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Archaeology and Metalwork in Early Medieval Bulgaria

The discovery of tenth-century centres of metalwork in the vicinities of the capital of Preslav, i.e., near the villages of Novosel in the municipality of Shumen and Zlatar in the municipality of Preslav, created a new trend in the investigation of medieval Bulgarian archaeology (**fig. 1**). The production centre at Novosel is spread over an area of 170 ha and operated with great intensity in the first half of the tenth century. At the same time, the centre at Zlatar was smaller in size, occupying an area of 40 ha. Both centres specialised in the casting of non-ferrous metals and the manufacture of fine metalwork. The main activity of the centres around Preslav was metalworking. There is no smelt ore here, so there were no remains of smelting furnaces, from the ore itself, or of waste from accompanying metallurgical activity. The third centre of metalwork in the vicinity of Nadarevo (Targovishte municipality) has not yet been studied systematically. The investigations at Novosel and Zlatar have helped clarify some controversial issues concerning the place and the role of a large number of metal items found by archaeologists or donated to museums in the past two decades. The results from the successful completion of the excavations at the Novosel metalwork centre are now the subject of a printed monograph[1]. The

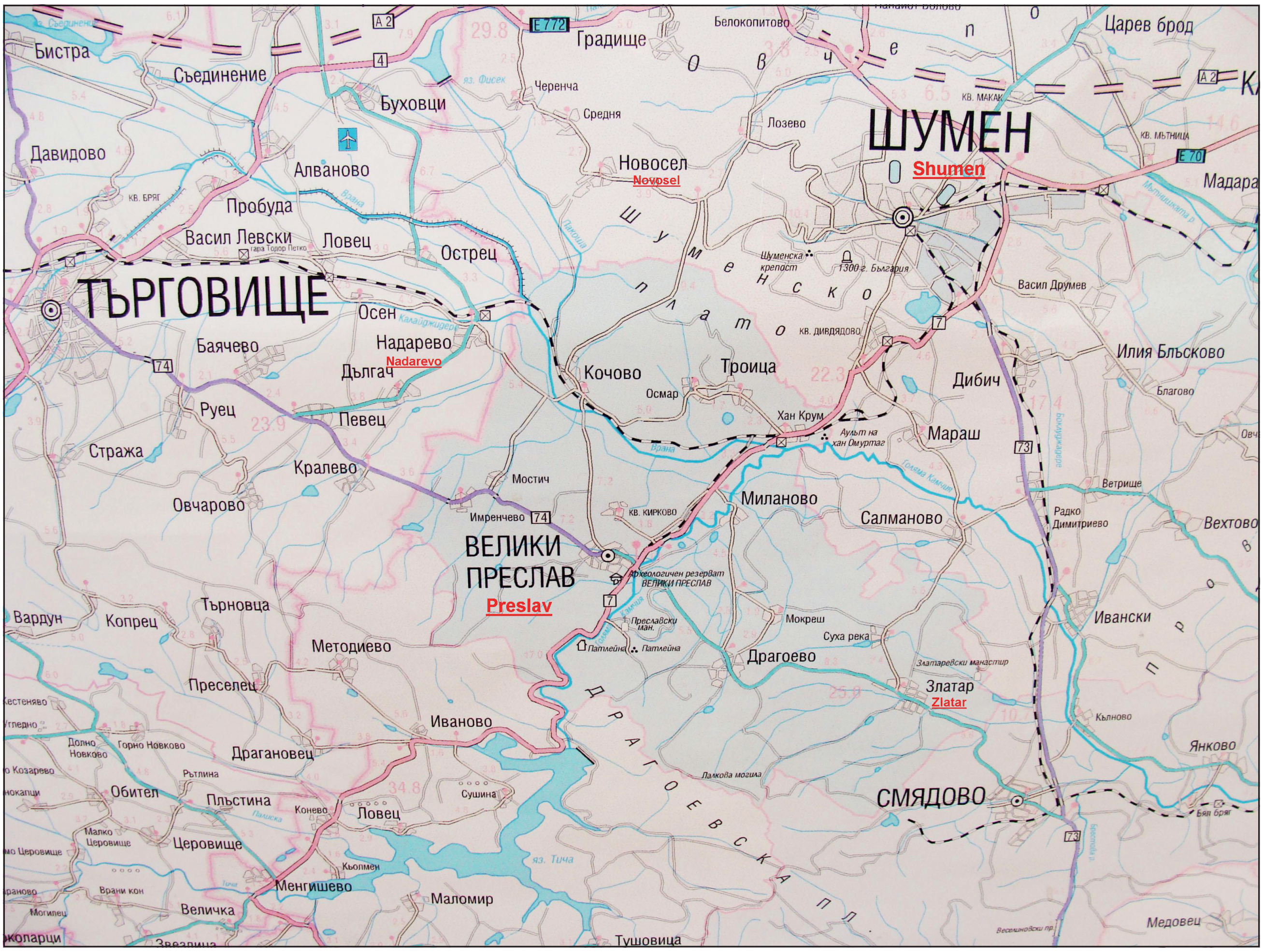

Fig. 1 Preslav and the surrounding metalwork centres. – (Map S. Doncheva).

1 Bonev / Doncheva, Starobalgarski.

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Fig. 2 Typical ceramic found at the metalwork centres. – (Photos S. Doncheva).

Fig. 3 Coins produced at the metalwork centres. – (Photos S. Doncheva).

excavations on the second centre near Zlatar started in 2007 and are still in progress. A total of 2200 artefacts have been found at both sites so far. Most of them are metal items, such as belt decorations (mounts, strap ends, buckles), cult objects (crosses and medallions), jewellery (rings and earrings), and single- and double-sided stamps. Typical ceramics (**fig. 2**) and coin finds – folles of Leo VI (866-912), Romanos I Lakapenos (920-944), Constantine VII and Romanos II (945-950) – allow us to date the activity of all the metalworking centres to the first half of the tenth century (**fig. 3**).

