual practices should be considered in the context of the development of the jewelry craft over time and to provide source data representing its diversity.

7. To present a rich pictorial material, illustrating the main generalizations on the topic and presenting the typological diversity of the findings; including images of similar objects from synchronous cultures; reconstructions of belt sets according to data from studied archaeological sites; tables and graphs with results from the elemental analysis of individual and groups of products from the three production centres.

The chronological scope of the topic is the first half and the middle of the 10th century, the time of the most massive and organized production of artistic metal in early medieval Bulgaria. **The territorial scope** of the study includes the regions of the production centres: Novosel - two complexes of 80 and 60 decares - a total of 140 decares; Zlatar - one complex - 40 decares; Nadarevo - two complexes of 70 and 60 decares - a total of 130 decares.

Sources of information are the findings from the production centres, similar objects found in synchronous archaeological sites in Bulgaria and abroad, source data on metallurgical production in the Middle Ages and the technology of artistic metal; source data on the composition of metal products in antiquity and the Middle Ages;

physical and chemical properties of metals and alloys; technical and functional characteristics of the jewelry tools.

The interdisciplinary nature of the research includes methodology from different disciplines - archaeology, history, chemistry, physics, metallurgy, microscopic and trasological observations. One of the main methods in the research is the typological one, which offers a complex summary of the numerous and diverse products on the basis of the stylistic analysis and the quantitative principle. The relationship between the development of production, the toolset and the objects made with it is accepted as a theoretical basis. To the extent that each production has a social character, the given products reflect on the one hand - the level of development of production and on the other - the degree of development of society itself. In accordance with this, the study of the works of jewelry production by the centres for metal art, reflect the laws in the history of social development. Following this principle in the course of the exhibition, except by place of origin, type (buckles, tips and appliquess) and quantity of finds, the products are grouped by shape, ornamentation and material. The typology is based on the form, as well as the material and production technology, ie. the system is a type-technological combination.

The constructive-morphological approach makes it possible to include the given category in the general classification and to determine the degree of connection between the separate information and the general space, which includes closer or more distant similarities and analogies. The term "type" in the exposition is used not so much as a taxonomic unit reflecting a certain feature of the object, but also as a general concept serving to denote the totality of objects having the same set of all morphological features.

The typological method is combined with the cultural-historical method, which traces the changes and the development in the composition of the belt set against the background of the changes of this type of products in the synchronous cultures. The methods of logic are also used - mainly the inductive and deductive approach. *The inductive method* consists in the observation and analysis of trends and recurring elements in the composition of the belt set based on data

from the findings of production centres. The conclusion is drawn about the widespread use and popularity of the decorated belt in Bulgarian early medieval society. *The deductive method* is based on the analysis of the general Eurasian fashion of the decorated belt at that time and its lasting manifestation in the Bulgarian environment through the mass production of belt details for belt sets, as a concrete logical conclusion. The deductive method tests theories about the role of the belt set in the cultural environment of each community, where this element of the medieval costume is used. The wide distribution of the decorated belt among the Bulgarian society proves a large part of the stated theories.

Particular importance has *the technical-morphological method,* which finds expression in the clarification of the functional purpose not only of the variety of belt details but also among the group of jewelry tools. Against the background of the reconstructive model of presentation of the whole exhibition, the comparative analysis is applied, especially indicative of the physicochemical characteristics of the metals, the results of the elemental composition of the finds, the graphic reconstructions of belt sets and the functional-semantic characteristics of similar objects from synchronous cultures.

Structure of the study

The dissertation consists of an introduction, presenting the relevance of the topic, goals and objectives; the chronological and territorial scope; sources of information; the methodology of analysis. Followed by Two parts with a total of seven chapters, Conclusion, References, List of abbreviations, three Appendices, including illustrative material in the text; the tables and graphs from the typological and elemental analysis of the finds. Total - 548 pages of text and 365 pages of appliquess.

PART I
PRODUCTION OF THE METAL ART CENTERS IN THE PRESLAV REGION
Chapter 1. METAL PLASTIC PRODUCTS. BELT SETS

The results of the research of the production from the three centres for metal are a good basis, presenting the rich variety of forms and ornamentation on the works of metal-plastic art. Preference among the range of products is given to the belt sets in their three main varieties - buckles, belt tips and appliquess, which make up nearly 80% of the total production in all production areas. The number of appliquess among them is the largest, which is a consequence of their widespread use. The number of appliquess needed to make a belt set is 30, and somewhere over 50, i.e. the making of belt gaskets is above all the making of appliquess. The remaining 20%, including some types of jewelry, single and double-crosses encolpions, hanging seals, etc., are accompanying the main production, influenced by fashion trends at the time. A large part of the production went to the markets, another - for the execution of individual orders and the production of single models and products that satisfy the taste of the guarantors. The products from this group, no matter how diverse they were, were not a priority for the jewelers.

Therefore, the purposeful study of belt sets makes it possible to present the whole variety of metal-plastic products, the work of the production activity of the production centres in the X century. All other products accompany the main activity and play a secondary role in relation to the predominant group of belt ornaments. The variety of species, the individual metals and alloys, the raw materials and the blanks, the technology and the practice - all this long and complicated way of the product, is successfully illustrated by the production of belt details. Therefore, the sets are considered in terms of their use and location. The beginning is by buckles, followed by the belt tips and finally is the large group of appliquess. Defining in the work is the striving for a relatively complete presentation of the products from each production centre in view of their type, location and analogies from early medieval settlements, fortresses and necropolises in the country and abroad. Where reliable notices are missing, they are not

specified. It is a fact, for example, that the information concerning the centre for artistic metal near the village of Nadarevo, Targovishte region is not complete. Given the planned resumption of research at this site and the hope for the timely publication of the Nadarevo collections stored in the National Historical Museum in Sofia and other museums in the country, I hope this gap will be overcome soon.

The picture offered by the two studied centres for metal plastics near Novosel, Shumen and Zlatar, Preslav region is relatively complete, which defines it as a reliable source of information and is the main basis for the comparative characteristics of the finds. The systematic archaeological excavations carried out in the last decades - near Novosel and Zlatar provide enough material and a reliable reference point for outlining the general trends in the production of metal art during this period. Hundreds of finds have been received from the two centres so far, and the majority of them are belt ornaments.

The present paper considers ornaments within the typological method. This method combines such aspects of objects as function, shape, decor, material and technology. In all sciences, including archaeology, the problem of description is solved within the typology. Depending on the degree of transfer of one or another feature, objects can be arranged in one or more typological rows, at the beginning of which the defining feature has a functional or decorative meaning, and then changes or disappears. Therefore, all objects are united by a type that includes several or more types. Each individual type is a separate unit of the general typological order in each type, included in one of the three main groups of belt details - buckles, belt tips and appliquess. The name "variant" is used only in relation to the shape and the related functional purpose, which divides the appliquess into three variants - "narrow", "wide" and "slotted".

The different material of the products made of precious metals is marked with its Latin name - Ag (silver), Au (gold). The total dimensions of the products (length / width / thickness) for each type are indicated separately. Photo and graphic view illustrates their appearance. All information is presented in tabular form, accompanied by figures and diagrams, organized according to the mentioned features.

The tables are divided into main: (Table I) - buckles, (Table II) - belt tips, (Table III) - appliquess; auxiliary: (Table I. 1-5) - buckles; (Table II. 1-5) - belt tips; (Table III. 1-5) - appliquess; in some of them the quantitative characteristics are summarized (Table I. 1-3), (Table II. 1-3), (Table III. 1-3), in another - the typology (Table I. 4-5), (Table II. 4-5), (Table III. 4-5). The main tables indicate the dimensions, image, inventory number and place of origin; the latter, together with the quantitative indicator, and the three main variants of the form are marked with a different colour.

The functional purpose of the products is also noted; the models (lead and bronze) are distinguished from the finished product by the letter "M". In general, the features on which the finds are presented follow the established practice in the description of such type of items, in accordance with their specific features. The graphic view is expressed in a series of diagrams and schemes, organized according to the functional division of the finds - (Fig. I.1. 1-4), (Fig. I.2. 1-4) - buckles; (Fig. II.1.1-3), (Fig. II. 2.1-2), (Fig. II. 3.1-2) - belt tips; (Fig. III. 1.1-22), (Fig. III. 2.1-22), (Fig. III. 3.1-22), (Fig. III. 4.1-22), (Fig. III. 5.1-22) - appliquess. The aim is to present the variety of belt sets in a more readable version, so it is important to mention at the outset: the present work goes far beyond the claims of a strictly established classification known from numerous attempts at such. Therefore, the individual types of products and their constituent types are not placed within narrow limits. Instead, it is based on a flexible and mobile system that aims to cover the entire variety of products. The system is open, in the process of development, which is yet to be expanded and supplemented with new findings, not only from the research of the centres for metal art but also from all known and newly discovered sites from the early Bulgarian Middle Ages and those that yet to be discovered.

§ Belt gaskets from production centers

Buckles

According to the location of details of the belt, in the beginning, are buckles. In spite of conservative forms in this period - mainly openwork and with thick tiles for attachment to the belt, the findings

from the production centres mark an enviable variety. Buckles are a total of three types:

- *A - solid tile*
- *B - openwork large*
- *C - openwork small*

The buckles produced in the centres for an artistic metal show an enviable variety of shapes and decorations. The results confirm the widespread of the two main types of buckles - openwork and buckles with a fixed plate with a round hole for the tongue, as the number of the latter is very slightly higher than that of openwork. The buckles of both types form a total of 15 different types. The individual approach in the reproduction of the forms is manifested mainly in their combination (the shape of the frames, the proportions of the tile and the type of the supporting frame in the heels with a solid frame, the decoration of the tile with different motifs; the shape of the two frames and etc.). The choice depended on the main and leading pictorial motif on the other details of the set - the appliquess and the belt tips, with which the buckles form a unified decorative system.

Belt tips

An important element of the belt is belt tips, which offer twice as many varieties as the buckles. The shape of all is similar - straight base or "swallow's tail", with a pointed or rounded tip. The fastening is mainly with spikes and less often with rivets on the reverse side. The differences are mainly expressed in the decoration on the front surface. In relation to it, the belt tips form four types:

- *A - smooth surface*
- *B - embossed decoration*
- *C - incised decoration*
- *D – openwork*

The belt tips differ in size - they are elongated and shortened; in the shape of the base at the upper end - type "swallow's tail", with a bud in the middle or with a straight base. A comparative examination of the different types of belt tips presents the smooth tongue-shaped objects as the most common. After them in number and importance are the elongated shapes - "swallow's tail" at the base and decoration of attached palmette along the length. In the relief decoration, the

motif is more realistic and approaches the plant form; in the incised decoration, the composition is more generalized and stylized, which leads to the gradual disintegration of the constituent elements - palmettes, volutes, twigs and etc. The buckles and belt tips from the three production centres are evidence of the variety of shapes and decorations, expressed in the different types. They are the result of both the wide pictorial program, saturated with combinations of established elements and compositions and its skilful reproduction in the workshops. The presence of a specific manner in depicting the rich ornamental style in each production centre is noticeable not only among the buckles and belt tips but also among the appliquess - the largest and most diverse group, both among the belt sets and other products.

Appliquess

The appliquess are made mainly of copper alloy (bronze). Articles cast in silver alloy have been found, but their number is insignificant against the background of hundreds of bronze castings. Along with them, the group of lead models is no less important. Therefore, in the text, both varieties are presented in parallel. The variety of shapes, sizes and especially ornamentation is the basis for the division of appliquess into several main subgroups. Leading in their presentation are the form and decoration, in accordance with the criteria imposed in the scientific literature. In addition, some new principles have been introduced in the analysis and interpretation of the products, which are the basis for the proposed reconstructions of belt sets in the present work. Among them are the two types of appliquess - narrow and wide and the addition of the third one - with a slot at the base, which has a practical appliques and serves to hang various accessories to the main strap.

All appliquess are presented in six large groups according to their shape and decoration. They are shield-shaped, heart-shaped, leaf-shaped, openwork, with geometric and zoomorphic shape. Each of the groups includes different variants of the basic decorative scheme, starting with the simplest variant and ending with the most complicated scheme. At the same time, there is a division in each

main group of appliquess, according to the two main varieties - narrow and wide.

The statement is far from the claims for classification and a strictly established scheme mentioned at the beginning. Many of the objects belong to more than one main group and this proves their diversity and rich ornamentation. In such cases, the most characteristic element is selected, which determines the type of product and places it in the appropriate group. For example, some of the appliquess could be assigned to both the group of heart-shaped and the group of leaf-shaped appliquess and in some cases to the group of shield-shaped appliquess. Determining is first the shape, followed by the decoration - with or without a fold at the base - heart-shaped; flat rounded at the top - leaf-shaped; the shape resembles a shield - shield-shaped; there are cutouts - openwork, etc. There are also appliquess with geometric and zoomorphic shapes.

There are a total of 6 types of appliquess:
- *A – Shield-shaped*
- *C - Heart-shaped*
- *C - Leafy*
- *D - Openwork*
- *E - Geometric*
- *F - Zoomorphic*

According decoration technique they are:
- *smooth surface;*
- *embossed decoration;*
- *incised decoration.*

In most cases, both decoration techniques are observed on one object - embossed and incised, which is mentioned in the text. The nature of the decoration and the details of the form require the division of each type of appliques into separate types. Each species includes a different number of types, reflecting the diversity in each production centre.

In the summary of the numerous material, the endless division of types, types of subtypes, subtypes of variants and etc., are deliberately

avoided, which can only create confusion and would not contribute to greater clarity. It is unnecessary to burden the text with terminology inherent in the numerous classifications and typologies, which in practice are difficult to use and confusing, and in some cases mutually exclusive. Orientation with them is difficult and is further complicated by the subjective opinion of their author.

Each serial number in the comparative table in the present work there is a separate and different from the other new subject, therefore the name type is used. The types are presented in two main variants (narrow and wide), very often cast together and united by their similar shape and ornamentation. Hole appliquess are the third option, which is not found in all types. Many of these appliquess are combined with more than one type, which necessitates their more limited variety.

The combination is based not only on the similarity in shape and decoration but also in the colour of the metal. Practice shows that all three varieties are cast simultaneously in the same foundry, which implies the same elemental composition of the alloy, and hence the similar colour shade of the finished products. In the main table, where all species and types are presented, this third variant is indicated separately. Determining was first the shape of the products, their size and finally the ornamentation. All these indicators find concrete expression in the numerous products of the production complexes and the variety of combinations of shapes and decorations.

It does not take into account the type and number of attachment pins applied to the reverse side of the appliquess, mentioning only their number. In most cases, the fasteners are completely broken or damaged, especially in the case of discarded products, which makes them an insufficiently reliable reference point in the comparative examination of the individual groups. Observations show the lack of established order in their location, often depending on the size of the object and the manner of the master. Production defects are predominant among the finds, so most of the products have visible defects. This does not exclude the discarded production from the general work, which participates on an equal footing with all other products and convincingly testifies to intensive production activity.

The considered ***6 types of appliquess offer a total of 198 types,*** which include an abundance of shapes and decorations. Most of them

were found at the production centre near Zlatar, which is due to the diverse imaging program followed here. Some of the finds from Zlatar are produced only here and have no analogues outside this region. Characteristic and original forms are observed, some of which are mass-produced. The other types occur in only one or two of the complexes. Most individual forms originate from Zlatar - a total of 81 types, followed by Novosel - 30 types and Nadarevo - 4 types, i.e. a total of 115 products are found in only one of the production centres.

Among the specific finds for the centre in ***Zlatar,*** in the first place are the shield-shaped appliquess with 9 types out of 38. The most numerous is the group of large shield forms with a smooth face and five buds along the outline, followed by small forms with 6 relief buds. Specific for the Zlatar centre is an original composition, which presents a three-leafed palmette, inscribed between two pairs of "S" - shaped curls (type 20). Another is a shield shape with a teardrop-shaped medallion in the middle and four buds along the outline (type 10). Out of a total of 45 types of heart-shaped appliquess, 22 are found only in Zlatar. Leading among this numerous group are appliquess with a relief heart-shaped image in the middle and a belt of notches (type 4). They are followed by the appliquess with three-leafed palmettes and two buds at the base and top and the large heart-shaped forms with embossed five-leafed palmettes and leaves wrapped opposite. In addition to these groups of appliquess, specific for Zlatar are the heart-shaped appliquess, of which the most finds have been found. They are part of the mass production here. These are heart-shaped appliquess with five-leafed palmettes with horizontal middle leaves (type 18). Three-leafed palmette variant with a diamond-shaped middle leaf and buds at the base and top is also popular. Small and large heart-shaped appliquess are among the leading products in these workshops. Particularly characteristic is the heart-shaped items with two inscribed hearts, as well as the variety of incised decoration in the long series of types.

The largest number of appliquess found in Zlatar with a leaf shape - a total of 24 of all 58 types. Apart from the fact that this is the most numerous group of appliquess, there are also some specific shapes and decorations. The compositions of palmettes, volutes and

"twigs", composed in various and original combinations. Among them, there is a five-leafed palmette with leaves turned inwards to the base or to the central bud, the S-shaped volutes, emphasized by cutouts and embossed lines and buds, the "V" - shaped stylized three-leafed palmettes, the complex compositions of several three-leafed palmettes and volutes with fields of notches on the silver appliquess. A whole series of types from the comparative table are found only in Zlatar. They are represented by single copies and are probably not mass-produced.

Openwork appliquess are also among the main range of products in Zlatar. Out of a total of 22 types, 12 are registered only at this place. In practice, all types are presented with a small number of items, which also applies to the other two centres. There are also some preferred shapes, such as the round appliquess with a hole in the middle and a heart-shaped cut at the base, the appliquess with a heart-shaped cut in the middle. The finds from Zlatar, representing appliquess with a geometric shape, are similar. Out of a total of 32 types of appliquess, one third are registered only with Zlatar. The largest number of products are found from the round appliquess with an incised five-leaf rosette (star). Round appliquess with 6, 8 or multi-leaf rosettes, protruding beyond the outline, are also preferred. Rectangular appliquess with a cut at the base, two of the types of which are presented only in Zlatar, are mass-produced. It is worth mentioning the stylized version of 5 and 7-leaf palmettes (type 27, 28), among the finds of which are two silver appliquess with gilding. All three types of zoomorphic appliquess have been found in Zlatar.

The group of finds produced only in Novosel is not small. The number of appliquess found is presented in the final lines after each type. A total of 29 types of appliquess are the work of the workshops in Novosel. Compared to those of Zlatar, here the variety of shapes and decorations is not so great and the produced belt details are more uniform, but still, there are some distinctive features specific only to this place. One of them is the production of shield-form appliquess. A total of 9 of all 38 types are registered only at this place. Here are made the shield-shaped appliquess with a relief multi-leaf rosette in the middle, and incised trefoil below it and double "S" - apparently

curled volutes at the base. Most of the shield-shaped appliquess with parallel sides and plant decoration in various variants - rosettes, "palm tree", symmetrical compositions are made here. In addition, the reduced forms of appliquess with drop-shaped medallions and moving outlines of palmettes and volutes can be pointed out. The thyroid appliquess with an embossed medallion in the middle and decoration of a "twig" and six buds along the outline are mass-produced in this place.

The heart-shaped appliquess are not so well represented in **Novosel.** There are only three characteristic types - the appliquess with seven-leaf embossed palmettes; five-leaf palmette and curled volutes at the sides and appliquess with smooth faces and a bud at the base. The leaf-shaped appliquess, like the heart-shaped ones, are presented with 3 separate types, representing incised decoration of five-leafed and seven-leafed palmettes. Specific for the production here are several types that have single representatives of the other two centres. This is type 5 - leaf-shaped with three buds on the outline and a stylized version of a three-leafed palmette. There are few single types presented in Novosel and of the openwork appliquess. Out of a total of 22 types, only 5 are registered with finds from this centre. Specific and circulated are especially types 4 and 5, ie. openwork appliquess in the shape of three-leafed palmettes with one or three buds along the outline, of which 7 objects were found. Finally, the geometric appliquess, which in Novosel mark 10 separate types out of a total of 32. Particularly characteristic are the triangular or rather plant forms, representing a five-leafed attached palmette with horizontal lower leaves and a shamrock at the top in various variants, divided into 3 types with a total of 6 finds, one of which is silver. The reduced 8-leaf rosette is also preferred in the workshops of Novosel and is known only here.

The finds from the production centre in **Nadarevo** complete the overall picture of metal-plastic works with some new shapes and decorations. Although not many, they still exist and include a total of 4 types. The first two types represent shield-shaped appliquess.

Among the mass-produced in Nadarevo are the hinged appliquess with a shield medallion with a six-leaf rosette, the related heart-shaped cut at the base and an incised five-leaf palmette and a heart-shaped medallion and a smooth face (type 15). Specific for Nadarevo are the two types of heart-shaped appliquess of five-leaf embossed palmettes in an elongated and shortened version. Also preferred are the three types of heart-shaped appliquess with embossed three-leafed and five-leafed palmettes with two buds at the base and top and five-leafed palmettes and "S" -shaped curved lower leaves. The range of products also includes several complex compositions. Such represents the type 16 found only in Nadarevo - leaf-shaped with five-leafed embossed palmettes of thin and smoothly curved leaves on the outline and face. One of the numerous varieties of small plant forms with five-leaf palmette with gilding is characteristic only for Nadarevo. Openwork appliquess are not presented in Nadarevo, but geometric ones are found. The round appliquess with smooth faces, the shapes with 6 and 8-leaf rosettes are typical. Particular attention is paid to the casting of lunar appliquess with several buds on the outline, of which silver with gilding. Along with them, mass-produced rectangular appliquess with a hole at the base.

Most of the examples at Nadarevo show the existence of unified and relatively homogeneous rows of belt sets, and here the diversity that is observed in the workshops in Zlatar is missing. If the research at this place is continued, the recent picture may change slightly, but in general, the characteristic types of products are clearly distinguished at the moment. The intensive production activity at this place is subordinated to a strictly established and regulated assortment, consisting of uniform and simplified products. The finds from the centre near Nadarevo complement the variety of shapes and decorations, the work of organized production of artistic metal in the first half and middle of the X century in Medieval Bulgaria and contribute to the enrichment of the general idea of its large scale.

The overall picture is complemented by the significant number of appliquess that occur simultaneously at the **three production centres.** This includes a total of 31 types. Among them, the shield-shaped appliquess are 8 types; heart-shaped - 6 types; leaf-like - 6 types;

openwork - 2 types; geometric - 9 types. The most numerous are the representatives of the shield-shaped appliquess with a total of 90 finds. No less are the heart-shaped appliquess in their classic form - with a smooth face, a sharp tip and a pimple in the middle of the base. Total of 87 finds were found from the three production centres. The heart-shaped appliquess with three-leafed and five-leafed relief palmettes (types 17, 18) are mass-produced in all three centres - a total of 232 finds. Of the leaf-like appliquess, those with smooth faces and five pimples on the outline are popular. There are numerous appliquess with four buds along the outline and incised five-leafed palmettes and three-leafed palmettes with separated leaves. Openwork appliquess are best known for their heart-shaped shape with a cut in the middle. The most common types are of geometric appliquess. Round shapes with a five-leaf rosette (star) predominate, followed by round appliquess with 8 and 6-leaf rosettes.

In addition to the individual and general types of appliquess, 52 more types of production centres have been registered, which can be found in only **two of them**. These are Novosel-Zlatar, Novosel-Nadarevo, Zlatar-Novosel, Zlatar-Nadarevo. The Novosel-Zlatar ratio has the most common types - 22 types. In both places, characteristic types of leaf-like (11 types) and heart-shaped appliquess (5 types) predominate at the same time. Of the leaf-like appliquess, the most numerous are the appliquess with five buds along the outline and incised five-leafed palmettes with a diamond-shaped middle leaf ("twig") (type 44) and the appliquess with five-leafed incised palmettes, curled lower leaves and a separate trefoil leaf (type 52). Next are the leaf-like appliquess with a bud at the base and the shape of a three-leafed palmette, highlighted by incised pits (type 56) and those with four buds along the outline, a cut at the base and an incised decoration type "twig" (type 54).

Several types of heart-shaped appliquess predominate, among which the appliquess with embossed five-leaves palmettes, highlighted at the base and top with two leaves (type 8) and the appliquess with the embossed palmette with lower curled leaves to the base ("palmette tree") stand out. (type 24).

The ratio of Zlatar-Nadarevo products marks 20 common types. The leaf-shaped forms (8 types) are predominate, followed by the heart-shaped ones (7 types). Among the leaf-like appliquess, the five-leafed outlined palmette with leaves curled at the base and three separate leaves at the top ("palm tree") (type 37) and the next similar type representing leaf-shaped forms with three-leafed palmettes with incised leaves and medium-rhombic with embossed ornamentation predominate. From the heart-shaped appliquess at Zlatar-Nadarevo, the forms with smooth faces with one bud at the base and the top and the heart-shaped forms with two three-leafed palmettes wrapped to the base and a separate three-leafed palmette at the top, predominate. A specific form produced only in these two complexes represents type 34, of which 7 finds have been found; it is a three-leafed stylized embossed palmette, forming a heart-shaped medallion in the middle.

The Novosel-Nadarevo ratio has 10 general types of appliquess, among which the leading ones are the leaf-shaped ones (4 types), followed by two types of shield-shaped and heart-shaped ones. Among them stands out the stylized plant form of three-leafed palmettes with three buds on the outline (type 5). Popular in both centres is the leaf-shaped form with incised five-leafed palmette and a lanceolate middle leaf and curled lower and middle leaves ("palmette tree"). Typical heart-shaped appliquess are the forms with a bud at the base, a sharp tip and a five-shaped embossed palmette formed by dense fleshy leaves occupying the entire field of the object (type 9). Particularly characteristic is the heart-shaped form with five-leafed embossed palmettes of "S" -shaped lower leaves and a middle two-part leaf, of which 20 finds have been found.

All 198 types of appliquess can be divided into three main groups: types that occur only in one production centre (115 types); types that occur in two production centres (a total of 52 types); and types that occur simultaneously in all three production centres (31 types in total). The composition of all types includes a total of 1936 appliquess, among which the finds from the production centre at Zlatar occupy a predominant place - 1282 pieces, followed by the one at Novosel - 388 finds and Nadarevo - 266 finds.

Attention is also paid to the group of silverware - 17 pieces. Representatives of them are in all types of belt ornaments and their variety depends on the number of products in each group. There are 3 silver buckles, two of which originate from Zlatar and one from Nadarevo. The belt tips are presented with 1 silver tip found in Zlatar. Most are silver appliquess - a total of 14 products. Predominant among them is the geometric shapes originating from Novosel and Zlatar. After this, they are the leaf-shaped appliquess from Zlatar and Novosel. There are a total of 4 silver appliquess of heart-shaped form from in Zlatar and Nadarevo. The general picture of the silver objects found at the three production centres does not differ significantly from that of the bronze castings. That is why the silver products are presented against the background of the respective type and shape. Silver products involve the production of silver alloy belt sets, which have limited distribution. The belt sets made of precious metal are made to individual order and for a certain circle of people, mostly solvent enough to afford it. At that time, as will be discussed, the belt was desecrated and has long since lost its original significance in the rank of social hierarchy. It is only an indicator of the prosperity and financial capabilities of its guarantor.

§ Ornamentation and style

The plant ornamentation is predominant among the belt sets, and the individual approach in the reproduction of the forms is manifested mainly in their combination. Examples of this are the buckles, where synchrony is observed between the shape of the frames, the proportions of the tile and the type of the supporting frame (for buckles with a solid frame), the decoration of the tile; in the case of buckles with openwork frames - the shape of the two frames, the umbilical ornaments between them and along the outline of the frames, etc. Among the group of belt tips, the leading motif is the attached palmettes with leaves wrapped at the end, the most numerous being the tips with palmettes, located rhythmically along with the object, with stems touching in the middle and wrapped in a circle of leaves. The individual motifs are separated by trefoils with a diamond-shaped middle leaf. A variant of the composition is the attached palmettes with leaves wrapped in a circle, but without trefoils between

them. Elsewhere, the leaves form a five-leaf shaped palmette with symmetrically arranged motifs of the ornament, which do not touch each other and are separated by a teardrop shape. The main decorative motif in the complicated composition consists of rhythmically repeating round medallions, composed of two three-leafed palmettes with curled leaves and a three-leafed palm in the middle. A variant has been developed, representing seven-leafed palmettes with a lanceolate middle leaf and curled symmetrically to the stem of the leaf, as the lower leaves of the palmettes under the base pass and merge with it. The composition of the belt lugs with incised decoration of thin twigs can also be considered as a ten-leafed palmette composed of two pairs of leaves.

The diverse combination of individual elements on the tips shows the presence of a realistic and close to the plant form drawing. In the case of products with incised decoration, the composition is generalized and stylized and gradually disintegrates into its constituent elements - palmettes, semi-palmettes, volutes, twigs, leaves. This principle of modelling is leading to appliquess. Among the shield-shaped forms at the head are those with a flat surface and a heart-shaped medallion, highlighted by an embossed frame. Developments from curved volutes to a small heart-shaped medallion and five-leafed palmettes with a different shape of the base are observed. A developed variant of the type is represented by the appliquess with a teardrop-shaped medallion and four leaves along the outline. An original solution is the appliquess with embossed rosette and incised three-leafed palmettes with “S” -shaped curved leaves.

The most common among the heart-shaped appliquess are the classic shapes with a smooth face, a pimple at the base and a sharp tip, presented simultaneously in the three production centres with a sufficient number of products. Embossed three-leaf palmettes and five-leaf palmettes with trefoils at the base and top are popular. Shapes with a heart-shaped inscribed medallion are observed. The ornamentation of two three-leaf palmettes combined with a three-leaf clover is exquisite. The varied representation of the palmette motif - with three, five, seven leaves, which are curled to the base, the top or are horizontal or "S" -shaped, divided or whole at the end, reflects the

aesthetic sense of the masters who made the basic models on which metal products are cast. There are many examples where the palmette is presented as a single composition resembling the tree of life or composed of individual elements united in a heart-shaped frame. In some cases, the ornamentation, consisting of incised lines and arches, emphasizes the volume of the plant motif and so the whole form dissolves in it. The stylization of the images leads to the disintegration of the main compositions, where the motifs are transmitted only with their main elements or changed beyond recognition and go beyond their classical form.

The greatest attention in the composition of the leaf-like appliquess is paid to the shapes with buds along the outline and incised decoration of five-leaf shaped palmettes with outlined leaves. An interesting variant offers the seven-leafed palmette with five buds along with the outline ("palmette tree") or the "twig" variant with a different arrangement of the individual elements - curved to the base, directed to the top, "S" -shaped, horizontally applied, double underlined, etc.

The development of the type from three-leafed to five-leafed palmettes is traced in the small leaf-shaped forms, where the unifying element is the diamond-shaped central leaf at the top. Some rarer compositional schemes have also been developed, such as the one with grape ornaments and the relief image of a nine-leafed palmette. An interesting combination is offered by the lead models, depicting a central motif of five-leafed palmettes, surrounded by "S" -shaped curls and a seven-leafed palmette, formed by two symmetrically arranged half-palmettes. A complex combination of plant ornamentation is offered by several types of embossed leaf appliquess, in which the palmettes are combined with volutes or attached and end with a three-leaf ornament. The plant form of the five-leafed and many-leafed palmettes is expressed in the external outline of quite a few products, such as the smaller forms. Their popularity is also due to the fact that some of them have been gilded. In any types, there is a combination of embossed and incised decoration. Somewhere there is a stylization and disintegration of the individual elements of the palmette motif or a highly stylized version of the plant ornamentation.

The openwork appliquess present rich ornamentation. Among the more pronounced motifs are those with five-leafed palmettes and a heart-shaped cut at the base or with openwork middle leaves, as well as the complex shapes with three three-leafed palmettes around a central bud. The appliquess with attached five-leaf palmette with openwork leaves and buds in the folds, as well as those with lower leaves and a trefoil at the top, are harmoniously composed. The products with five-leafed palmettes with a heart-shaped cut at the base, with openwork lower leaves, with openwork middle leaves predominate. Heart-shaped appliquess with a smooth or ornamented surface and a heart-shaped cut in the middle are widespread. The original solutions offer a combination of more than one palmette motif on one object, a diamond-shaped geometric composition with curved sides and an inscribed cross, a teardrop-shaped outline and radial notches.

The main pictorial motif in geometric appliquess is the rosette with six or eight leaves, and sometimes more. The preferred shape is the products with a five-leaf rosette (star). The incised decoration is predominant, emphasizing the individual details of the composition. The quadrangular shapes are richly ornamented with geometric and plant motifs, among which are the combinations of concentric circles. The group of appliquess with a rectangular cut used alone or in combination with other types is popular. An original solution is offered by the appliquess in the form of a five-leaf attached palmette, whose decoration presents all possible variants - from a smooth front surface to the embossed and incised ornaments of the linearly emphasized leaves.

The freedom of stylistic interpretation in the transmission of the form dictates the content of the decorative system in the composition of the belt details. Therefore, given the identity of the generally accepted principles laid down in works of art, their specific solutions vary. The immediate searches of the medieval masters are expressed in the desire to master the form - where there is the creativity. After the form, the ornament is secondarily applied to the art object and accentuates its idea. The essence consists in the repetition of basic motifs in a plant-geometric rhythmic system, which contains a specific

meaning and corresponds to the certain functions of the artistic image. In this way, all motives are transformed and traces of their origin are erased. The ornamentation on the belt sets at that time was distinguished simultaneously by detailing and stylization of the individual elements, where the plant and geometric motifs have only a decorative meaning and do not have a sacred meaning. The heart-shaped figure, for example, which predominates among the appliquess, is one of the ancient symbols of the tree of life, along with the rhombus, known since the Neolithic and underlying many compositions in the art of the Far East and Byzantium. In the ornamentation of Byzantium and the Balkans, the simpler variants of these compositions prevail. Such are also on the products from the production centres for artistic metal. They are built vertically from repeating elements located symmetrically around a central axis. Geometric and plant motifs prevail, while plant motifs predominated. The decoration on the belt sets can be considered as ornamental, where the individual motif is not independent. It appears to be included in a system of linear repetition, in which a movement of the ornament is obtained, based on the connection between all details.

The composition is based on the most common in the Middle Ages oriental ornamental theme. This is the theme of the endless cycle of nature and life or the theme of eternal return. Visually, it is expressed in the interpretation of the fruit and colour - the two most important phases of the plant cycle, identified with the universal cycle of life. The tree of life embodies the universal concept of the world. In ancient Iranian mythology, the tree of life is represented as a vine, symbolizing the constantly renewed and eternal life. The vine motif is popular in Hellenistic and early Christian art, and after this period, it became more and more stylized. The tree is constantly present in the Byzantine epic, and hence in the plant ornament, built according to a vertical scheme with a conditional interpretation of the stem. Similar compositions are observed on the presented products. The plant motifs growing one after the other on the belt tips depict the tree of life as a basic element in their ornamentation.

Leading in the decorative system in appliquess is the palmette in its two variants - closed and open. The reproduction of the palmettes

goes from a realistic to a stylized image, in which the popular motif changes so much and in some compositions, the real forms begin to be lost and dissolve in themselves elements of the geometric imagery. Three-leaf, seven-leaf and nine-leaf palmettes are equally successfully used, as well as their variant in the image of semi-palmettes. The floral ornament of the fife-leaf palmette is popular in Byzantine art, and in this period free and unrestricted compositions became widespread. There are a stylization and disintegration of the plant image of individual elements - a specific feature that is particularly pronounced in the Byzantine miniatures. The repetition of identical and interconnected palmette motifs (three-leafed and five-leafed) form the single and double frames of most of them. Somewhere the frame with plant motifs is so wide that it "absorbs" the main composition and sinks into the multicoloured field of winding shoots and palmettes. This is especially true for headers that include up to a third of the text, as well as for colour strips (vignettes) that separate the text.

Particularly characteristic of the IX-XI century is the heart-shaped ornament, which turns into a stylized three-leafed palmette. The way the heart-shaped frame connects and grows into palmettes is specific to Sassanid art and Byzantine ornamentation. In this form, it is transferred to the works of art metal. Along with the three-leafed palmettes on the belt sets, five-leafed palmettes are depicted in various variants and techniques. This ornament is more or less directly related to the palmettes, included in a heart-shaped frame growing from its base. Each subsequent motif derives from the previous one and is part of regular rows or groups of pairs of connected motifs. At the same time, there is a pronounced stylization and disintegration of the plant ornament. The palmettes popular in the Byzantine art find expression in the Bulgarian ornamentation in the free and unlimited compositions on different types of monuments - stone sculptures, miniatures and as shown by the numerous finds from the production centres, on the products of the artistic metal. According to the manuscripts from the Preslav Literary School, exact copies of the three-leafed palmettes included in a heart-shaped frame are observed, as well as of the five-leafed palmettes with volutes and drafts, serving for shape and decoration of the belt sets from this period. The imitation in the literary decoration of the enamel technique is a distinctive feature of

the richly illustrated manuscripts published in the IX-X centuries by the Byzantine and court Constantinople scriptoria. They embody the special "colour" ornamental style, created in Byzantium in the X century, which has long remained in the capital's art. The repetition of identical and interconnected palmette motifs (three-leafed and five-leafed) form the single and double frames of most of them. Somewhere the frame with plant motifs is wide and includes the main composition, sinking into the multicoloured field of winding shoots and palmettes. The role of frames is growing, which is due to the gradual stylization of Byzantine decoration under the influence of the East.