Fig. 4 Zlatar, complex III, workshop 2. – (Photo S. Doncheva).

Fig. 5 Novosel, complex I, workshop 3. – (Photo S. Doncheva).

Workshops

The workshops are partially dug structures with a rectangular plan arranged in a north-south direction that together form larger complexes. Each workshop complex consists of three to five interconnected dwellings, separated only by temporary seasonal hedges enclosed by clay. The most important thing, however, is that all their elements are connected along an absolutely straight line in one axis and correspond to precisely defined elements in the other ensembles. There have been many traces of piles that have supported these clay skeleton constructions (**fig. 4**). The location of the individual workshops in the complexes follows the terrain. At the production centre in Novosel, they are 80-100 m apart, and 50-60 m apart at Zlatar.

Furnaces occupy the central space in the elements that make up each workshop (**fig. 5**). Most of them are located at the northern end of the workshop, sitting about 0.2-0.3 m higher than the floor level. Their design and dimensions are the same. They have circular bases with a diameter of 0.6-0.7 m; the diameter of the larger ovens reaches to 0.8-0.9 m. They are also similarly constructed. The oval is outlined on a higher elevation site designed with small limestones. The stones themselves, as well as the inside of the oven, are em-

Fig. 6 Zlatar, complex IV, workshop 3. – (Photo S. Doncheva).

Fig. 7 Crucibles. – (Photos S. Doncheva).

bossed and then coated with clay. The furnace body is built on the stone row, also with loose soil, by overlaying layers on a prepared base. All preserved specimens have a domed shape, accurately delineated as a profile whose height varies from 0.6-0.7 m to the base.

The second element directly connected to oven is the area in front of the furnace (**fig. 6**). The holes were irregularly shaped and had oval contours. A large amount of coal, sometimes unburned wood debris, burned animal bones and wood ash was found in front of the furnace areas. From the same places, whole and fragmented casting vessels (crucibles) were found. It is curious that in areas in front of the furnaces were discovered also highly burned bronze mounts, numerous melts and waste products from casting.

The last element forming the workshops, which is necessarily present in their structure, is the waste pits. More of them are dug at one of the corners of the workshop. The plan has an oval shape, whose diameter varies between 1.2 and 1.4 m. They narrow slightly in depth and generally have a cylindrical shape without lining or reinforcement of the walls. They are about 0.5-1.2 m deep as measured from the floor level. They were filled with fragmented household ceramics, animal bones, whole, but used and broken crucibles, defective items, damaged lead models and iron tools. It is clear that these are waste products from the production process.

As a group, these crucibles, together with ceramics, were found in the largest numbers (**fig. 7**). Results related to the number of crucibles are very reliable on a single element in their design: the single rear handle. On the basis of this feature, it was discovered that more than 600 foundry vessels were used in the two complexes excavated. The crucibles are made of clay, which, after being subjected to a thermal impact, has burned to such an extent that the shape, 3-4 mm thick, has become very fragile. Their outer surface has been burned by high temperatures to take on a glazed appearance. Some of the fragments inside have traces of melted bronze. The crucibles were made in a mould, probably wooden. Their length is between 9 and 11 cm, with a height of 6-7 cm.

There is a hole on the top of each crucible that, after raw material was placed inside, was sealed with a stopper of the same material. The fact that closed or sealed vessels were found is clear evidence that they were used only once. Simple as a device, the crucibles had perfect functionality.

Products of the Metalwork Centres

A significant result of the studies is the rich collection of magnificent examples of metalwork. Their number amounts to more than 2200 items, which can be divided into two main groups. The first includes finished bronze articles and, the second, the models for their workmanship. Preference is given to the belt-set elements in their three main varieties: buckles, strap ends and mounts. Among these, the quantity of mounts is the greatest, which is determined by the number of required items on a single belt set (from 30 to over 50 mounts). Mounts are divided into different groups according to their shape and decoration. The differences in shape span shield-shaped, heart-shaped and leaf-shaped (embossed and engraved decoration), geometric shaped and single specimens (**fig. 8**). Heart-shaped mounts are the most popular. The lack of extra pimples on the subject's outline,

Fig. 8 **a** Artefacts of non-ferrous metal. – (Photos S. Doncheva). – Scale 1:1.