The rosette is among the most common motifs in the decoration of belt sets. It is a solar symbol that is established in the art of Central Asia and the Mediterranean world. A rosette with heart-shaped leaves resembles a lotus - the sunflower of Anahita. The rosette is especially common in Byzantine art, mainly in works of metal, ivory and painting. Rosettes are a preferred motif in the decoration of ivory reliquaries in the 10th – 11th centuries. Although less common than palmettes and vultures, rosettes are found within Byzantine miniatures from the earlier period (10th – 11th centuries). In medieval Bulgarian art, the rosette is found mainly on metal belt details and less often on miniatures (the image of Simeon in Hippolytus' words) and the ornamentation of painted pottery, with the predominance of rosettes included in a circle (the church in Tuzlalaka and the Round Church in Preslav).

Geometric ornamentation is also expressed in the compositions of metalwork. The main figures - circle, square, rectangle are manifested mainly in the general shape of the object. The geometric composition, consisting of a circle inscribed in a rhombus, in turn, included in a square with circles at the corners, is characteristic of Byzantine art. It is observed mainly in stone sculpture, flooring and wall coverings and less often in sculptures and works of a small sculpture. Combined with the plant details on the belt sets in original solutions, it is the main building block and emphasizes their expressiveness. Especially popular are the composite motifs, built by combining elements of the two systems, which dissolve in themselves the main idea and carry the

individual handwriting of its creator. They are dominated by the plant element, which is the core around which the whole composition is built. The geometry complements the picture and emphasizes the main elements in it, bringing an additional nuance to the pictorial manner.

At the same time, decorative elements, mainly plant motifs (palmettes and semi-palmettes) and geometric-floral ornaments have aroused interest not so much with their symbolic significance in cultural development, they are perceived only as an ornament. The result of all this is the original reproduction of motifs and shapes - the basis of the rich ornamentation and style of belt ornaments. Each of the production centres had its own individual program, in which all known and established decorative programs were developed. Some of them are especially popular and that is why this type of products are mass-produced in large quantities. Others, single representatives, show peculiar individual solutions that have no analogue and are not subject to mass circulation. Each composition is an original interpretation of certain details and shapes and complements the rich pictorial program. As a result, two main groups of products emerge among the production of centres - with a mass character and individual solutions. Similar examples of the first group are known from most early medieval settlements and fortresses on the territory of medieval Bulgaria. This applies not only to the most numerous group of appliquess but also to other types of belt ornaments - the work of organized production of belt sets in the first half and middle of the X century in the vicinity of Preslav. A significant part of them are registered at many sites outside the country - mainly Hungarian necropolises and Romanian fortresses and settlements - synchronous with the period of operation of production centres in the X century. There are many examples from some more distant regions of Russia and Ukraine.

Most of the single products bearing their original handwriting are not found in the mentioned places and are often the only representatives of the respective type. The richness of forms and ornamentation is a consequence of these products - an expression of individual decisions, recreated with the means of established artistic expression during this period. The fruit of the creative thought of its

creators, the diverse range of products, testify not only to a mastered craft but also to a jewelry art full of the richness of themes and plots.

Chapter 2. ELEMENTAL ANALYSIS OF RAW MATERIALS AND PRODUCTS

A significant place in archaeometry research is occupied by the study of ancient production. Data on the composition of medieval metals is a new historical source that reveals an unknown and inaccessible side of life. Particularly informative for working with the shape, composition and production technology are the details of the set belts and horse equipment. The chemical composition of the products reflects, on the one hand, the peculiarities of the specific raw material base, which has its own peculiarities (microelement composition) and on the other - the degree of development of the technology in a given society at a certain stage of development. The study of the structure of the various materials, the traces of deformations on them, as well as the reconstruction of the production methods allows to significantly expand the historical picture.

It is known that in the process of metallurgical processing of ores, all or almost all impurities present in the ore pass into the metal. The study of the chemical composition of metal products makes it possible to determine the field - source of raw material, the relationship between the compositions in the alloys, production methods and the use of certain recipes in the technology of alloys. An important point is a relationship between the shape of the products and the alloy from which they are cast, ie. between composition and typological categories. A series of objects of the same type are attracted, with the help of which the methods and habits of working with metal are best studied and the connection between the manufacturing technique and the types of alloys is established.

§ Chemical and mineral composition of ores and metals

With the development of metallurgy, the path from the raw material to the finished product becomes longer and at each stage there are serious changes in the alloy, sometimes excluding the possibility to identify the origin of the metal. To determine the ore used in smelting, it is necessary to show all the characteristic elements

in the studied alloy. Only then can be obtained data compared with chemical analyzes of ores of different origins, determine the type of ore and the area of its extraction. According to trace elements, it must first be established which of them are normally present in copper alloys and what their significance is for determining the nature of the ores. Therefore, in many cases, the chemical composition of copper contributes to the unambiguous answer to the question of origin. Thus, the products are diverse not only in their chemical but also in their metallurgical composition. In practice, the elemental analysis in the history of ancient non-ferrous metallurgy solves two main groups of questions: the history of the use of various metals and their alloys and the dynamics of the development of metalworking; the ore sources of the metal and the consequent conclusions about the trade relations between the cultures, the ways of movement, the synchronization of the separate groups of the population, etc. We have the task of clarifying what set of alloys was available to the master jewelers at that time and whether the same recipes were used to make the items in the production centres.

Determining the nature of the alloy on the basis of chemical elements is a simple task in historical and metallurgical research. It is difficult to clarify from which deposit the ore from which the metal was extracted is. Copper and other ores from each deposit, in addition to the main component - copper, contain many other elements that form a variety of qualitative and quantitative combinations. The metal extracted from the ore duplicates the elements that are in it. The general combination of the elements of the ore can be established precisely enough on the elements that make up the metal. Finding the source of the raw material is more important than determining the type of alloy. Then the trade routes through which the metal and its products entered the various communities and cultures will be revealed. In this way, the connection between the metallurgists, traders and consumers of products can be restored.

In practice, the set of impurities in the metal is a "mirror" of the ore impurities, but this mirror is sometimes distorted. The distortion is due to the uneven transition of the various elements of the ores in the metal, which determines their chemical properties. Some of the

elements pass into the slag, others entirely into copper or take off with the gases. This distortion is an insurmountable obstacle, and its correction is so difficult that it calls into question the very idea of metal-ore comparison. The obstacle can be overcome, taking into account the special behaviour of each of the elements. For example, iron Fe, manganese Mn, cobalt Co, titanium Ti, molybdenum Mo, vanadium V, etc. are almost completely excluded from the metal. Zinc Zn and cadmium Cd, which are found in the ore, fly off with the gases. Elements such as arsenic As, bismuth Bi, antimony Sb, are able to increase their content in copper. The content of gold and silver increases 10-100 times.

The transition of the elements in the products depends on many conditions - the temperature and melting conditions, the mineral composition of the ore and others. One thing is for sure - during the extraction of the metal in the metallurgical furnaces, ligatures were not added. Another problem in the comparison of ore - metal is the weak study of the geochemical features of copper ore bodies and especially in the oxidation zones. In this case, the set of elements in these zones differs from the set in the sulfide zones. Disturbances in the mixing of metals from different ore sources are also significant. There is another obstacle and that is the artificial impurities in copper. When casting the product, the master adds a ligature to the copper-tin, arsenic, antimony, lead, silver. These additives can add other impurities. Tin Sn, for example, is often combined with a known dose of lead Pb, and large impurities of lead Pb lead to an increase in the content of bismuth Bi. The impurity of lead improves the casting properties of the metal compared to pure copper. Such action is exerted by arsenic As and antimony Sb. Foundry metallurgists obviously knew about the properties of copper obtained from various ores: carefully selected copper minerals (malachite, azurite) or crude polymetallic ores. This is constantly captured in static correlation analyzes of the concentration of these elements. In order to bind the metal of a group of products to an ore deposit, the exact chemical characteristics of the ore minerals must be known.

With the exception of gold and platinum, most of the metal artefacts used in antiquity were derived from the smelting of metal-

bearing ores from which various metals and alloys were derived. One of the first tasks of archaeological chemistry is to return these metal objects back to their ore sources, using the analyzes of the so-called "Trace elements", which is a direct method for the reconstruction of ancient models. Thus, the use of the term 'trace element' refers to an element in the alloy which is not deliberately added and which contains and is characteristic of the ore from which the metal is derived. Such a "trace element" can be from a fraction of a persentage to a few tens of persentage. The ratios of antimony-arsenic Sb-As, cobalt-nickel Co-Ni, gold-silver Au-Ag are indicative from a metallurgical and geochemical point of view and their concentration and ratios indicate ore sources more than technological factors, such as melting conditions or degree of refining. Cobalt and nickel are safe markers for identifying artefacts made from melted copper and those made from natural copper.

In the classification of metal finds, it is better to consider the leading elements specific to the deposit, rather than those that depend on the production conditions. Important for paleometallurgy are the trace elements arsenic As, antimony Sb, silver Ag, gold Au, selenium Se, tellurium Te. The model of trace elements in ore deposits can be compared with that of artefacts, where variations in the deposits themselves are well studied. This gives several advantages: 1. The connection with a given locality is possible only through these elements; 2. Their distribution is determined by the deposit itself and in the processes of metal production, it hardly changes; 3. The model by elements of the deposit is independent in time; 4. The composition of copper can be calculated assuming that the sum of the elements in question together with copper gives 100% of the metal.

In studies of the origin, it is important to consider those elements which accompany copper during the processing of copper, so that the copper/element ratio does not change significantly or does not change at all on the way from the ore to the crude metal. Thus, the elements can be divided into those whose content in copper is determined by the content of ore and those whose content is due to the methods of production, ie. of the traditions in the workshops and in particular the alloying of metals. The influence of ore processing and metal

production processes can be minimized if the ratios of chemically related elements are considered instead of individual concentrations. Suitable ratios are considered to be antimony-arsenic Sb-As, cobalt-nickel Co-Ni, gold-silver Au-Ag, selenium-tellurium Se-Te, gold-palladium Au-Pd, platinum-gold Pt-Au, and other ratios between platinum metals. Of the most commonly analyzed metals, the ratios antimony-arsenic Sb-As and cobalt-nickel Co-Ni are the most suitable. Metals tend to have slightly increased Sb / As and slightly reduced Co / Ni ratios. The relationships between copper and ore are derived from the physicochemical conditions of melting and dating. It is important that any deposit used in antiquity be studied not only chemically but also geologically to obtain information about its structure, mineral composition and changes in general.

§ Mineralogy and geochemistry of the deposits in the Burgas-Strandzha ore region

The Strandzha-Sakar region in metallogenic terms represents the eastern part of the famous Srednogorska zone. Nearly 95% of the potential of modern Bulgaria for copper ores is concentrated in the Srednogorska zone, which is part of the Alpine Eurasian copper ore belt. The mineralization in the main deposits of non-ferrous metals in Strandzha belongs to two types, different in age and genesis: copper-gold-polymetallic-hydrothermal ore formation and old pyrite, copper-pyrite and polymetallic-pyrite iron sulfide formation. Representatives of the first type of mineralization are the deposits in the regions of Makotarnovsko, Rosensko, Zidarovsko, Varlibrezhko and partly Gramatikovsko ore field, and the second - the mineralizations near Gramatikovsko orefield. With the help of accurate quantitative (atomic absorption, neutron activation, quantitative spectral, X-ray spectral and chemical analysis) and semi-quantitative spectral methods for determination of impurity elements, the main minerals in the more important deposits were studied.

1. Geochemical characteristics of the Malko Tarnovo and Gramatikovo deposits. Distribution of impurity elements in minerals

Quantitative indicators show a wide range of elements in the mineralizations of the deposits. The main elements in both types of

mineralization are copper Cu and iron Fe, which are characterized by an extremely high degree of concentration in the ore bodies. According to their content, distribution and frequency of occurrence in minerals, the other elements of the geochemical spectra of the deposits are typical satellite elements in the ores. More important among them are the elements Bi, W, Mo, Co, Ni, Ag, Au, Re, Se, Te, Pb, Zn, Cd, Tl, As, Sb. In most of the minerals studied, bismuth shows a pronounced and high concentration relative to its Clark (the content of the element in the earth's crust). More important studied ore fields are Gramatikovskoto, Staro Rezovo deposits, Mladenovo and Propada deposits, Bardtseto deposit.

The proximity of the mineral associations from the Malko Tarnovo and Burgas deposits is well known. This parallelism is observed not only in relation to the common basic copper mineral - chalcopyrite but also in the content in the deposits of the two ore regions of minerals bearing specific elements. Such are the minerals containing the associations of the elements copper-nickel-iron Cu-Ni-Fe, as well as copper-cobalt Cu-Co, molybdenum-tungsten Mo-W and silver-gold Ag-Au. The most significant difference between the deposits from the two regions is the higher content of magnetite in the Malko Tarnovo deposits and the insignificant amount in the Burgas deposits.

2. Geochemical characteristics of the Burgas deposits. Distribution of impurity elements in minerals

The geochemical characteristics of the elements in the different deposits are based on a significant number of semi-quantitative spectral analyzes of monomineral samples of the main and part of the secondary minerals. The analyzes were conducted by Assoc. Prof. T. Todorov in the 80-90s of the XX century. The summarized results are presented in several consecutive publications. Data from quantitative spectral and atomic absorption analysis were used. Mineral samples are samples previously subjected to a detailed mineralogical examination. The degree of purity was checked simultaneously by spectral determination of the contents of silicon, aluminium, calcium and magnesium and by microscopic study of cemented anshlifs from

them. In this way, information was obtained about the forms of an encounter of a large part of the impurity elements in the studied minerals. Comparison of the obtained data shows good convergence of most of the elements in the different minerals.

The present paper presents the results of the analysis of samples from ore deposits and slag dumps in the Burgas-Strandzha region, summarized in the monograph of E. Chernykh "Mining and metallurgy in ancient Bulgaria. Sofia, 1978 ". The results are presented in histograms showing the average persentageages of contents, together with the frequency of distribution of the individual elements in the samples. To the total set of analyzes are added the results of the study of samples from several deposits in this region, conducted by A. Kovachev by plasma spectroscopy, reflected in persentageages. The main attention in the analyzes is paid to the main and partly to the secondary minerals in the deposits, for which information is obtained about the content and distribution of the impurity elements, the geochemical spectra and the characteristic elemental microparagenesis in them.

The studied localities are Zidarovo, Rosen, Varli Bryag localities. The main form of the presence of the elements is the intrinsic mineral. The elements form individual minerals that enhance their role in ores. Such are Bi, Se, Ag, Pb, Zn, As and others. Cu, S, Pb, Zn, Bi, Se, Ag, Cd are of practical importance. According to the degree of concentration, the main elements in the deposits are Cu, Fe, S, Ca, Si. From the other elements, the group of the secondary ones is separated, which includes elements with a high concentration in the ores and minerals - Pb, Zn, Bi and others. The characteristic impurity elements that are present in all samples with increased clarke content are Au, Ag, Se, Te, Cd, Mo, As, In, Co, Ni. Important geochemical features are the low contents and the sharply reduced concentration of Co, Ni, W and Mo. These elements are characteristic of the Rosen orefield. Specific to Worley Beach is that chalcopyrite does not contain cobalt Co and nickel Ni. The same goes for galena. The insignificant content of cobalt Co and nickel Ni in pyrite is considered as a sign of the low temperature of their formation.

§ Investigation of finds from the three production centres for artistic metal through quantitative elemental analysis

In order to obtain more detailed information about the objects studied in the present dissertation, a highly sensitive energy-dispersion elemental analysis of over 120 samples from the three production centres for artistic metal was performed. In it, a beam of protons accelerated by a Van De Graaf-type charged particle accelerator bombards the test sample and excites characteristic X-ray radiation, the analysis of which makes it possible to determine the specific type of atoms of the chemical elements that make up the sample and the intensity of this radiation. their quantity in the sample is also established. The analyzes were performed on a proton accelerator at the Atomic Nuclear Research Institute of the Ukrainian Academy of Sciences in Debrecen, Hungary. The PIXE method is used for the first time to study archaeological finds in Bulgaria. The research was carried out in 2011-2012 within the European project CHARISMA for preservation, conservation and research of European cultural heritage PAMOMB (Production of Art Metal Objects in Medieval Bulgaria). In 2017-2018, new research was conducted at the Atomic Nuclear Research Institute within the project IPERION-CH TNA - ACONOMAB (Analysis of the Composition of Non-Ferous Metals from the First known centres of Metal Art on Medieval Bulgaria). During this second stage, mainly ingots and scrap metal were analyzed.

1. Investigation of metal finds from production centres

The analyzes give an idea of the elemental composition of the alloys from which most of the products from the production centres are cast. Simultaneously, a study of the elemental composition of most coin finds from the complexes in Novosel and Zlatar was conducted. The data from the study of one of the main sources of raw material, such as ingots, are also analyzed. The results of the elemental analyzes of all mentioned categories of objects are considered in a comparative plan with the behaviour and concentration of the more important elements in the composition of the ores in order to highlight the characteristic dependencies between them.

The copper of the studied objects contains all the elements-impurities in various concentrations. The main alloying elements are tin Sn, lead Pb and zinc Zn. The significant fluctuations of the other elements in the alloys are explained by the use of scrap recycled metal and one from different ore sources. Correlation analysis performed for lead and tin shows an artificial alloying limit for a tin concentration of 3% Sn. Copper alloys are divided into several groups. The first includes objects made of pure copper and tin bronze. In the second group - lead bronzes with a basic tin alloying element. The increased concentration of tin leads to increased lead content. Probably this is one of the methods of the Bulgarian masters for obtaining high-tin bronze. Decreasing the tin content below 3% Sn does not reduce the lead Pb content. Probably this is explained by the fact that lead as an impurity is part of the copper raw material.

Arsenic is from 1.2 to 1.8% As, and antimony - from 2 to 5% Sb. In objects with a low content of arsenic, it was not added by the masters but fell into the metal as a result of melting pieces of arsenic bronze. Arsenic bronze is from 0.5 to 5% As with an increased concentration of nickel. The limit of the artificial introduction of arsenic into copper is assumed to be 0.5%. Lower arsenic scores of 0.1-0.4% As are obtained by adding pieces of arsenic bronze to copper. The amount of arsenic is evidence of the use of bronze from old and obsolete products containing such. They all occur simultaneously and in tenths of a persentage. In tenths and hundreds, there are bismuth Bi, silver Ag, nickel Ni, cobalt Co, zinc Zn. The results show heterogeneity of copper, both from a metallurgical and chemical point of view. The frequency processing of the data from the analysis shows that mainly tin Sn and lead Pb were used as alloying components to copper. Arsenic As, antimony Sb, silver Ag and zinc Zn do not play a leading role in the alloys. Insignificant concentrations of these elements give grounds to consider them as natural impurities; the anomalies in the distribution of their concentration are a consequence of the extraction from ores of different origin.