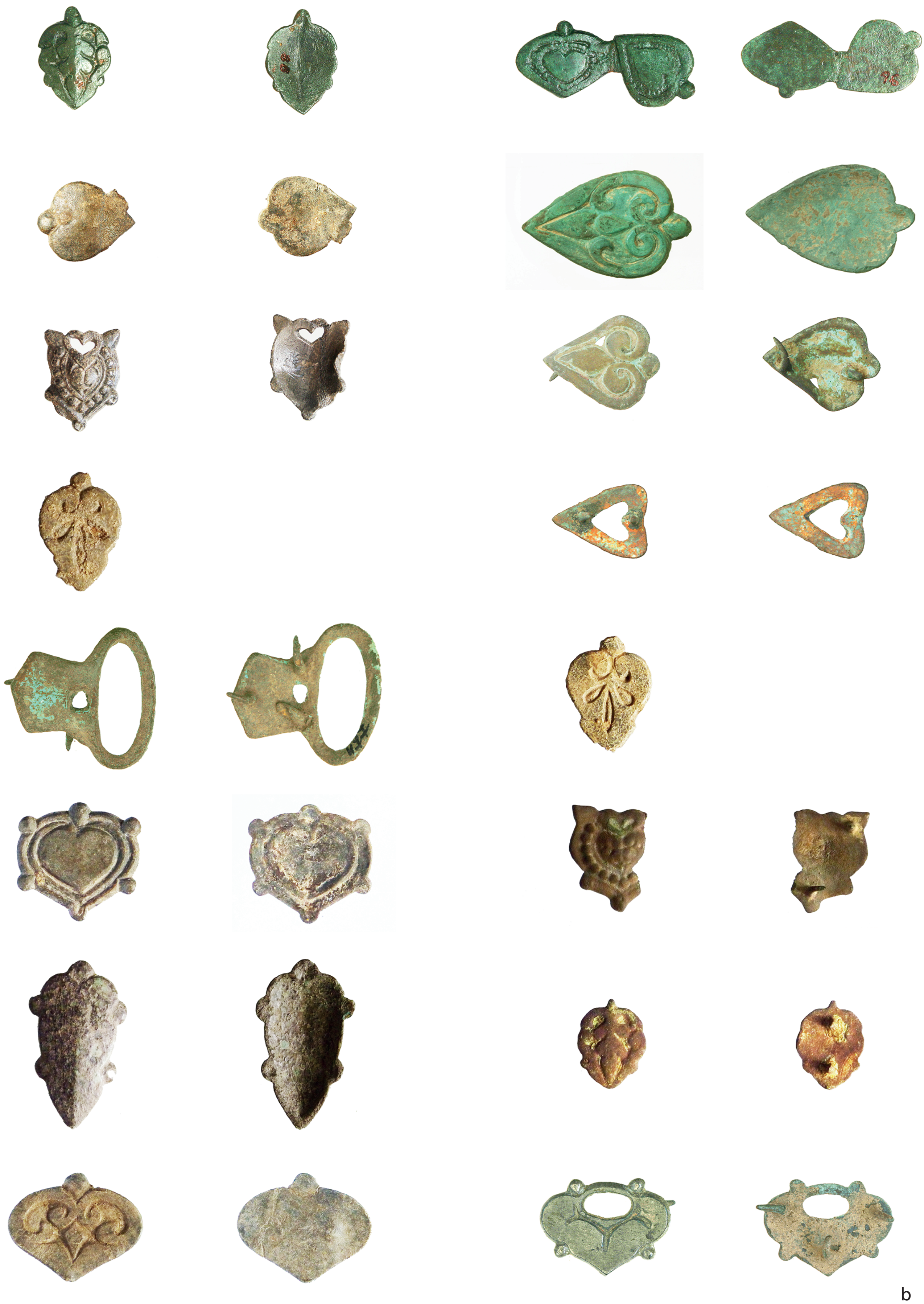


Fig. 8 **b** Artefacts of non-ferrous metal. – (Photos S. Doncheva). – Scale 1:1.

Fig. 9 Artefacts of non-ferrous metal. – (Photos S. Doncheva). – Scale 1:1.

except at the base, is significant. The other mounts are mostly leaf-shaped. There is no strict separation between the two groups, which is confirmed by the different variants of the mounts. Thus, from the heart-shaped to the leaf-shaped mounts, ornamentation gradually becomes complicated and modified, although the forms remain similar.

The remaining items produced in the workshops are stamp-amulets with animal images, earrings, rings, book clasps, embroidery crosses and cross-encolpions. The quantity and variety of this group of articles is less than that of the belt sets. Thus, in practice, it appears that the main activity of the metalwork workshops in the vicinity of Preslav is precisely the production of elements for belt sets (**fig. 9**).

Another category of articles is made of lead and more rarely of bronze. These are models for the making of items (**fig. 10**). The complex use of casting practices leads to the pursuit of serial production and, in many cases, mass production. The position of the lead models in the metalworking

Fig. 10 Lead models of sand-casting. – (Photos S. Doncheva).

process was largely clarified after the discovery of metalwork centres in Novosel and Zlatar[2]. It turned out that they are a small and important group among other articles that provide the rich ornamentation of finished items. Moreover, lead and rarely bronze models and finished articles are those on which metal objects, including those made of precious metals, are cast. Lead models have several advantages: they are easily manufactured due to the low melting temperature of the metal, are amenable to additional shaping and are easily detached from the moulding earth[3]. Their presence indicates the existence of active production. This activity does not necessarily have to be concentrated only in the mentioned production centres. More likely, there are similar complexes or single workshops in many settlements in the region that have yet to be explored.