Certain amounts of lead are deliberately added to bronze. Depending on its values, bronzes are lead, lead-tin or tin-lead. In the case of micronutrients, it must first be established which of them are

normally present in copper alloys and what their significance is for determining the nature of the ores. As a result of these parameters, the following correlations appear tin-lead Sn-Pb, arsenic-antimony As-Sb on a copper basis. Thus, in practice, lead-tin bronzes are one of the most popular alloys in the centres for the production of artistic metal. We can talk about the artificial introduction of tin Sn into the alloy when it is in the range of 0.3-0.5% Sn. The limit of artificial lead doping is very clearly defined: a concentration of 0.5% Pb is the limit of natural and artificial ligature. In the samples, the amount of lead is over 1%, which is a mandatory condition for the determination of the alloy as lead bronze. Lead, in turn, increases the thinness of the molten metal and helps to obtain higher quality products after casting. High values of lead determine its deliberate addition to the alloy. That is why lead is used as a special alloying additive, along with other impurities - antimony, arsenic, zinc, nickel. Below these limits, it can be assumed that some of the elements, such as arsenic, bismuth, antimony and nickel, are not specifically introduced into the alloy, but fall into its composition as an impurity from the raw material. Therefore, it can be assumed that different raw materials were used for different product groups.

The ratios of antimony-arsenic Sb-As, cobalt-nickel Co-Ni, gold-silver Au-Ag are indicative from a metallurgical and geochemical point of view and their concentration and ratio indicate ore sources more than technological factors such as melting conditions or the degree of refining. Cobalt and nickel are safe markers for identifying artefacts made from melted copper and those made from natural copper. Zinc Zn in most cases acts as an alloying additive, which, however, is not in sufficient quantity to define the castings as brass. It falls by way of secondary smelting of high-zinc copper or as a result of its transition from copper to ores. With repeated melting of alloys, zinc gradually decreases. The low zinc content of the articles means that obsolete items have been used or copper, lead, bronze or brass have been added to the metal. The relatively higher content of zinc in some single items confirms the use of brass ingots. In these cases, zinc is accompanied by a significant concentration of lead Pb.

Most of the items are made of a multi-component alloy, in which, in addition to tin and lead, arsenic is present in tenths of a persentage. If the dependence between antimony and arsenic is over 1%, we can talk about arsenic-antimony alloys, where arsenic is an artificial ligature. For all other items, the impurities are in a concentration below 0.3%. Some of the products are also cast from metallurgically "pure" copper, in which the content of all impurities does not exceed 0.3%. A certain difference between the objects is the concentration of bismuth. In some, it is a decimal part of the persentageage, in others - a hundredth. This is the concentration between nickel and cobalt. Some have low content, others - with a high (0.01-0.04%). This means that the products are cast from metal from two chemical groups - with a low and relatively high content of the main elements - micro-impurities. Products with a low concentration of elements predominate. In practice, alloys of different composition and nature were used, but preference was given to high-tin bronzes with the addition of lead. In all likelihood, the supply of raw materials came from several sources.

2. Study of coin finds from production centres

The results of the long-term archaeological researches prove that the found bronze coins were made on site according to the technology approved for the other products. The casting of coins of the Byzantine rulers Leo VI (886-912), Roman I (920-944), Constantine VII and Roman II (945-959), Constantine VII and Zoe in the Bulgarian production centres was carried out similarly to most of the finds made by the same studios. The importance of the finds determines their consideration against the background of the elemental composition of the alloy from which the imitations of the Byzantine follies were cast. The most significant amounts of copper are gold Au, silver Ag, arsenic As, bismuth Bi, antimony Sb, tin Sn and lead Pb. Elements such as manganese Mn, molybdenum Mo, vanadium V, zinc Zn, which escapes during melting, almost completely remain in the slag during metallurgical processing, so their amounts in the alloys are minimal.

The alloys used for casting coins in the production centre in Novosel differ from the alloys from which the other products are made. Here the quantities of lead, as the main alloying additive, are significantly increased, therefore the alloys are defined mainly as lead bronze and lead-copper alloy (pewter). In multicomponent alloys, almost all registered elements in the samples are present, albeit in minimal quantities, with a copper base averaging 90% Cu.

Predominant among the alloys of Zlatar's coin castings is "pure" copper, the impurities of which have entered from the raw materials. The microelements in the alloys (cobalt Co, nickel Ni, arsenic As, antimony Sb, etc.) are in a very low persentageage, which is an indicator of the achieved high level of refining of metals. The average value of iron in these objects is 0.2% Fe and testifies to extremely good reduction conditions in the furnaces during melting. Next is lead bronze, in which lead is intentionally added to the alloy. Products with a low lead content belong to the group of natural alloys obtained as a result of the penetration of this element from the source ores. The elemental composition of the alloy of the two original coins minted in Constantinople differs significantly from that of the cast imitations in the production centres. It can be concluded that the minted coins in Constantinople and the coins in the production centres have a completely different composition of the metal. This is determined by the manufacturing technology - the first is cut, and the second - flies. There were different practices in the use of raw materials and the manufacture of alloys in each production centre. Different recipes and alloys are used for each group of products, depending on their purpose.

3. Elemental analysis of raw materials

The necessary raw material in the workshops for artistic metal is delivered in the form of ingots, from which in the further process of processing various products are obtained. In this case, one part of the metal went for melting and casting of finished products, another part was used to obtain blanks - sheets, strips, rods, wires. Selected ingots, together with parts of casting systems ("trees"), were subjected to PIXE analysis at the Atomki Institute for Nuclear Research, Debrecen

(Hungary). Here are some of these results. In the centres near Zlatar and Nadarevo similarities in the metal, the composition is observed. In Zlatar, "pure" copper and brass predominate, and lead brass is also used. The metal composition of the studied ingots from Novosel was distinguished by the use of lead-tin and tin-lead bronze (less often).

The most common trace elements that come from ores are bismuth Bi, silver Ag, antimony Sb and arsenic As and the transitive elements - iron Fe through zinc Zn. Less common are gold Au, mercury Hg, tin Sn, cadmium Cd, tellurium Te and selenium Se. The concentration of these elements in the molten lead metal naturally depends on their actual concentration in the ores and the melting regime in the furnaces. Thus, the trace elements and their signature reflect the ore deposits and the melting conditions. The various elements in the composition of these alloys enter the metal in different ways: due to the extraction of the metal from the ore; as a result of the action of the jeweler, combining components in certain proportions to obtain an alloy with the necessary optical and mechanical properties; as a result of secondary use of scrap metal products.

There is the presence of brass and rather lead brass in Nadarevo items. The addition of lead Pb to the prepared alloy is also confirmed by the lead bronze objects. Multicomponent alloys and those of lead-tin and tin-lead bronzes are less common, in contrast to the other two complexes. The result of the analyzes of the ingots is comparable to that of the examined objects. Thus the workshops relied on 'fresh' metal supplied by the metallurgical centres in the form of a bar or round ingots. The former have a round or elliptical section, and the latter - a flat base and rounded side.

In addition to finished raw materials in the form of ingots, the use of scrap from scrap and scrap castings is widespread. Remelting old and obsolete products was a common practice in the Middle Ages. Scrap is often used as the main raw material. Alloys are recognized by their colour. The variation in them is considered on two levels: by the guarantor and the manufacturer. Different alloys also create differences in the rank of the user, such as colour, texture, taste and sound. These features carried social and symbolic meanings for the

guarantors of the products. The selection of different types of alloys plays an important role in this process. The material separated for recycling (scrap) was carefully sorted, separating the items with the predominant content of some of the elements. Leading was the colour, but there were, albeit primitive, methods for studying the quality of the collected material - by cutting to determine the density, by applying notches on special stones to determine the metal and others. The craftsmen were very well versed in what raw materials they had and in what proportions and proportions the individual ingredients had to be added to the alloy in order to obtain quality products.

§ Comparative analysis of the elemental composition of minerals and metal finds

The development of metallurgy makes the path from the raw material to the finished product longer and at each stage, there are serious changes in the alloy, which, however, does not exclude the possibility of identifying the main source of metal. When choosing an analytical method, the correct formulation of the research task is of great importance. The issues relevant to the Early Metal Age are significantly different from the problems associated with the study of later epochs. For early metallurgy it is important to determine not only the alloying components of the alloys but also the micro-impurities, allowing to assume the source of raw material.

As a result of the elemental analyzes, we can summarize that there are several types of alloys - copper, lead bronze, brass, lead brass, tin-lead bronze, tin bronze. The products are made of tin-lead bronze, tin bronze, lead bronze, which except tin and lead contains all other elements only in parts of the persentageage. The additives were imported mainly through the source ores, and then from the added scrap metal scrap. The preference for tin bronze is also due to the lower melting point - elementary technical feasibility. The findings of pieces of pure copper and separately the analyzes of the metal products, showing the presence of many elements, give a direction for studying the appearance of these alloys. In fact, the metallurgist extracted pure copper, and then the master foundryman, when the

copper smelted in the crucible, added tin, lead, and other metals to the molten metal.

The study of the phase diagrams of the various chemical elements shows the amounts of metals added to form the individual alloys. Each metal has a different phase shift, which changes in contact with other metals. The peak point is important for determining the reached melting temperature at which all the elements of the added piece of metal dissolved in the alloy. The masters knew these dependencies, although not proven by natural science methods. They carefully sorted the collected metal by composition. For them, the weight by which they determined his presence is also important. Depending on the desired effect, metals were added that successfully reached the desired goal, resembling the precious metals - gold and silver. The colour and weight per unit of metal are a reliable indicator of the presence of lead, tin, zinc, arsenic, antimony.

Copper-porphyry deposits are the main source of copper production today, and according to ancient traces of mining, in the past. The extracted ores contain valuable ancillary components, important for determining the source of raw material in the production centres in the vicinity of Preslav in the X century. Some of these elements are gold Au, silver Ag, molybdenum Mo, selenium Se, tellurium Te, bismuth Bi, cobalt Co and nickel Ni. The contents of the accompanying elements in the mineral types of ores from the copper-porphyry deposits are different, as most of them meet their own mineral form. Their main carriers are sulfide minerals, which favours their concentration in the final product. In turn, the presence of impurities in bronze, such as iron Fe, silver Ag, zinc Zn, nickel Ni, gold Au, is a consequence of their entry from complex ores, ie. these impurities are natural geochemical impurities. If the so-called "Trace elements", a significant part of which also come from ores, we could more confidently go towards a successful reconstruction of the origin of the raw material in the centres for artistic metal. For this purpose, the registered ratios in the concentrations of the most important elements in the ores and metal find found in the production centres for artistic metal - copper, tin, lead, zinc, silver, gold, arsenic, antimony, bismuth, are considered. iron, nickel, cobalt, manganese.

The main source for copper production during the different historical epochs has been proven to be the Burgas-Strandzha ore region, where the metallurgy of copper has existed without interruption from the deepest antiquity to the late Middle Ages. The large-scale developments, which are one of the largest not only for the region and the country, but also in the Balkans, have satisfied not only the production centres for artistic metal from the X century in the vicinity of Preslav, but also other regions of the country and probably regions outside it. The comparative presentation of the results of the elemental analyzes of raw materials and products from the metalworking complexes on the one hand and samples from the ore sources in the Burgas-Strandzha region on the other contributes to the establishment of the organized movement of raw materials and metals at that time.

In the epoch of sufficiently developed trade relations, raw materials from various ore sources fell into the hands of the masters, which were mixed in arbitrary proportions. The use of complex ligatures largely leads to a change in the initial batch in the copper impurities. The analysis of the products shows that they are cast from metals of different origin. Alloys imposed on a certain territory, including on the territory of production centres were used for a long time, and elements (tin, zinc, lead, etc.) were periodically added to them, which improved the casting qualities of the alloys and the mechanical properties of the products.

Chapter 3. RECONSTRUCTIONS OF BELT SETS

A defining feature of the style of a work of art is the unity of its constituent elements. Each item is created by masters who create in the vein of certain traditions, by virtue of which these items have a special "language" well known to members of the community. Typesetting belts, as works of decorative and applied art, should be considered depending on their stylistic features. This allows expressing the stylistic unity characteristic of the epoch and the diversity in its manifestation. The individual stages of this process underlie the typology and stylistic analysis.

Belt sets are determined not only by the shape of their details but also by the accompanying architecture, composition and ornament, the presence or absence of hanging straps and more. The unity of all these elements determine the artistic regularity and create their own style, which according to some researchers, is a method of organizing the form. The result is a single, interconnected structure, which flows from form to composition and ornament and reflects the incredible variety of combinations of individual elements in it. Therefore, appliques in the present work finds the reconstructive method or graphic visualization. Its use is determined by the fact that the typesetting belt is composed of two materials - leather and metal, the former is rarely preserved, and the location of metal ornaments is not always preserved. On the basis of examples preserved in a safe archaeological environment from the territory of the country and especially outside it, in cultures parallel to the early Bulgarian, an attempt was made to make graphic reconstructions of complete sets of belt sets with the location of the individual details on them. The abundance of finds discovered during many years of systematic archaeological research in the centres for the metal art in the vicinity of Preslav is a good basis for such an endeavour. Their variety and quantity imply countless variants and combinations within one belt set.

The proposed graphic reconstructions are only a small part of the possible compositions, which makes the system open to new and new solutions. It preserves the conditional nature of the individual graphic solutions in cases where there is no exact parallel. The situation is similar with the typochronological scheme, uniting the different types of belt sets in the previous chapter. Such circumstances should not be the only criterion for assessing the reconstruction method, not least in view of the limited territorial scope of archaeological research, which cannot cover all the lands in which the fashion of the ornate belt is widespread; but also in view of the variety of details for the production of belt sets, offering a wealth of compositional solutions. The variety is suggested by the found single specimens of metal parts and in most cases, these are the most complex compositions.
The single copies are made to order and are without analogue and limited quantities. The found pairs of appliquess from the two variants

- narrow and wide, which form the full belt set, serve as a model for the implementation of such individual solutions. Along with them is the mass production of belt sets, some of which is attested by hundreds of finds. This defines at least two categories of belt sets produced in the workshops in the vicinity of Preslav - elite and mass. In the course of the present study, attention was paid to both categories, and the graphic vision complements the observations made.

1. The belt - a symbol of social affiliation

The belt is one of the categories of archaeological and ethnographic material and is permanently present in research on the subject. It is a leather strap with functional and decorative significance (buckles, appliquess, distributors, tips). According to archaeological data, the belt sets appeared in the equipment of the nomads at the beginning of the 1st millennium BC. Throughout the whole time of existence and layout in time, there is a clear ethnic colour. The given circumstance determines the extremely important function of this part of the costume as a source of historical reconstruction. Thanks to the combination of different functions - utilitarian, ritual, ethno-defining, social and symbolic, the belt through the shape of the circle are identified with the universe, with its borders, by virtue of which it acquires a sacred character. For primitive notions, only that which is sacralized is essentially real, and that which constitutes a part of the cosmos derived from it, involved in it, is sacralized. The isomorphism of the macro and microcosm (the universe and man) respectively gives rise to the idea of the identity of the Circle-Universe and the Belt, the closed state of which symbolizes the divine essence of the ruler, gives him cosmic strength, protects and defends his personality. The unravelling, the lowering of the belt means a rupture with the Cosmos, the Universe and leads to catastrophe and decline.

Being a part of the cosmological consciousness, the idea of the belt acquires, gradually in the course of the development of the society, new functional-semantic connections and relations. Two lines of perception of the belt are established - folk, based on the notions of the magical ritual role of the belt in the life of the person and the team; and military-aristocratic, which arose in the heroic age and became

popular when war became a factor in interethnic relations. The belt carries saturated information and has chronological variability with a tendency to form a uniform and single-style variants over large areas during different periods. The genesis and development of the belts follow common paths and regularities in their formation. This is reflected in the similarity in the socio-economic and cultural development of the communities in Eurasia. Despite the general tendencies in it, some peculiarities in the types of belts, characteristic for huge space-time boundaries, can be traced.

The belts are products of masters, processing into original alloy components of different cultures - from samples of Byzantine art and elements of German production to the fashion of Eurasian nomads. The late antique structure of the belts was widespread in Eastern Europe in the second half of VI - early VII century, and its modifications, under Asian influence, dating back to VII century. An integral part of military equipment, the decorated belt is a great value. In addition to the significance of an amulet from the archaic era, it acquires a real and concrete function as one of the important elements of military armour. The earliest heraldic sets were found in fortresses from the second half of the 6th century, inhabited by federations of Byzantium. In the IV - first half of the VI century in the Crimea are worn sets, which lack additional straps. Such kits are used in Iran, Altai, the Volga region, in the North Caucasus. The typesetting belt in the equipment of nomads from Central and North Asia appeared at the beginning of the 1st millennium BC. and in the time after that, it has a pronounced ethnocultural colouration.

The simultaneous production of belt sets in the Eurasian steppe in the second half of the first millennium proves the widespread fashion of the decorated belt. Metal finds from such are found during the excavations of the settlements of almost all of Central Asia - Fergana, Khorezm, Vakhsha, Penjikent. The first belts with additional straps began to be worn by Roman soldiers. From the middle of the 6th century in the Byzantine army and among the federations, belts with additional belts, decorated with various heraldic details, became widespread in Eurasia. Production centres meeting these requirements began to operate in Kherson, the Bosporus and the southwestern Crimea. Avars, Alans, Anti, Bulgarians, Goths and Lombards alike

strive to adorn themselves with belts symbolizing military dignity. Belts are distributed as a gift and a symbol of honorary title not only to Romans but also to foreigners. The example of the patrician belt received by Khan Kubrat from Emperor Heraclius is well known. At the same time, the elements of material culture typical of the Slavs and nomads in the Dnieper spread among the Alano-Gothic population through the mediation of the Kutrigurs. With the advent of Greater Bulgaria, the heraldic belt sets (the necropolises in Risovo and Bogachevka) also entered.

The composite belt from the end of the 6th century was worn mainly by "barbarians" with a certain social status and from a Byzantine point of view is associated with horses and hunting. In this context in Sassanid art, the belt appears in hunting scenes and is missing in scenes of royal investiture. The main indicator of the prestige of the belt is the material from which its components are made, as well as their number. An additional feature is ornamentation - geometric, floral or zoomorphic. In the Middle Ages, the belt played various roles - from purely functional to symbolic. Simple, undecorated belts made of leather and buckle, often without a plate, have only a functional purpose. Belts with metal details and belt tip play a much more significant role in social status. Among most steppe formations, such attributes are a marker of social rank.

In the time before the baptism in Bulgaria, the belt had its sacred functions and was of decisive importance in the hierarchy of the society of that time. The belt is a sign of military affiliation and investment in the structure of the military class. It is worn mainly by members of the aristocracy and the military caste. This is evidenced by the number of belt sets that have reached us from the pagan period and the initial period after that. The identification of the ornate belt as an insignia used by the old Bulgarian official aristocracy explains the presence of the numerous and varied belt elements. They are the product of masters who worked for the needs of a ruler and aristocrats with different ranks in the official hierarchy. Probably the ornate belts were ordered by the ruler and then distributed to the aristocracy according to rank. Military belts, weapons, stirrups, horse harness and items related to military life, such as horns and utensils made of precious metal, are closely related to the life of the medieval military

and high nobility. The items included in the funerals reflect belonging to the elite of nomadic society. Precious items were made in the workshops of the ruler's estates, often under the auspices of the supreme authority of the prince, emperor or khan.

From a military distinction and a sign of belonging to a certain class, the belt gradually began to be profaned and spread among the general population, which is confirmed by the mass production of parts for belt sets. The ubiquity of the decorated belt among the general population, after the beginning of the 10th century, permanently changed the material of manufacture. The castings are mainly of copper alloys (bronze), less often of billon and silver. Gold belts were also made, as evidenced by the small gold bar found at the production centre in Zlatar.

After the baptism and the imposition of the Christian tradition, the decorated belt began to lose much of its sacred and symbolic character. Moreover, in Byzantium itself, where the new religious system came from, and the whole social structure changed, such as military decorations and attributes to clothing were not used in this form. The sets known from this period have different material and manufacturing technology - they are forged from metal plates, have larger dimensions and have specific ornaments.

When, however, is the final desecration and profanation of the belt in Bulgarian society? Apparently at the time when the mass production of belt sets began in medieval Bulgaria - at the end of the Simeon era and the time of Peter. With the onset of the peace period in Bulgarian history, after the signing of the 30-year treaty between Bulgaria and Byzantium, appropriate conditions were created for the development of various arts and crafts. Confirmation is not only the huge volume of production from the three centres for the metal art in the vicinity of Preslav (over 3 thousand details so far, excluding those in the museum collections) but also their location. Like the numerous settlements in the area, the complexes were not protected in any way, which speaks of the calm atmosphere and security in the state and society at that time. One of its manifestations is the ornamented belts, belonging to the group of objects with constantly high status. Historically, the determination of this status depends on the idea of the mechanisms of power and the way of delegating powers in the strictly

hierarchical model of imperial society. The ritual shapes the relationship of subordination and is dictated by the real military superiority proven in battle. Replacing war with peace also changes the social status of military regalias, such as the decorated belt. Probably the belt as a supplement to the military costume retains its importance of distinction in the formation of the hierarchical structure in Bulgarian society in the late period. Then there is no complete division between the world of symbols and that of things. It is as a thing that has fallen out of the sign system, the belt set should be considered since the X century. Its growing popularity among the population, proven by the mass production of belt sets of relatively cheap and affordable material (copper, bronze), is an expression of fashion trends in society and the purely pragmatic role of the belt. From the tenth century, the belt was desecrated and largely lost its basic significance, which in earlier times had as a sign of origin, position or military rank. Belt sets are unified and become uniform and simplified. The role of a social marker begins to play mainly the material from which they are made, and the main criterion - the financial capabilities of its guarantor.

A similar trend is observed outside the Bulgarian state. At the end of the 9th and the first half of the 11th century, a specific polytechnic team culture appeared on the territory of Eastern Europe. Belt sets, which became widespread in the VI-VII centuries, are known in Russia, Scandinavia and the Steppes and in the IX-X centuries. The study of these objects allows us to obtain information about the chronology and internal structure of medieval settlements, as well as social interpretation. of individual monuments and local groups of communities united around the idea of the military status of these items. At that time, there were already enough standard ways to decorate various products: from the details of belt sets to artistic silverware. With all the versatility of the fashion of the decorated belt, a number of characteristic principles of decorating the belt sets, typical for different schools and individual monuments, stand out.

The most widespread is the belt, called in the Byzantine sources "Bulgarian belt". From the main strap hung small straps also decorated with details. The belt is double - inner belt and main belt, decorated with metal ornaments and passing over the main belt, its end is hung

down on the left side. Personal belongings are hung on the belt - a bag, an iron knife, a weapon, a cup. The ornaments reflect not so much the cultural affiliation, but the phenomena of fashion, as evidenced by the necropolises with ethnically homogeneous items. In these areas, where numerous tribes and cultures collide, the fashion and its style come to the fore. The monuments, located away from the major trade routes and contact areas, are dominated by ethnoculturally homogeneous complexes and ornaments, and here there is a fashion, but already within the cultural traditions. The type of motifs, the metal of construction, as well as the number of details on the typesetting belt, mark a certain rank and social status. The size and density of the details give a similar indication. Individual taste recedes into the background. The metal belt encircles the body around the waist, with one end hanging in front of the knee. The belt sets are made according to similar patterns but in workshops located in different areas. This is evidenced by the technique of making the details of the belt sets and the chemical composition of the metal.

2. Reconstruction of belt sets based on finds from the production centres for metal art

The specificity of the belt sets is determined firstly by the constituent elements and secondly by the composition they make up. At the level of the elements, the objects are presented as a system of features - general geometry, design, decoration, a materialization of a scheme or symbol. The metal details also serve as a means to embody the visual image and composition of the entire belt. The proposed several reconstructions take into account a large number of examples of belt sets and reconstructions found in different parts of Eurasia, as well as some unpublished finds dating to the chronological framework of the intensive activity of artistic metal complexes.

2.1. Reconstruction of belt set with hanging straps and decoration - "twig" type

One of the most numerous groups of metal ornaments for belt sets, found in the research of the production centres, presents leaf-like appliquess with incised decoration, type "twig", of both varieties. Exact analogies of these decorations are only among the finds from

the territory of Bulgaria. Their stable typological group is confirmed by the mass production in the centres for artistic metal. A large number of appliquess and the variety in size and decoration are the basis for the current reconstruction. After reviewing all the similar products received so far, several of them have been selected, on which the individual parts of the belt have been reconstructed. The main strap is 2 cm wide and is determined by the selected model of appliquess (1.8 / 2.7 cm). Narrow vertical straps are mounted on the horizontal part, also decorated with appliquess (1.7 / 1.3 cm). The vertical straps pass through the slots of rectangular appliquess and are connected with a metal ring at the base. The slits in the middle of the rectangular appliquess (1.5 cm) coincide with the width of the hanging straps. On them are mounted 6 narrow appliquess and one nozzle in the same style of execution, ie. a total of 30 small narrow appliquess and 5 belt lugs attached with three spikes each were used.

The main belt tips with a hanging end and a tip, similar in ornamentation to the small vertical straps. Narrow appliquess are mounted on the hanging strap, the beginning of which starts from the horizontal part. In the current reconstruction, a total of 16 narrow appliquess along the hanging end (2 / 1.6 cm) are used. The belt is fastened by means of two additional small straps attached to the inside of the main strap. In the reconstruction, the right side was adopted for the transfer of the belt. One of the considerations is that the suspension of the weapon is on the left side, for convenience when using it with the right hand. The diverse production of details for belt decorations confirms the existence of different options.

2.2. Reconstruction of belt set with the decoration of shield-shaped appliquess

There are quite a few copies of the appliquess in question, originating from the production centre in Novosel. During the excavations, products of both types were found - narrow and wide, and in total from the northeastern regions of the country - over 40. The group is also represented among the finds from the workshops near Nadarevo, Targovishte region. A belt set of similar appliquess was found in a tomb near Bátmonostor, (Bács-Kiskun county), Southern Hungary. Several such appliquess, made of silver alloy with gilding,

originate from the Hungarian necropolis in Jászapáti and Kétpó (Jász-Nagykun-Szolnok county), Hungary.

The proposed reconstruction includes 58 shield-shaped appliquess with four buds along the outline and a teardrop-shaped medallion in the middle. Of these, 23 - narrow (2 / 1.7 cm) and 35 - wide (1.7 / 1.8 cm). Both versions have three studs for attachment to the belt. One end of the main belt tips with a nozzle and the other with a buckle consisting of a pentagonal plate with a hole for the tongue, an embossed edge and an oval support part. The selected tip has a relief decoration of attached palmettes and a flat frame along the outline (4.8 / 1.8 cm). The buckle with which the other end of the main belt tips (2.1 / 1.8 cm) corresponds to the width of the belt tip. In this reconstruction, another variant of belt fastening has been proposed - not with two additional straps additionally attached to the inner side, but only with one on the left side, on which several holes for the buckle tongue are made. The hanging strap in the proposed reconstruction is placed on the left side. The whole belt reaches a length of 1.60 m - 1.20 m horizontal part and 40 cm - vertical (without overlap).

2.3. Reconstruction of belt set with hanging straps and decoration of openwork appliquess

The reconstruction is based on the two types of openwork appliquess - rectangular, with a slit at the base, and heart-shaped. A full belt set, consisting of rectangular appliqués with a cut at the base, a fold at the top and relief decoration of a petal-flowering blossoming palmette, was found in the rich Hungarian necropolis, dating to the early 10th century, at Tiszaeszlár-Bashalom (Szabolz-Szabolc-Szabolcs-Szabolc-Szabolcs-Szabolcs-Szabolc-Szabolács), Hungary.
The large number of rectangular and heart-shaped openwork appliquess found at the three production centres are a confirmation of their widespread use and popularity among Bulgarian society in the tenth century. traditions, but is not an ethno-defining feature, as is accepted in Hungarian and Russian literature. Focusing on details of decoration or shape, such as a chronological marker, is not justified. The marked bevel on the edges of the appliquess, for example, is found both in some earlier objects and in the products produced in the

workshops for the metal art in the 10th century, where both types of details are made. The thickness of the casting is also not decisive and depends on the technology and skills of the master. Rectangular appliquess with a slit at the base are probably one of the most common products in a large area - from Central Asia to the Danube and in a wide chronological range - from VII to XI century.
A model was chosen according to which all rectangular appliquess in the reconstruction were dimensioned (1.6 / 1.3 cm). The second group of metal ornaments in the belt set are the heart-shaped openwork appliquess. There are two types - large and small, examined in detail in the finds from the production centres. Larger items are located on the main strap, and those with smaller - on the hanging straps. The latter is also used in the decorations of horse ammunition. One heart-shaped appliques (1.7 / 1.3 cm) was adopted as a model for the reconstruction.

After applying the two types of appliquess on the main strap with a width of 1.8 cm, it turns out that a total of 40 rectangular appliquess with a slot at the base, at a distance of one centimetre from each other, and 24 heart-shaped appliquess can be placed; 18 of them on the hanging end and 8 - behind the buckle at the opposite end. The vertical part ends with a bronze tip with a white metal coating on the front and without decoration. The buckle has an oval support part and a pentagonal bearing plate with an opening for the tongue and decoration of two parallel incised lines at the base. The length of the whole belt is 1.70 m - 1.20 m horizontal part and 45 cm vertical hanging end (without overlap). The fastening is with the help of an additional attached leather strap (18 / 1.3 cm). In this reconstruction, the fastening is on the underside of the main vertical strap, by analogy with the location of the buckle in some burials from Hungarian necropolises.

The proposed reconstructions of belt sets, based on findings from the research at the production centres, are only part of the numerous variants of such. The rich variety of metal ornaments - buckles, tips and appliquess, allow for their skilful combination on the straps in a variety of stylistically similar rows. Variants existed in the decorative design of the full set, the dimensions of the main strap (length and width), the way of fastening (under the main strap or

above it), the use of additional straps for fastening (one or two), the position of the hanging end (left) or on the right), the addition of hanging belt tips, the hanging of various objects on them, etc. Such a variety of forms and variants presupposes the ubiquity and popularity of the decorated belt in the tenth century in Bulgarian society. During this period, the belt exceeded its significance as a mandatory military distinction and became an element of the clothing of wider groups in society.

Part II. TECHNOLOGY AND PRACTICE OF JEWELRY PRODUCTION IN THE MIDDLE AGES

Chapter 1. MINING AND METALLURGY

Metallurgy or in translation metalworking includes the extraction of metal from ores, the manufacture of alloys and the manufacture of metal objects. The discovery of ore deposits and the extraction of ore minerals is a subject of mining and is largely part of the general metallurgical process during different historical periods. Ore deposits are geochemical anomalies in the earth's crust and accumulation of certain minerals and rocks, which, depending on their size and content, are considered economically viable to develop. Ancient metallurgy is a broad concept and is associated with both mining and metalworking and in many cases is evidence of their existence. The data on metalworking is indirect evidence of the development of mining. Where no metals have been extracted (in the ore-free areas) and only imported metal has been processed, there is talk of metalworking. Metal cannons, weapons and ornaments are the most mobile material, and metal and its products are one of the main objects of the ancient barter trade. With the help of such finds, the copper ore zones and the distribution of the metal in the ore-free areas are localized, which is a prerequisite and a means for establishing the synchronization between the separate regions and the absolute chronology. Numerous facts show that the extraction and processing of metals are not done by everyone, but by experts in this activity, people who have passed on their knowledge to a small circle of the community. An important issue is the one about the used ore deposits, and hence about the mining, which is difficult to solve without

comparative analyzes of samples of metal objects and the presumed raw material sources.

§ Mining

The process of mining is the result of their extraction from the rock mass and subsequent concentration and purification. The main activities related to the activity are prospecting, exploration, development, exploitation - extraction of minerals, enrichment - grinding of ore, separation of ore minerals from rock impurities in concentrates, eg copper concentrate, separation and purification, metallurgy - extraction and purification of metals from concentrates, marketing - selling the product to the consumer. If the extraction activities for the extraction of a mineral are entirely on the surface, these are "open-pit mines"; if they are completely below the earth's surface - "underground mines". Deep changes occur in the ore bodies on the surface as a result of weathering. Their visible composition and surface thickness are different from those of ore bodies underground. The thickness, the angle of inclination, the physical properties, the mineral and chemical composition of the ore bodies change. Non-ferrous sulfide ores are one of the most volatile. Sulfide mineralizations from the so-called iron caps, which are observed as negative forms of relief. Chalcopyrite turns into azurite and malachite, and the colour becomes blue and green, respectively. In case of hydrothermal changes, the rocks can turn yellow - sulfur, molybdenum, copper; red - iron; blue - azurite; green - malachite, honey; purple - chrome.

Mining activities on the surface are carried out mainly by the method of mechanical excavation of open-pit mines and quarries and the construction of terraces or steps. The mines are used to extract near-surface deposits. Water technology is also used - with the provision of water, spilt - to extract poorly fused deposits, such as sand and gravel, etc. Underground mining is: vertical (shafts and chimneys), horizontal (tunnels, traverses, galleries, orts, sections) and inclined (inclined shafts, bremsbergs, slopes, etc.).

The metallurgical processing of copper ores occurred simultaneously in the Balkans and Asia Minor. Long before 6000 BC.

in Southwest Asia, metalworkers shifted from the use of natural copper to its extraction from oxide and sulfide ores, which marked the beginning of metal production by smelting. It is assumed that the process was adopted directly from the casting of natural ore. Natural copper mixed with small amounts of unwanted impurities of rock material formed from silicates or iron oxides, but containing copper oxides, is heated with the intention of separating the rock impurities from the pure metal. Carbon from the fuel extracted oxygen from the copper oxide (reduction process) to give metallic copper. Silicates and iron oxides also had to be melted and turned into slag. The observing master noticed that most honey is produced when it is placed in the fire with impurities from the rocks.

The general features of the early Balkan metallurgy can be summarized as follows: gold-copper bimetallic, which uses pure, non-alloy metals; casting of heavy cannons; practising complex foundry technologies; metallurgical and mining activities, turned into specialized crafts, which are practised separately from other activities. The development of metallurgy has become one of the main drivers of economic life in different historical epochs. The main ore areas containing copper mineralizations are the Malko Tarnovo, Burgas, Panagyurishte, Bor-Maidanpek (Serbia), Banat and Beica (Romania). The data show that the area south of Bourgas and the eastern parts of Strandzha have been known honey-producing areas throughout antiquity. A large mining centre has been opened near Malko Tarnovo. Many of the Roman mines continued to function during the Middle Ages and the Renaissance.

Most known ores, both in the past and now, are found due to their surface appearance. The metals were initially collected, used and processed as native, ie. as a natural product, as a special kind of stone. According to the scarce data and analyzes of finds, the melting and casting of metals precede the metallurgical processing. Simultaneously with it, the first (accidentally obtained) alloys appeared. Many other indicators are used, including the determination of anomalies in the elements in various samples taken from the soil, water, vegetation, snow, natural gas, algae, animal organs, which can serve as concentrators of traces of metals.

The subject of exploitation is the weathering zone of the copper deposits and mainly the oxidation subzone. The weathering zones of the vein and skarn copper deposits are the most convenient for operation. Data from studies in the vicinity of ancient ore mining centres and possible metallurgical technologies for copper extraction from the weathering zone of copper deposits show that the most likely method of metal extraction is the reduction of ores with carbon monoxide. Malachite and azurite have the property to decompose on heating, first releasing the hydroxyl group and then CO2. The reduction can be carried out at relatively low temperatures (500-600 ° C), without the need for fluxes and catalysts. Highly porous copper is obtained, which melts to 1083 ° C and is poured into moulds. For the implementation of this activity, it is enough to have wood as an energy carrier and to create a reduction environment in a relatively closed volume, which is obtained by arranging the fuel and ore in alternating layers. This technology explains the lack of slag as waste from the metallurgical process. All that remained was the ashes of the charcoal, which did not differ from the ashes obtained from the household.

The smelting of the ore was carried out in the immediate vicinity of the mining areas themselves, designated as metallurgical centres. Of these, the raw material, in the form of a semi-finished product (ingot), is transported to the production centres. Such are the complexes for artistic metal near Preslav from the X century. This process was carried out mainly for a profitable purpose, as most of the deposits are located in mountainous or semi-mountainous areas, which provided a sufficient supply of fuel in the form of timber. In this way, the settlements were protected from the pollution of the gases released during the smelting of the ores. Transport was also facilitated by the reduced amount of ingot raw material. In the workshops, the ingots were separated, whereby one part of the metal went for melting and use for casting finished products, and another part was used to obtain blanks. The latter include the thin copper and bronze plates and strips, the various cross-sections of metal rods and wires, found in abundance in the workshops and the area around them.