The models of lead differ, not only in shape and decoration, but also in the way of making. The technology used for their production is evident from the peculiarities that are visible both on the face and on the opposite side. Several techniques were used, beginning with the use of wax. With reason in the history of casting, it is noted that there is hardly any more suitable material for making models than beeswax[4]. It is highly malleable, allowing changes to be made to the original design and the correction of mistakes during the process of production. A number of decorative elements can be placed on the surface of the model, which can then guide the engraver upon finishing the metal surface. More lead moulds have been used to make the wax patterns, too; clay moulds were used less often. An example is a lead mould found in the vicinity of the production complex at Zlatar. It is identical in form and decoration to some bronze mounts and lead models found in the same place[5].

Tools and Technology

An essential point in the subject of the production of artistic metal in the Old Bulgarian jewellery complexes is that related to the different tools used. In craft development, the quantity of tools and jewellery products is approximately 1:100 in living culture. Casting and tools make up the full set of tools needed by medieval craftsmen. They are also reflected in some key stages in the production process (**fig.11**). Tools designed for specific operations and rarely used in everyday life are an indicator of the level of craft development practised in metalwork centres (**fig. 11**). On the one hand, they are a product *of* craft activity, and on the other hand *for* this activity. This allows us to talk about the technological opportunities of both the society as a whole and the particular groups related to specific archaeological monuments.

First of all, it is appropriate to pay attention to the tools related to the preparation and implementation of casting, which is a basic practice for jewellery production in the complexes around Preslav.

Models are made by craftsmen who possess the necessary knowledge and skills, and have a creative approach and a sense of style embodied in an exquisite way in their works. To create the source model, a special set of tools was used. They have specific shapes and are associated with the individual stages of production. Instruments have a rectangular section and characteristic curvature at one or both ends, which is tapered on most of them They are used to cut or engrave the decoration on the pattern surface and to smooth the wax outbursts along incision edges (**fig. 12**).

Some tools are also used for the model processing. In addition to shaping lead and bronze models, all these tools are also used for artistic engraving on metal, because the tools and activities themselves are somewhat similar. Most of these tools were found in the workshops at Novosel and Zlatar[6].

A next and very important stage, after making the models, is manual moulding. The bulk of the finished product was

2 Doncheva, Centar 2007; 2008; 2010.
3 Georgieva/Buchinski, Staroto 40. – Sotirov, Chiprovska 185.
4 Vasilev, Bronzovi 22.
5 Doncheva/Nikolov, An Early 81-92. – Doncheva, Metal 43-56.
6 Bonev/Doncheva, Starobalgarski 257 Tab. XV, 9-10; 259 Tab. XVII, 22-24. 26-33; 266 Tab. XXIV, 113-117; 267 Tab. XXV, 120-128.

Fig. 11 Iron tools. – (Photos S. Doncheva). – Not to scale.

Fig. 12 Iron tools. – (Photos S. Doncheva). – Not to scale.

obtained by moulding in double sand-cast boxes filled with moulding mixture. The choice of the frame size depended on the cast articles, but it is obvious that these metal shapes were not large – the width of fittings varies from 0.5-2 cm. Remains of such elements correspond to the sand-cast boxes from the later period[7]. There is no fully preserved form among them, but all fragments show their intense use in casting practice[8]. The non-durability of the material from which most of the moulding tools were made is the reason why some of them were not found during excavation of the production

7 Georgieva/Buchinski, Staroto 261 Tab. XC.

8 Bonev/Doncheva, Starobalgarski 262-262 Tab. XX, 66-73; Tab. XXI, 74-76.

Fig. 13 Bone and iron tools. – (Photos S. Doncheva). – Scale 1:1.

centres. These included the wood in hammers and tambours for sealing the moulding mixture in the sand-casting boxes, the cleaning brushes used for the mould surface, etc.

Concerning tools here, we must also refer to the group of bone awls, which is also the most numerous. Due to the ready availability of the material and its ease of working, they are widely used in the practice of jewellery production in the Middle Ages. Among the findings from the two centres, there are large and small shapes, with more or less pointed tips, with roughly shaped or precisely polished surfaces. The bone awls are used for modelling and forming sand-cast box surface – gasket and thimble, angle shapers, casting channels (**fig. 13**).