§ Ore deposits

Ore deposits are formed as a result of the concentration of a certain complex of elements, combined with minerals, collected in certain points of the earth's crust - in a given area, region, zone, section, deposit and body. The set of conditions under which the processes of concentration and deposition of minerals take place affects not only the qualitative composition of the mineral but also the structure of the mineral mass - as a whole and separately of the minerals from which it is formed. These conditions are the composition of the elements in a given solution; the degree of concentration; the nature of the deposition process and its speed; temperature and pressure. The formation of the qualitative composition, structure and texture of a given locality depends on these factors.

In mineral deposits, in addition to metallic or non-metallic minerals, minerals are usually found that accompany minerals but have no practical significance. In metal ores, there are ore minerals containing valuable metals - chalcopyrite, pyrite, galena, sphalerite, cassiterite, non-ore or vein minerals - quartz, calcite, barite, etc. For each individual deposit of minerals, there is a certain pattern that allows to they look for the elements of the mineral according to its characteristic paragenesis, which they orient very correctly when searching for minerals.

From the point of view of the mineralogy, geochemical composition and morphology of the ore bodies, on the territory of Bulgaria and its adjacent countries there are seven types of copper deposits: copper vein deposits; contact-metasomatic (skarns); massive copper-pyrite; copper-porphyry (copper-molybdenum) copper; stratiform; copper-containing sandstones; volcanic-sedimentary deposits. The copper vein deposits are typical for the eastern parts of the zone (Burgas ore region). There are skarn deposits in the easternmost part of the zone (Strandzha ore region) and in smaller quantities in the northwestern part of the zone (Serbia). Copper deposits of the vein type are characterized by linear weathering zones developed along faults coinciding with the ore veins. In the classical vein deposits, the ore minerals remain in concentrated form. This

determines the good opportunities for the exploitation of copper oxide ores and native copper.

In Bulgaria, there are more than 150 sites with traces of ancient mines and slag, in which were found facilities, tools, vessels and monuments, testifying to the intensive extraction of ore from ancient times. Many of them are not accurately dated due to violations of later developments and the deletion of old remnants of mining and metallurgical activities. In modern mining archaeology, dating is done exclusively on the basis of dendrochronological analyzes of remains of timber found in ancient mines.

The fragments of pottery, tools and remains of settlements found near the studied old mines are considered as a secondary source. Mineralogical and geochemical analyzes of collected pieces of ores and minerals are also performed in order to establish the mineral paragenesis and to identify the source material that has been mined by miners in the past. The mineral resources, especially of the copper in the region of Strandzha and Burgas are considered to be one of the factors that stimulated the ancient Greek colonization along the coast in the VII-VI century BC. Greek colonies were established along the coast in areas close to ore deposits. On the territory of Strandzha Mountain are located several dozen areas of ancient mining from all historical periods. Numerous toponymic data of settlements and localities also testify to the intensive mining activity in Strandzha.

During the geological observations in the Burgas-Strandzha ore region, numerous piles of slag, hundreds of excavations, entrances to old galleries, vertical and inclined shafts, dumps and quarries were registered. The long absence of a definite context of the discovered archaeological finds and the lack of purposeful research of the ancient mining in the area is gradually beginning to be overcome in recent years. The information on honey production has significantly increased during the different historical epochs in the region.

The Strandzha ore-metallurgical region is in itself an exceptional phenomenon. The ancient miners managed to find and develop all the ore-bearing bodies in Strandzha. Ore mining was concentrated in the area of the deposit. Hundreds of ancient works with various shapes of

vertical and inclined shafts, stoles, ditches, open pits were laid here. The shafts reached a depth of 100 m, the quarries occupied an area of up to 150/100 m, and the narrow quarries in Varli Bryag reached several hundred meters. Millions of tons of ore have been mined in the Strandja mines during antiquity and the Middle Ages, without taking into account the ancient developments on the territory of Turkey.

Simultaneously with the colossal ore developments in Strandzha, the extraction of copper was also developed. The slag dumps testifying to this production have been found in the areas of almost all deposits and reach several hundred tons of copper slag. This proves the large-scale metallurgical activity, estimated at hundreds of thousands of tons. All remains of metallurgical production are accompanied by archaeological materials from antiquity and the Middle Ages. For the miners and metallurgists at that time the ore region of Strandzha turned out to be attractive not only because of the abundance of copper ores and the proximity of the mines to each other but above all from the well-developed rich secondary zone, where the most suitable for metallurgical production. The dense forests that cover Strandzha also contribute to local honey production. The proximity of the fields to the seashore, which facilitated the transportation of the extracted honey, further supported the activity.

The complex use of the foundry practice leads to the aspiration to realize serial production, and in many cases mass production. The organization of such large-scale production requires the import of raw materials. The discovery of ores as a raw material for metal mining, as well as the widespread practice of metal casting in our lands, dates back to the second half of the Eneolithic. At this time dates the beginning of the separation of the two activities into an independent and organized craft industry. Sources of supply are not constant, which is a common practice in the history of metal production. Over time, they change, as a consequence not so much economic as of ethnocultural reasons. Such a factor as territorial proximity has not always played a decisive role. The places that were far from the sources received the metal in the form of ingots and processed it on site.

The change of culture also meant the change of places of metal production. Each such centre could have some autonomy and serve a population of several cultures, although it is associated with one of them. External relations and his destiny depended on her. In order for these centres to function properly, the supply of raw materials had to be timely and in the required volumes. This requires a well-established system, both internal and external (interethnic). There are many examples in ancient history where large copper and bronze processing centres appeared and functioned for a long time in the ore-free zone. There is probably a free trade in metals. The trade-in finished products is also going on. In many places, as a consequence of these integration processes, local production variants emerge, which differed in the typological features of the released production. However, the intensity of production depended on the proximity of the raw materials.

The main activity of the centres around Preslav is metalworking. There is no smelted ore here, although if they did, the foundries, with their proven skills, could handle it without much effort. But these moments, if any, must have been very rare, due to the lack of remnants of smelting furnaces, of the ore itself and the waste products accompanying such metallurgical activity. The main raw material came to the workshops in the form of metal ingots and separately in the form of scrap, which included discarded products and metal objects from earlier eras. The main source of copper raw material in the workshops for artistic metal is the Burgas-Strandzha region, which shows the comparative analysis of the elemental composition of the metal finds and ore samples from these deposits. Large-scale developments, which are one of the largest not only for the region but for the whole country, have satisfied with metal not only the production centres of the first half of the X century, but also other regions of the country, and probably those outside it.

Chapter 2. METALS AND ALLOYS

In jewelry production, it is necessary in the first place to take into account the physical properties of metals and alloys - density, melting point, thermal expansion, thermal conductivity, reflectivity. Knowledge of these and other properties lead to the correct choice of

the thermal regime of casting, forging, soldering, etc. The mechanical properties of metals are important, especially in the processing of precious metals. Some of them, such as durability, hardness, elasticity, plasticity are important for the use of finished products, their durability and durability. Taking into account the operational requirements and mechanical properties, the master was able to adjust the content of the alloys by adding some elements to them or to change some of the technological operations in the production process. No less important are the chemical properties of pure metals and alloys, such as resistance to environmental influences, for example - acids, gases, water and others. A special place is occupied by technological properties, such as thinness, liquation, shrinkage, etc., which is especially important for the choice of method and a certain mode in the processing of jewelry.

All these properties, although not scientifically explained for their time, were known to the masters who worked in the complexes for the metal art in the vicinity of Preslav. Their knowledge relied on practical experience, traditions in the craft, continuity and good preparation. Evidence of this is the products found in the research, which represent a small part of the diverse products made in jewelry centres. An idea of the knowledge of the medieval masters and the level of development of the jewelry craft during the early medieval period is given by the acquaintance with some basic principles in metallurgy. The specific characteristics are a starting point for the determination and analysis of the chemical composition of metals and alloys, the study of production technology, processing methods and others. All these and other issues are given special attention here and in the following chapters.

§ Construction of metals and alloys

Pure metals in the products of the art industry are rarely used, usually working with their alloys. Pure metals are chemically simple substances - copper, lead, silver, gold, etc. Obtaining absolutely pure metals is associated with great difficulties. Even in the purest honey, there are impurities of arsenic, bismuth, antimony, iron and other substances that are difficult to get rid of. Pure copper is rarely used,

even today, unlike its alloys - brass, which have important properties missing in pure copper. Depending on the number of components that form the metal alloys, they can be two-component, three-component, etc. The addition of various components significantly changes the formed chemical compounds and their crystal lattice. Knowing the basic principles in the theory of alloys, alloys with different purposes can be formed, which allow the subsequent stages of technological processing to form the required dislocation-phase structures and the necessary complexes of mechanical and other properties.

Typically, metallurgists strive to obtain a fine-grained structure, which implies the simultaneous formation of a large number of crystallization centres and a high rate of crystal growth. To ensure these two conditions, it is necessary not to overheat the molten metal and, if possible, to cool the hardening metal rapidly. The possibility of obtaining high-quality castings from metals and alloys is determined by a group of technological properties (casting properties). They represent a set of physical, chemical and physico-chemical properties of metals and alloys, which are manifested to a certain extent under the specific conditions of production. The ability of a metal to cast into moulds depends on a number of its physical properties. The most important casting properties are thinness, absorption and release of gases, sealing and shrinkage, surface tension.

§ Base metals and alloys used in workshops

According to a Byzantine medieval text, generally dated to the 10th-14th centuries and entitled "On the Differences of Lead and Gold Leaf", the main metals used in medieval workshops were gold, silver and copper. best quality, tin and various types of lead, specially treated. Other materials are sulfur, copper ore, gypsum and others. Wax, oil, fish glue, beef glue, resin and other substances of unknown composition were also used. The fuel material is coal and charcoal.

The main components that make up the morphological structure of the products, the work of the production centres for the metal art in the vicinity of the capital Preslav are no exception to the established practice. Along with their main characteristics, the principles of interaction with other metals and chemicals, which are relevant to the

study of the elemental composition of the finds from the various complexes, are noted. Thus, the idea of the raw materials that make up the metal compositions and their differentiation of original and artificially added to improve the properties of the alloys will be more clearly presented. According to the nature of the interaction of copper, the alloying elements and impurities used in the production centres for artistic metal are divided into three groups:

1. The elements (Ag, Al, As, Au, Cd, Fe, Ni, Pt, P, Sb, Sn, Zn) that interact with copper to form solid solutions. They increase their strength but decrease (due to the presence of arsenic and antimony) heat and electrical conductivity.

2. The elements (Bi, Pb), practically insoluble in solid copper, form a fusible eutectic with it. The increased content of bismuth (more than 0.005%) leads to cold brittleness of copper.

3. The elements (Se, S, O, Te, etc.) form brittle chemical compounds (Cu2O, Cu2S) with copper. The increased sulfur content in copper provides, on the one hand, an increase in the qualities of machining (cutting), and on the other hand, leads to brittleness. The presence of oxygen is the cause of its "hydrogen disease", manifested in the formation of microcracks. Areas of high stress occur in the metal, leading to the destruction of the material.

In the jewelry production in early medieval Bulgaria, high-alloy alloys are used, in which the individual alloying elements affect in different ways the casting properties of the alloy. Thus, iron and manganese reduce the thinness of brass, and tin (up to 2%) increases it. Aluminium and silicon increase the ductility in double alloys. The presence of aluminium in silicon reduces the thinness of brass and leads to the formation of pores. With a prolonged increase in zinc in copper (above 45-50% Zn), the strength decreases and the brittleness increases.

In the case of complex multicomponent alloys, the total content of alloying components does not exceed 9%. Additional alloying elements, with the exception of zinc, reduce the solubility of zinc in copper. The addition of lead improves the antifriction properties and

the cutting treatment. Al, Mn, Sn, Ni increase the corrosion resistance of brass. The use of high-zinc alloy by medieval masters, with a zinc content of more than 15% Zn, was aimed at obtaining decorative products resembling gold. The golden colour and corrosion resistance occur at a zinc content in the range of 20 to 30% Zn.

It is unlikely that medieval masters were familiar with all the technical characteristics of brooms and alloys, but one thing is certain - they knew the basic properties of metals, their physical characteristics and had the necessary skills to influence them and change them when they saw fit. Numerous production from production centres proves this. The presence of whole ingots, fragments of such, as well as the numerous molten solidified metal, are skillfully used in the preparation of the melter for another series of products. The exact proportions and amounts of metal are strictly observed in the process of work. The properties of the metals are well known and with the addition of more or fewer quantities, they are modified to meet the requirements. The proportions of the metal prepared for melting, where a precisely determined amount of scrap and separate parts of the ingots entered, were strictly observed. The measuring instruments found - dishes and scales, the abundance of exaggerations are a confirmation of the fact that the individual metals entering the alloy have been precisely dosed. Whether the product should resemble a gold or silver object or have its own individual appearance, depending on the composition of the metal placed in the crucible before melting. All other activities related to the production technology are also important - heating temperature of the furnace, heating temperature of the crucibles and together with the metal in them, greater or lesser access of air in the combustion plant and many others. The hundreds of products found at the place of production present a rich palette of colours and ranges, a reflection of the complex compositions of the alloys. The colour effect is especially noticeable when removing the upper oxide layer (patina), layered over time and "sealed" its authentic appearance.

Achieving high-quality production with the means known at that time depends not only on the knowledge but above all on the skills of medieval masters. Their enviable height is evidenced by the numerous

remains of specific tools and instruments that were used in the production process. It is unlikely that the medieval masters had any special "education" in this field, but rather all these skills were acquired through many years of practice in the craft. On the question of the professional specialization of the medieval masters, there is a lot of information and a lot of accumulated bibliography, which goes beyond the scope of the present work and is a matter of a separate topic.

More important here are the achievements of this well-organized class, among which are the skills to compose individual metals and alloys, the purpose of which is to obtain quality products. Probably the desired effect was not always achieved, which is suggested by the discarded products and the numerous scraps of hardened metal. Certainly, the experiments did not stop and the whole process was repeated until the moment when the desired result was obtained.

Perhaps it would be an exaggeration to consider the Bulgarian medieval masters as items in alchemy and its philosophical concepts, as no written or other evidence of such activities is known. It is more likely that certain beliefs and rituals associated with the worship of fire and metals, based on centuries-old traditions, existed in this community. What we can say for sure is that in the tenth century in early medieval Bulgaria there was a large-scale and very well-organized production of artistic metal, realized by craftsmen.

Chapter 3. TOOLS

The study of a given production, in separate settlements and specialized centres, is inconceivable without the study of the whole instrumental set used in practice. The research of the production centres gave a rich and varied material, which turned out to be a good basis for refining and clarifying the technology of production and processing of metal during the early Bulgarian Middle Ages. For the study of the craft, the ratio of the number of tools and the total number of products is important. At the workshops in the vicinity of Preslav, this ratio is approximately 1: 100. Found foundry and jewelry tools make up the full set of tools needed by the medieval jeweler. They are a reflection of the main stages in the production process. Specialized

tools, designed for specific operations and rarely used in everyday life, are an indicator of the level of craftsmanship practised in production complexes. On the one hand, they are a product of labour activity and on the other hand, they are the tools for this activity. The results allow talking about the technological possibilities, both of the society as a whole and of the individual groups in it, related to specific archaeological monuments.

So far, no burials of master jewelers similar to the ones known from the territory of Eastern Europe have been found on the territory of Bulgaria. The tradition of burials with jewelry and blacksmith tools is popular not only in Eastern but also in Western and Northern Europe from III to XI century. The disappearance of tools from funerals occurs under the influence of Christianization, which made the funeral rite uninventory. In addition, with the development of the specialization of crafts, the transmission of tools by inheritance became decisive and important much more than their symbolic placement in grave pits. Various instruments are present in the funerals of the elite, as evidenced by the rest of the rich inventory in them.

Some of the tools are stable forms that have retained their character and purpose from antiquity to the late Middle Ages and modern times. Finding quite a few examples from the late periods and modern practice, significantly help the functional definition of most of the tools found at the production centres in the vicinity of Preslav. The traditions established over time show the conservative spirit in the development and changes of most of the foundry and metalworking practices, perfectly mastered and applied by the Bulgarian masters. The fact that even today, modern jewelers observe and follow the basic principles of this craft is indicative. The purpose of some of the tools found in the research is determined by their long-term use. If there are any changes, they are insignificant and are expressed mainly in the use of some modern tools and materials to facilitate and accelerate the work process, rather than in its change.

The collection of metalworking tools is divided into several functional groups: support, percussion, cutting, cutting, padding,

gripping, pressing, for applying decor, forming and auxiliary. The tools are discussed in connection with the technology of jewelry production and the specific techniques associated with it. The complex presentation outlines the picture of the whole process, in which the place of each group of tools is strictly established.

§ Foundry practice

The wide range of tools that carry out this activity is divided into several groups: - made of metal, mainly iron and less often bronze; shaped by bone - bone awls, needles; production ceramics - foundry vessels (crucibles).

1. Metal tools

At the beginning of the foundry process is the production of models, which are subsequently cast finished products. The making of the models is the work of people specifically engaged in this activity - artists and painters, possessing the necessary knowledge and skills, and showing a creative approach in the work. To create the initial model, a special set of tools was used, which have specific shapes and are related to the different stages of work. In addition to shaping lead and bronze models, the tools were used for artistic engraving on metal. Among them are awls, trowels and scrapers, cutters, knives.

The next and very important stage, after the production of the models, is the manual moulding. The main part of the finished product is obtained as a result of the molding in double foundry boxes filled with moulding mixture. The size of the case depended on the size of the cast products, but it seems that these metal moulds were not large. That is why the remains of plates and fasteners, whose width varies from 0.5 to 2 cm, corresponding to the foundry moulds of the late periods, speak. Iron fittings from foundry crates were found at both studied centres for metal plastics. Among them, there is no completely preserved form, but quite a few fragments show their intensive use in foundry practice. Remains of bronze crates have not been found and have probably not been used. Wooden moulds have been used, mainly for the casting of low-melting alloys (lead), but no traces of them have been preserved.

A separate set of tools was used to prepare and fill the foundry box with moulding compound. The impermanence of the material from which most of the moulding tools are made is a reason not to find many of them in the research. The group includes wooden hammers and rammers to seal the moulding mixture in the crates; brushes for wetting the mould along the contours of the model before removing it from the mould; brushes for clearing sand from the surface of the model and from the surface of the mould; lines for levelling and smoothing the filling in the frame; sieves for sifting the facing moulding mixture, when applied to the model, etc. Mostly metal tools were found, including blades for filling foundry moulds; caps for mixing and levelling the moulding mixture; lancets for reshaping the negative images of the model printed in the foundry soil and for cutting casting channels to it; lifting hooks with a sharp tip and special tweezers for removal from the form of small and medium models; iron needles for making ventilation ducts in the mould; lancets for precise processing and repair of narrow depressions and radial surfaces; a set of trowels for precise processing of corners, grooves, etc.

After the moulding of the foundry crates, the pouring with metal melted in the crucibles is started. Special pliers, which are a rare find, were used to transport the crucibles to the crates. Special pliers are among the tools that have been taken special care of, are carefully guarded and carefully removed when leaving the workshops. The crucible pliers were used by the master jewelers to place the crucible in the furnace and transport it with the molten metal in it, as well as for some metallurgical activities. Traces of such tools can be seen on the walls of clay smelters (crucibles).

The tweezers are used for gripping and fixing the products during their machining. There are two types of tweezers, differing in their edges. The first type is tweezers with flat edges, which are used mainly for gripping small objects, stones and details. The retention of the products during the processing is done with another type of tweezers, made of double spring plates. Some of their edges are covered with notches, ensuring good grip of the part. Most of the tweezers are made of iron, but there are also those made of bronze

plates. This type of tweezers is used not only for gripping small parts with a simple shape but also for holding intricately profiled objects with indentations, as well as for pulling thin wires.

2. Bone tools

To the tools used in foundry practise, we must include the group of bone awls, which marks a variety of sizes and shapes. Due to the easily accessible material and method of construction, bone awls were widely used in the practice of jewelry production throughout the Middle Ages. Among the finds from the two centres, there are large and small firms, with more or less pointed tips, with roughly shaped or precisely polished surfaces. Bone awls are used both for the refinement of wax and lead models, and as moulding tools - ventilation needles for making vents in sand moulds, seals and rammers of the casting mixture, angle shapers and laying of grooves, lifting hooks for removing the models, etc. The awls found in the research are only a small part of this type of product that has reached us. Most of them were destroyed during the long-term mechanized cultivation of the agricultural terrains on which the metal-plastic complexes are located. Traces of their processing with metal cutting tools - knives and cutters can be seen on the found specimens.

3. Production ceramics

Of the whole set of tools found in the study of metal plastics centres, the largest share falls on those that are directly related to the casting processes. To this day, the foundry is one of the most important technological methods for processing non-ferrous metals. The two groups of objects that testify to the presence of metal production are foundry vessels and moulds. Foundry vessels are called by different names. Some researchers call them pots, others crucibles, and often take both names as synonyms. In practice, however, there is a significant difference between them, expressed in the functional purpose, which implies changes in both form and structure. In metallurgical practice, crucibles are mostly closed vessels, limiting as much as possible the access of oxygen and oxidative processes in them, while the pots are open wide conical or spilt vessels.

The shape and structure of the crucibles contribute a lot to the restoration of the production process and the sequence of the individual stages in it. This requires their detailed study. Vessels usually reach us in a fragmentary state, and finding whole specimens is rare. This is due to both their structure and the high temperature, which turn the dishes into brittle and fragile products. However, there are enough whole vessels that are a good basis for studying their functional and technical characteristics. Foundry vessels provide information in several areas: shape and size (determined by the cultural environment and chronology); production and composition of ceramics (determined by traditions and specific use); functional processes (determined by technology). Archaeological excavations at the first centre for artistic metal near Novosel have contributed to the completion of the collection of this type of rare items with over 120 targets and fragmented vessels. The results of the study at Zlatar are similar. So far, more than 350 whole and fragmented vessels have originated there.

The crucibles have a hemispherical shape with an elongated and widened bottom (belly), a pinch grip handle and a narrow mouth for casting molten metal. The found whole and fragmented vessels also show that they were made on a model (mould), with the help of which the hemispherical volumetric body was formed together with the mouth. This is confirmed by the visible edge above the latter and the outline of the oval wide opening next to it at the top of the crucible. The initial assumptions about the separate construction of the gripping handle were confirmed by the numerous fragments found from different parts of the vessel. Like the handle, the stopper at the top is made separately. It is also shaped into a mould by plugging the container after the metal shavings have been placed and after the clay has dried completely. The assumption that the crucibles are made with shape and pattern is confirmed by the size and thickness of the walls (0.5-0.8 cm). A large number of crucibles confirms their single-use and the fact that they are made in the studio. The metal - copper, bronze alloy or lead, was placed in the vessel in the form of small pieces and shavings. One sure sign of this is those found in one of the crucibles, which was not placed in the furnace.

The analysis of fragments of the vessels showed the high values of iron in them -48% Fe, where the colour of the skull is bluish-black and there are pores in it. The presence of some uneven warming is due to particles of feldspar and mica, which at high temperatures act as melting substances. This explains the significant amount of potassium - 24%, which is a major component of potassium feldspar (orthoclase). The colour of the clay in pale yellow is due to the mineral limonite, which is confirmed by the predominant iron in the chemical composition of the foundry vessels. The colour of the clay gives some idea of its properties. In large quantities and at high temperatures, as in the present case, limonite is converted to iron trioxide (Fe2O3) and stains the vessels dark red. There are quite a few whole and fragmented crucibles, where such colouring is observed.

In some places, it has a rust-brown colour with a violet tinge, which is due to nickel silicates (NiO, Ni2O3). The violet hue is a consequence of manganese compounds (MnO2), while the dark green colour indicates the presence of chromium compounds (dichromium trioxide (Cr2O3), potassium chromate (K2CrO4), lead chromate (PbCrO4)) and copper oxide (CuO). Last but not least, the presence of zinc Zn should be noted. Zinc oxide (ZnO) is obtained from the oxidation of zinc vapour, which is due to the colouration of some of the walls of the vessels in a matte (opaque) white.

The presence of potassium and calcium indicates that the predominant in the composition is alkaline and alkaline earth aluminium silicates, such as orthoclase, favourite, kaolinite. They are a major component of all clays, sodium carbonate (Na2CO3), potassium carbonate (K2CO3) and others. In particular, the clay from which the crucibles are made can be defined as secondary (sedimentary) clay and depending on the substances of which it is composed - as marl. Significant quantities of these clays are found in the northeastern regions of Bulgaria. An important reference point for the place of extraction of clay for foundry vessels in the presence of the element strontium in the chemical composition. It shows the presence of strontium sulphate (SrSO4), which is formed by the crystallization of seawater. It has been established that in Bulgaria there is celestine in the Popovo and Shumen regions. On the other

hand, in the region of Preslav, there are known deposits of pure white clay. Grey clay is located in the Koriyata locality, and red - in the Korijata locality and near the village of Vinitsa.

§ Cleaning of castings. Grinding and polishing

1. Metal tools

After separating the castings from the casting mould, the surface is cleaned, which is never perfectly smooth and always needs finishing. Leeches, metal outbursts, bays, roughness are removed. The products are smoothed and chiselled, then sanded and polished. For this purpose, files of various shapes and sizes, cutters, knives, special tools for cleaning castings, grinding abrasives of soft stone, wooden sticks are used. In the workshops in Novosel and Zlatar were found files, curved ironing knives, a large number of straight knives of different sizes and a dozen grinding stones. To the mentioned tools we have to add some of the awls and lines with a bevelled and pointed end at one of the working sides. In addition to retouching lead models, they are used for finishing bronze castings, along with other grinding and polishing tools. At the final finishing of the polishing, leather and fabrics are used, as well as coals of different sizes. Scrapers of different sizes were also found - tools with several cutting sides. They can be flat and straight, flat with a curved edge, profile or triangular. They are used to scrape a thin layer of metal from the surface of the part. Scraping is applied when the surface needs to be smooth; straight and curved fields, usually pre-ground, are processed.

2. Stone abrasives

Grinding stones are the most numerous group of sharpening tools, offering a wide variety of shapes and sizes. The advantage of the soft abrasive material is the ability to make the desired shape. Stones with a rectangular cross-section predominate; the thickness varies and varies from thin plates to massive pieces. The surface is also different - some are polished, others are rougher and rougher. There are also those with round holes for hanging or smoothing a thin wire. Grinding stones are auxiliary tools, which after use, remained at the place of production.

§ Forging. Stamping. Artistic engraving

Forged relief is one of the oldest techniques for metal processing, which does not change over time. The practice is associated with a certain set of tools, the main ones being the support, percussion and cutting tools and those for applying decor. Jewelry anvils are one of the rarest tools found in production centres not only in our country but also in most medieval complexes outside the country. Insertion anvils originate from the production centres, which end at the end with a spike. Their work surface is hemispherical and round, flat or rectangular. Two anvils were found in Novosel. The first has a rectangular workspace and the second has an oval. A hammer and a lead pad were found, used for applying and cutting ornaments, chisels with round and rectangular working part, etc. In Zlatar originates a Bronze matrix and an imprint of it with an image of a sirene have been found in Zlatar. There are several fully preserved jewelry hammers, two small anvils, different in size chisels and chisels, half of the pliers with long handles, chisels with round and square cross-section, drills and more.

The metal sheet gets the desired shape with the help of different types of chisels, punches, pads, sticks, dies, prints. The stamping consists of cutting, drilling, bending and stretching of the metal, which in practice is done with special scissors, saws, holes, cutters, hammers, pliers and more. Each stamp consists of several elements, the main one being the matrix, followed by the punches. Various iron clamps and restraints are used for fastening. The chisels and chisels are very well preserved, which is due to their larger size compared to other tools. The artistic engraving and relief use the full range of awls, lines, incisors and scrapers mentioned. Many of the tools find appliques for more than one activity, confirmed by the production found with them. The tools received from the research of the workshops for artistic metal are evidence of the appliques of the techniques of artistic forging, stamping and engraving, along with the basic foundry craft, ie. the individual jewelry practices are equally well mastered and successfully applied by the same masters in the same place.

The comparative examination of the received research tools and the one used in the modern jewelry practice finds striking similarity. One of the most important and classic tools for metal processing are hammers, described in detail by Theophilus. Used hammers with low and flat warhead and wedge hammers - rounded and without sharp part. The work surface must be very well smoothed so that it does not imprint any unevenness on the product. The minimum size is 28 mm, and the mass depends on the force of the impact. The jewelry pliers differ from blacksmiths mainly in their reduced size. Half of them were found in Zlatar. Pliers are used, with different shape of the working part and the handles, depending on the activity for which they are intended. Chisels are another important group of tools widely used in workshops with a length of 120 to 180 mm and a conical double-edged workpiece. Chisels cut pieces of metal, plates, wires. Thin chisels apply ornaments - notches, spiral notches and more. A significant group of punches are used for hammering ornaments with an incised pattern, for cutting small plates and more. This type of tools are common on all monuments with traces of metalworking and are an indicator of such.

The final sheet processing is done with the help of scrapers. The shape of the cutting part is a typical shape of a wedge removing chip metal. The scraper blade cuts into the metal and leaves a groove of uniform thickness. Sometimes the bottom of the tool is bent at the front so that it can be held at a sufficiently large angle to the surface. There are narrow and wide sharp scrapers, with triangular and polygonal cross-section, horseshoe-shaped and trapezoidal working part, etc. The file is one of the most important tools used for cold metal processing - cleaning castings, smoothing, grinding, polishing and more.

It is known that during the Middle Ages the master professional had the skills to perform a wide range of operations related to several related crafts, including the processing of iron. The iron tools found in the research of the production complexes, no doubt, were made by the masters who worked with them. Evidence of the latter is some unfinished tools and blanks for those found in the workshops and their surroundings. The practice of reusing damaged and broken iron tools

is also applicable. Throughout the Middle Ages, the toolset was considered a great value and especially the jewelry set; the livelihood of the whole community depended on its maintenance and storage. Therefore, if necessary, individual tools and metal raw materials, in the form of scrap, are carefully vaulted, along with other noble values.

The jewelry tools found in the production complexes reflect the high degree of development of the craft and the appliques of many practices. The dimensions of the tools, their shape, method of manufacture, testify to the precise and fine processing of metals. The set of tools reflects the whole variety in the technological process of cold and hot processing of metals and their alloys. Apparently, the medieval master was not firmly attached to a particular scheme, and in practice, morphologically identical products were made differently. However, the effective, economical and easy way to achieve the desired result is preferred. This was largely determined by the volume of production and the nature of the production.

Production activity was strictly regulated; each specific work is performed by professionals, ensuring the successful realization of the specific goal. These are foundries, fashion designers, blacksmiths, tanners, manufacturers of foundry vessels and household local ceramics. The found tools confirm the stationary nature of the production activity, concentrated mainly on the territory of the complexes themselves. Large-scale and well-organized production is a prerequisite for the existence of a work program that goes beyond individual practice and satisfies more consumers, which is achieved by entering the market.

Chapter 4. TECHNOLOGY AND PRACTICE

The task of technology as a science is the manifestation of physical, chemical and mechanical laws in order to determine and use in practice the most efficient and economical production processes. The technology of artistic processing of metals in the Middle Ages includes mechanical and manual methods with different properties and qualities. The technological scheme or metalworking is a set of basic methods for the manufacture of metal objects in view of their strict sequence. Most of them are known from the dawn of metalworking in

antiquity, others emerged later on the basis of practice and some technical innovations.

§ Foundry practices

1. Fusion moulding (cire perdue)

Obtaining castings in foundry moulds, made by fusible models - cire perdue or lost-wax casting is one of the oldest methods for obtaining cast blanks. The spread of the wax casting technique is the simplest way to make quality castings, as well as to obtain products with a complex configuration. The process goes through several steps: making the model; the appliques of wax; model coverage; melting and leakage of wax; metal casting; removal and finishing of the casting. In practice, however, only a small part of the products found in the research of production complexes, mainly lead and bronze models, are made with this technique. The disadvantages of wax casting include the high cost of cast products and the long duration of the whole process. Therefore, in practice, one-sided moulds were used for casting the original wax models, on which lead and bronze models were subsequently made. The lead mould found for appliquess in the vicinity of the production centre in Zlatar proves this. Made of lead, the mould was not used for casting lead models, especially bronze ones. This shows that the method of "lost wax", which requires a lot of effort and time, was not among the leaders in the production centres for artistic metal.

2. Sand-casting

The most common method for the manufacture of metal products in the production of artistic metal in early medieval Bulgaria was casting in a moulding mixture. This method is known as sand-casting. One of the reasons for the lack of visible remains is that the sand goes through several procedures, such as sieving, drying and subsequent use, in which it is lost, replaced and falling into the soil leaves no visible traces.

Finished products and product defects are sure proof. The dividing line of the two halves of the sand moulds, printed on the

outer outline of the castings, where it has not been removed, is a major feature. So far, no serious attention has been paid to this feature and it is accepted for the use of two-component stone forms. However, there is a significant difference between the two dividing lines and one of them is the width. The latter, respectively larger in the case of stone moulds, is narrower in the sand moulds. It is believed that the stone moulds were used mainly for casting articles of refractory alloys, such as lead and tin. The prolonged casting of bronze objects and copper alloys in general, having a high melting point (above 1100ºC) in stone forms leads to their rapid wear and subsequent destruction.

The more efficient and safe method of "sand casting" is preferred in production with a more mass character, such as in the complexes near Preslav. The process of obtaining the casting consists of the following: with the help of the model of the cast product through various devices and tools from the moulding mixture is made a mould. The molten metal fills the mould and cools in it, casting with the desired shape is obtained. In this way, not only the bronze objects were cast, but also most of the models. In practice, the preparation of the models is carried out by means of finished product; fusible alloy model (lead); copper alloy model (bronze). Metal models have a number of advantages over wax models: they do not break down, retain their shape well, have durability, clean surface and significant durability. The metal models guarantee long-term preservation of the original work of art embodied in them. They also show additional surface treatment. In the moulding process of such models, the moulding mixture does not stick to them. The models are well separated from the form, leaving a clean and clear imprint on its walls. Some of the bronze models are additionally remade products, on which the spikes have been removed, the traces of which have been precisely smoothed and erased. In this case, it must be considered that it is a matter of using a finished product for a model, which is supported by the lack of additional processing and reduced dimensions from those of other models.

§ Grinding and polishing

The finished casting comes out of the uneven shape, covered with the so-called. casting leather, there are exposed pores and pores in the metal and many other defects. Products with larger defects that cannot be removed or repaired require more time and effort are scrapped and remelted and new castings made. The purpose of grinding and polishing is to give the finished product certain surface cleanliness and accurate dimensions. Grinding serves to obtain a smooth surface, the shape change in this treatment is insignificant and plays a secondary role. Polishing ensures a smooth but matte surface with a strong metallic lustre (gloss). There is no sharp line between grinding and polishing, as the two processes pursue similar tasks. Cleaning from sand moulds is done with the mentioned tools - files, cutters, scrapers, knives, and polishing - with grinding stones, leather, charcoal, bone awls and more. This is a long process of processing, including polishing the surface, correcting the detected defects and additional engraving of the ornaments and details.

The most responsible operation consists of the removal of the castings and all defects and inaccuracies of the casting. From the found blanks it can be seen that this is one of the final stages in the preparation of a certain type of product. In many cases, the artistic casting is additionally painted and ornamented, and this applies most fully to the lead models. There are many finished bronze products, which also bear visible traces of processing not only the outlines but also the ornamented surface. Visible traces of polishing and grinding are noticeable on a significant part of the castings and are most clearly visible on the products with an additional metal coating.

§ Blacksmithing practices

1. Forging

Forging is a method of processing metals under pressure; the technological property of metals related to their plastic deformation. The purpose of forging is not only to give the desired shape to the processed metal but also to improve its mechanical properties. There are two types of forging - free and with stamps (dies). From the ingots of copper and silver and from the bars of gold are hammered metal sheets (sheets) - copper with large iron hammers, and gold and silver -

with smaller hammers. The sheet metal obtains the desired shape by hammering on various anvils, splinters or elastic pads and powdered pieces of ceramics or sawdust. Various techniques are applied - hammering on an anvil, hammering with chisels, rolling, hammering with dies, pressing with dies, etc. In the workshops in the vicinity of Preslav, the last two techniques were mainly applied, which are somewhere defined as stamping techniques.

2. Stamping

Stamping is a later, defined as medieval, method of metal processing, which became especially popular in the tenth century. The method is a simplified version of forging according to the craftsmanship and training of the craftsman. Sheet stamping allows recreating the author's sample on a larger scale with a high degree of accuracy. Thin-walled parts with a clean surface, the same size and weight are obtained, without additional processing. For sheet metal stamping, metals and alloys susceptible to plastic deformation in the cold state can be used. These include precious metals - gold, silver; coloured - copper and its alloys. Stamping consists of several operations: separating (cutting, cutting, drilling); shape-shifting (bending, stretching, moulding, mechanical forging). Each of them can be used in a different combination with another, as the sequence in their use varies depending on the nature of the manufactured product.