After the casting moulds are removed, the surface is cleaned, which is never perfectly smooth and needs to be refined to remove the founders, outbursts of metal, bays and roughness. The products become smooth and are subsequently sanded and polished. Various shapes and sizes of files, cutters, knives, special tools for cleaning, grinding stones, and wooden sticks have been used for this purpose. Files, curved knives for smoothing, a large number of knives of different size and a dozen grinding stones were found in the workshops at Novosel and Zlatar[9]. The grinding stones are an auxiliary tool, which, after being used, remained at the place of production (**fig. 14**).

The remaining set of tools characterising individual manufacturing operations, made of metal and especially valuable, is less common. Forged relief, for instance, is one of the oldest metal processing techniques that has not changed sig-

9 Bonev/Doncheva, Starobalgarski 259 Tab. XVII, 34-38; 260 Tab. XVIII, 39-49; 264 Tab. XXII, 82-92; 265 Tab. XXIII, 93-97.

Fig. 14 Grinding stones. – (Photos S. Doncheva). – Scale 1:2.

nificantly over the years. The practice of this activity is related to a certain set of tools, among which are basic cutting and decorating implements. The metal sheet receives the desired shape with the help of various types of dies, punches, pads and prints.

Some of the silver objects are gilded, and copper and bronze objects are gilded or silver-plated. This is one of the means to give an aesthetic appearance to metallic alloys of base metals. It is known that copper products and their alloys are the best source. There are a number of items on which gold is applied. Much of the bronze cast has a greyish white metallic finish on the face. The chemical composition of the metal coating proves that the use of silver alloy and tin amalgam was cheaper than silver alloy alone. Prior to coating, the castings were carefully polished and the clean, smooth surface became mandatory not only for the coating, but also for all other parts of items.

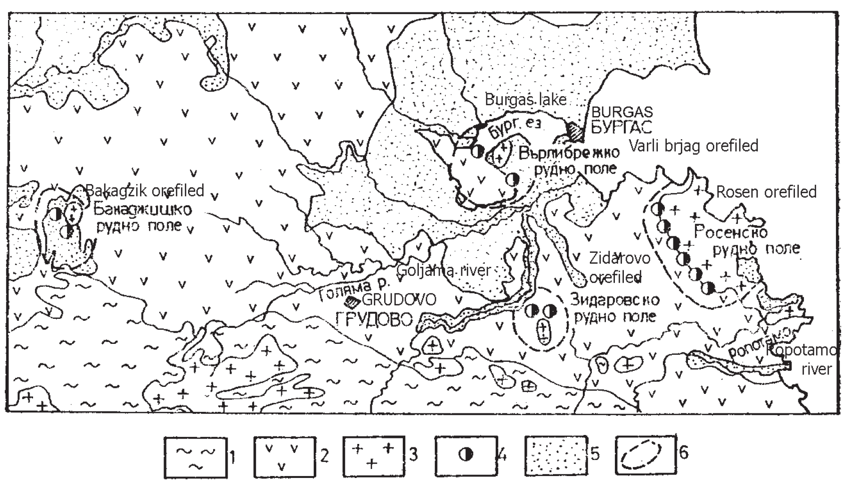
Tool sets reflect the full diversity in the process of cold and hot metal making and their alloys. In the tenth century, the Old Bulgarian workshops were equipped with a large variety of tools. The good equipment of the workshops testifies to the wide range of various technological operations and the high quality of the production, which is a reliable indicator of state of the jewellery craft during this period.

Origin of Raw Materials

The analysis results give us some idea of the origin of the raw materials used by medieval craftsmen, as well as the possible supply routes to the metalwork centres. Along with recycling scrapped items, the jewellers used ingots of precious metals. A considerable number of such ingots have been found in the metalwork centre of Zlatar. A well-known fact is that in Bulgaria there were native silver and copper deposits (**fig. 15**)[10]. Silver and some silver-containing sulfosalt minerals (such as tetrahedrite, pyrargyrite, polybasite, etc.) can be found near Chiprovtsi. The highest silver content deposits are found near Yavorov dol. They belong to the so-called Balkan metallogenic belt, where there are two basic types of mineralisation: lead-zinc mineralisation, with key representatives of galena, sphalerite, chalcopyrite, pyrite (there were found some ancient galena mines); and gold-bearing polymetal minerals, represented by galena, sphalerite and gold-bearing pyrite. Gold is placed in the oxidising zone of the galena and pyrite and was mined from open pits along the ore veins.