The mentioned activities are performed with the help of special tools - stamps, which have a different shape depending on the purpose. Artistic stamping is performed under the blows of a hammer on a blank (sheet material), which can be preheated or without heating. It is the forging of a thin copper sheet on a matrix of a hard material - most often a bronze casting, in which by striking the back of the matrix - its positive shape is printed on the object filled with the elastic mixture. By putting a lot of effort into casting the die on a wax model, the master has the opportunity to use it long enough. The blows of the wooden hammer through the thick lead cushion and the sheet metal did not cause major damage to the die, and therefore the set of dies did not require frequent replacement. The use of matrices speaks of mass production. A bronze matrix for hammering ornaments was found

during the research of one of the workshops in Zlatar. It has an image of the mythical creature mermaid and is the only one of its kind known from the period of the early Bulgarian Middle Ages. It was used to make appliquess from thin copper sheet, which were subsequently gilded with mercury amalgam. Proof of this is the found imprint of one with a mirror image.

§ Metal coatings

1. Coatings types

A metal coating is a method of applying one metal to another metal. The goal is to coat less corrosion-resistant metals and alloys with more durable and valuable ones. The resulting metal layer can be ground, polished and processed by various methods. The coatings are hot and cold. In hot coatings, the metal layer is applied to the surface in a hot molten state. The method consists of immersing the finished products in hot metal and removing them quickly. A thin layer of metal is formed on the products, which penetrates into all recesses of the relief. When applying hot coatings, the metals must be fusible and the melting temperature of the products must be significantly higher than the melting temperature of the metal intended for its coating.

Cold coatings are applied in solid form on the metal base of the object. The method consists in placing on the surface of the object thin sheets of precious metals - gold, silver or a two-layer sheet of silver and gold or silver and copper. To obtain thin sheets of gold and silver, special seals were used, between which the individual sheets were forged. Most of the bronze products have a grey-white metal coating on the front surface. The study of the chemical composition of the metal coating proves the use of silver alloy and tin amalgam.

2. Gilding and silvering

Some of the silver objects are gilded, and the copper and bronze ones are gilded or silvered. This is one of the means to give the base metal products an aesthetic and attractive appearance. It is known that items made of copper and its alloys are best silvered.

Amalgamation as a functional techno chemical imitation operation is known in alchemy as ars sacra. Amalgams are alloys of mercury with metals, which depending on the metal content can be liquid, doughy and solid. Amalgams most easily form gold, silver and tin. In the practice of production of artistic metal, several methods are applied for applying the precious metal on the object: by immersing the object in molten gold or silver; gilding and silvering with mercury amalgam (obtained by grinding gold or silver powder with mercury). The well-cleaned and pre-polished object is smeared with the prepared mixture with the sole of a rabbit's foot, after which the object is heated, the mercury evaporates and only the gold coating, tightly adhering to the surface of the object, remains. The advantage of amalgam gilding is the use of small amounts of raw material and the possibility of repeated appliques to achieve the desired effect.

Along with amalgam gilding, the method of gilding with gold solder is also used. The pre-cleaned object is smeared with an aqueous solution of table salt and fine ash from grape boats, then sprinkled with gold solder and wrapped on top with a thin gold leaf. When the object is heated, the gold leaf adheres firmly to the object. Gold solder is obtained by mixing molten gold with arsenic and the resulting compound, which has a much lower melting point than gold, is poured into cold water, where it solidifies into grains. Subsequently, the grains are ground to a powder, which is the golden solder. The copper or bronze object can be treated with mercury and form a copper amalgam on the surface to which the gold leaf joins; the whole object is then heated to evaporate the mercury.

Silver plating with silver solder is done in the same way as gilding with gold solder. Silver solder is obtained by mixing molten silver with arsenic and sometimes with sulfur. When gilding with lime, the object is pre-cleaned, smeared with fish glue and wrapped with a lime sheet, after which the lime sheet is pressed with a soft brush to adhere tightly to the surface of the object. This is how blanks are made of gilded copper and silver-plated sheet metal, which is closed between the metal sheets and heated until soft.

In the specialized centres for art metal different variants of these methods are used - from immersion of the product in the molten metal to amalgamation. Gilding and silvering with the help of amalgam allow obtaining a very thin but strong coating with a small amount of metal. The gilded products completely resemble those made of precious metals. The richly ornamented surfaces created reflections in the movement and play of light, and the belts and horse ammunition decorated with them could be seen from a great distance. This made them preferred and sought after items.

§ Artistic decoration

Artistic engraving on metal casting is used in the production of artistic metal. The essence of the method consists of applying for a linear pattern or relief on a material with a sharp tool. The engraving serves as a supplement to the artistic solution of objects of a different metal. The decorative design of the objects is done in view of the observance of rhythm, symmetry, harmonious combination of the strokes, etc. The engraving is flat and voluminous. Plane engraving consists of decorating the surface of the product by applying a contour drawing or pattern. The possibilities of planar engraving are very wide - details, drawings, graphics, executed precisely with a cutter on the metal surface of the product. The models on which the bronze products were cast are formed by engraving.

§ Connecting individual elements

Soldering is the separate joining of metal parts in close contact by means of incandescence and molten alloy (solder) with a lower melting point. The following requirements are met: the hot molten solder must wet the surface of the hard metal, ie. the adhesion forces inside the solder drops must be less than the adhesion forces arising between the solder and the soldered part; the soldered metal and the solder need to adhere tightly to each other; the welded joints must be well cleaned; the solder and the soldered metal must form an alloy with each other that has the ability to penetrate each other; the solder must melt at the time when the base metal is in the solid-state; metals and alloys with a high melting point are soldered with hard solder and low-melting - with soft solder.

§ Withdrawing

Pulling is a process of plastic processing of metals in a cold and hot state, in which the shape and the cross-sectional surface of the workpiece change due to the drawing through a plate with holes of different diameters. As a result, the cross-section of the workpiece decreases and its length increases. The preparation of blanks and wire of different diameters is used. Withdrawal is by forging and calibration. In the first case, the ingot or piece of metal is forged with a hammer into a rod of a given thickness and profile. Another way is to get a sheet from an ingot or a piece of metal by forging, which is cut into square strips, the end of which is rounded by hammer blows. There is also a method similar to the second, with the difference that the cutting of the sheet is not straight, but rounded. Rounded cuts produce long pieces of wire, which is the advantage of this method. This technique makes it possible to obtain relatively long pieces of wire but is unsuitable for making very thin wires.

The attempt to facilitate the work of making a fine and thin wire leads to the development of a new method - calibration, which consists in passing the raw material through holes in solid materials. Flat round wires of great length are made with special tools called hates. Under the influence of external traction, the material is pulled through the opening of the hut, the dimensions of which are smaller than those of the raw material. A similar instrument was found at the centre in Zlatar, which, together with numerous finds of copper and bronze wire, confirms the appliques of this practice.

The manifestation of all technological schemes allows us to speak about the high mastery of the Bulgarian jewelers. They perfectly distinguished the properties of the processed alloys, grouping the different methods into a coherent system of interconnected and repetitive actions. In addition to the foundry, all other methods related to achieving an original and finished look of the finished product have been applied in practice. The exquisite ornamentation on the lead models and the bronze products shows high professionalism and mastery, expressed through the means of artistic modelling and engraving. An important point in the overall picture of production is

the skills for applying and applying metal coatings on cast products. The use of the well-known and established in ancient times recipes for amalgams based on gold, silver and tin are evidence of the continuity in mastering this practice. The coatings of precious metals on the bronze castings are a result of the mass nature of production, the desire to reduce the cost of production and last but not least the achievement of the aesthetically durable appearance of the finished products. Along with this appliques are the main types of solders, some of which remain unchanged to this day. The most important condition for the development of this activity is the presence of good specialists, strictly profiled in their field, who have successfully met the needs and aesthetic taste of a wide range of consumers in society.

CONCLUSION

Byzantine civilization had a lasting impact on the development of many peoples in the medieval world. The area of distribution of the Byzantine culture is wide - Sicily, Southern Italy, Dalmatia, the countries of the Balkan Peninsula, Ancient Russia, the Caucasus, the North Caucasus and Crimea. The most intense is the influence where Orthodoxy is established. Through Byzantium, the ancient and Hellenistic cultural heritage was passed on to other peoples, with which the Byzantine influence became a continuation of the cultural traditions of the Greco-Roman and Eastern Hellenistic worlds. In different areas of culture, the impact is manifested with varying intensity. In some areas, there is a synthesis of Byzantine heritage with local cultural traditions, and in others - it is a completely new phenomenon. Such is the influence in the field of church dogma, canon law, liturgy, liturgical literature and cult fine arts - all innovations after the adoption of Christianity. After this act, the Byzantine culture became a natural and important factor in the development of the early medieval Bulgarian culture. As in Russia and the countries of South-Eastern Europe, the Byzantine civilization became the foundation of the original Bulgarian culture. Most of the works of metal sculpture are an example of a synthesis between local traditions and Byzantine cultural influence.

Especially consistently secular motifs can be traced in the works of jewelry. In monuments that are less dependent on the official religion - it is easier to enter the distinctive features of local practices. Confirmation of this is the belt sets made in the local centres for the production of artistic metal. Some of the shapes and ornaments have some similarities among the common garnishes in Hungary during this period. However, the direct analogies are not so many and this does not give grounds for deriving the origin of all belt sets found on the territory of our country, with the Hungarian expansion against the First Bulgarian Kingdom or with the direct cultural influence. In Hungary, belt ornaments are perceived as an original ethnocultural phenomenon with Sassanid or post-Sassanid characteristics, which is based on the combination of the floral ornament with zoomorphic or anthropomorphic images. The basis of the old Bulgarian ornamentation is in its own cultural tradition. There is no denying the interaction between the late Avar and Bulgarian practice in the production of belt sets. On the one hand, it is expressed in the direct cultural influence of the empire, and on the other - in the practice witnessed by the Byzantines themselves to wear such belts, defined as "Bulgarian belts", consisting of gold and silver belt tips and appliquess.

After the adoption of Christianity by Byzantium, the richly decorated belt set became widespread in Bulgarian society in the tenth century. Its decoration combines Byzantine floral ornamentation with the inherited proto-Bulgarian tradition in a compositional interpretation, the basis of which consists of individual elements edges). The fashion to wear decorated belts in the 10th century in early medieval Bulgaria was widespread and this is confirmed by the presence of specialized workshops for the preparation of such sets. This practice is supported by most of the reports in the sources about the use of decorated belts. Among them are the ruling images of Boris and Simeon from the Teacher's Gospel and Hippolytus' collection; the descriptions in the Six Days by John the Exarch, the chronicle of Regino, the information of Liutprand, Ibrahim ibn Jakub, the letters of Pope Nicholas I to Boris, and others.

The existence of local production confirms the existence of established traditions in jewelry practice during this period. Their combination with the new style in Byzantine ornamentation brings an individual look to the works, both stylistically and technologically. The main way in which Eastern compositions enter Bulgarian art in Byzantium - it itself was influenced by the East during the various periods of its development (early Byzantine, iconoclastic and during the Macedonian dynasty). The importance of Constantinople as a major center of artistic crafts determines the spread of established practices and technical skills, as well as patterns and specific ornamental motifs in the provinces and far beyond the empire. Similar processes began to take place in the early medieval Bulgarian art and in particular in the works of artistic metal. Despite the proven influence, there are not enough grounds to assume the existence of workshops on the territory of Bulgaria, run by Greek masters. Small art forms rarely need the relocation of foreign artisans. Rather, the original is copied directly by local, more or less qualified craftsmen. The guarantor does not dictate the desired style of the artist but can choose the master performer, working in his own specific manner. Art enters more broadly into the life of the whole society.

The achievements of artistic processing in the X-XI century testify to the development of jewelry based on the experience of the craft adopted by Byzantium. Byzantine products are often used as models, even when it comes to Eastern traditions and "Orientalism". At that time, the typesetting belt was "desecrated" and went out of the orbit of its symbolic interpretation in the role of rank distinction, which it carried in previous centuries. The fashion of the decorated belt is widespread among society and is a specific manifestation of the popular tendencies in the Eurasian fashion. Observations show the existence of their own style in each community, which manifests itself with its own specificity and varying intensity, marking its upward development at a particular time. For example, large-scale production and widespread use of the decorated belt in Bulgarian society is determined mainly in the early and mid-tenth century, in Hungary - in the middle and third quarter of the century, and in Russia, fashion enters the second half of the tenth century. , during the era of Olga-Svetoslav. Influenced by Byzantine ornamentation, the new style in

the fashion of the decorated belt in the Bulgarian lands was adopted by the Arpad Magyars with their settlement on the lands of the Middle Danube. At the same time, they preserve their old traditions and form their own style within the general Eurasian fashion. Due to this, the stylistic closeness between the two schools - the Bulgarian and the Hungarian - is small. The tendencies in Russia are similar, where the Byzantine ornamentation, filtered through the Bulgarian traditions, is spreading.

The specific features in the composition of the belt set in each cultural environment are determined by the sustainable nature of local traditions and the level of development of crafts that actually realize the products. The transformation of known and established schemes brings the individual handwriting of the community and the level of perception of the general fashion trends. Therefore, the same, at first glance, motifs and compositions are recreated in their own manner and technique of performance, which distinguishes them from the neighbouring community. The origin of the ornamentation is similar, and the interpretation - strictly specific and emphatically original. This is due to the closeness and at the same time the difference between the products of the different production regions, both in terms of decor and material and manufacturing technology. Numerous monuments, including belt sets, crosses, jewelry and many others are copies, closer or farther, have greatly changed their prototypes. This is especially characteristic of the countries entering the orbit of the Byzantine cultural influence, among which is the early medieval Bulgarian state. The set goal - to study the production of artistic metal in early medieval Bulgaria on the basis of the findings of the centres for metal plastics has been achieved. The results prove the existence of large-scale and organized production of metal gaskets in the vicinity of the capital centre Preslav in the first half of the tenth century. technological and stylistic attitude details have also been achieved successfully. This was due to the enviable number of objects and the numerous findings from research abroad, proving the role of the decorated belt in society at that time.

In the course of the research, all set tasks were solved. The role of the belt is presented against the background of the numerous belt

ornaments from the place of their production. A general compositional scheme has been developed, uniting the species diversity of products, subordinated to the functional division between them. The attempt to reconstruct belt sets based on data from finds and parallels from synchronous cultures gave very good results. The presented variants reflect the richness of the artistic metal products made in the first half of the tenth century, among which the details for belts are predominant.

The analysis of the elemental composition of selected samples from the three production centres, conducted at the Atomki Institute for Nuclear Research in Debrecen, is a starting point for the comparative study of the elements in the products from each production centre. This makes it possible to highlight the specific elements in the alloys, which are leading in the search for the origin of raw materials for large-scale production of metal. Thus, the origin and the way of the raw material to the production centres are established on the basis of a comparative analysis of the results of the research of the elemental composition in ore sources and finds from the workshops. The main source is the Burgas-Strandzha region, which is proved by the similarity in the elemental composition of the products and samples of ores from the deposits.

The task of presenting the whole set of jewelry tools on the basis of its practical appliques has been successfully achieved mainly in view of the later and modern appliquess of most tools. The research of the tools is directly related to the production technology and their synchronous research gives satisfactory results. The peculiarities of jewelry practices are set against the background of the development of the craft from antiquity to the late Middle Ages, solidly supported by the rich source material. All observations in the course of the developed topic are illustrated by numerous images, presenting the main summaries and conclusions.

The implementation of the set goals and objectives justifies the efforts and proves the importance of the developed topic for the production of artistic metal in the early Bulgarian Middle Ages according to the findings of the first known and studied in Bulgaria

centres for metal plastics. Based directly on the results of systematic archaeological excavations, the work proves not only the existence of large-scale organized production of artistic metal in the vicinity of Preslav but also presents the species diversity of this activity. The rich pictorial program that the finds carry is a reflection of the creative potential and artistic sense of its creators. These are not ordinary craftsmen, but actually jewelers - creators of a world saturated with vivid imagery. It is in this direction that the prospects for future research should be sought. The study of the two production centres - near Zlatar, Preslav and Nadarevo, Targovishte will contribute to the enrichment of the overall picture of the production of artistic metal at that time and will outline the full range of products, which include not only the details of belt sets but all other works - jewelry, cult objects and many others.

An important direction is to fill in the database of analyzes of the elemental composition of finds from the places of their production. All product groups must be added to this. In addition, it is good to analyze findings from surveys of settlements and fortresses from near and far regions, chronologically relating to the same period, in order to trace the territorial scope of distribution of products from production sites to their users. Where possible, similar examples from related cultures should also be analyzed to outline the characteristic metals and alloys for each region. This, in turn, will contribute to finding the sources of raw materials and their use. The proposed direction would outline new horizons in the study of technology and different practices in metalworking. To this should be added studies of the alleged ore sources of fresh metal entering the production sites. Examination of ore samples and those of ingots, finished products and scrap products of the same equipment will refine the results and provide even more reliable evidence of the origin of the raw materials. Providing additional source data and similar examples will complement the efforts in this direction.

The study of the production of metal art is a vast and wide-ranging topic. In the present work, only the beginning is set. Future research will outline the full picture of this organized and comprehensive activity.

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Contribution statement

1. The first of its kind study of the production of metal art in early medieval Bulgaria based on data from items found in the production centres are proposed. All finds of belt sets are presented, which are the main products of the metal-plastic workshops, which functioned in the first half and the middle of the 10th century in the vicinity of the capital Preslav.

2. A typology of belt sets has been developed by the three studied production centres near Novosel, Zlatar and Nadarevo. The similarities and differences in the compositional scheme of the products from each complex are presented. The species diversity and the quantitative ratio between the finds are emphasized.

3. Reconstructions of belt sets based on items from the production centres are proposed. The reconstruction lines are in accordance with the shape, proportions and ornamentation of the different types of products, as well as with the examples of synchronous cultures outside the country. Given the numerous and diverse production, the possibilities for recovery are unlimited and the work in this direction continues.

4. The elemental composition of the finds from the production centres has been established as a result of research at home and abroad. The main metals and alloys used in various combinations by the master jewelers in the workshops for metal art are highlighted. The results are presented in a comparative plan for each complex.

5. The origin of the raw material in the jewelry complexes has been established through a comparative analysis of the elemental composition of ore sources from the deposits in the Burgas-Strandzha region and finds from the three production centres.

6. The complete set of tools, which has found appliques in the production of artistic metal, on the basis of findings from the individual centres, has been studied. A reconstruction of their appliques is proposed on the basis of historical information and modern tools.

7. The technology of production and the separate stages in it are studied according to data from the researches of the complexes for metal art, the finds of belt sets and the data from ancient and medieval treatises, related to the technology and practice in working with metals.