There are more than 50 mines remaining from copper mining and smelting in the Burgas region dating from the Early Bronze Age through Classical Antiquity to the modern period. It is difficult to accept the idea of an interruption to

Fig. 15 Location of the ore fields in the Bourgas ore region. **1** Foundation of metamorphic, intrusion and sedimentary rocks. – **2** Upper cretaceous volcano-sediment complex. – **3** Upper cretaceous intrusion rocks. – **4** Deposits of a copper polymetal ore formation. – **5** Tertiary and quaternary deposits. – **6** Boundaries of minefields. – (After Bogdanov 1987).



10 Georgiev, Polezni 21.

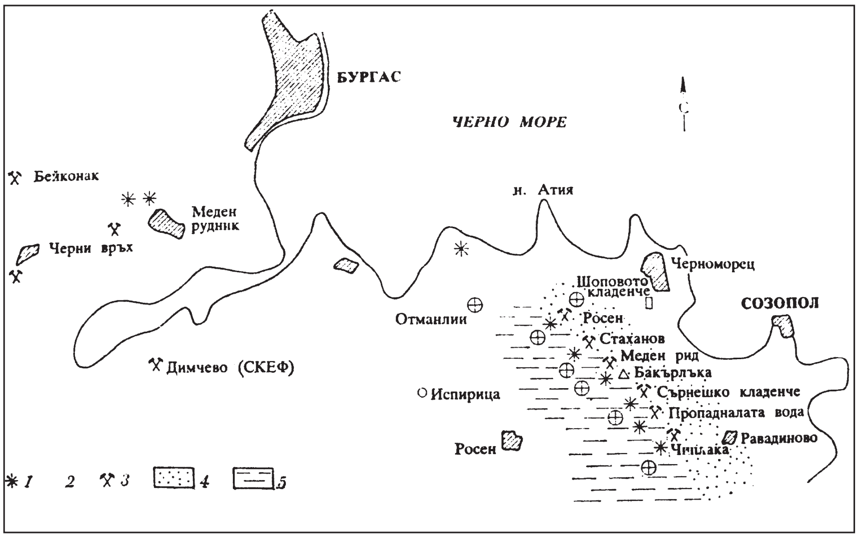


Fig. 16 Fields of ancient works of copper ores and slags in Burgas-Strandzha region: **1** old mine workings. – **2** slag. – **3** ore veins. – **4** Rosen pluton – **5** contact-altered rocks. – (After Georgiev 1987).

metallurgy activity here from the ninth to fourteenth centuries because of the enormous need for fresh ore for the production centres of metalwork and separated workshops in other settlements.

Silver mining remained almost unchanged from Antiquity to the late Middle Ages[11]. Cupellation, which is the melting of silver-bearing lead in an oxidising air stream, was the only known way to separate precious metals (silver [Ag] and gold [Au]) from base metals and for the production of pure silver. The cupellation of a lead bath, not only oxidises lead itself, but also all inclusions. The cupellation continues until all the lead is removed. The silver remaining contains 94-96 % of Ag. The remaining elements are bismuth (Bi), copper (Cu), lead (Pb) and gold (Au). At the next stage, the silver so extracted is subjected to purification in special furnaces by the addition of copper (Cu). During this oxidising or refinement »baking« of silver, the inclusions of lead (Pb), copper (Cu) and bismuth (Bi) which have remained in the precious metal after the primary processing are separated to give way to the purest silver with minimum impurities.

Investigations into the remains of the antique copper mines indicate, with great certainty, that the major portion of the raw materials (copper and bronze) came from the Burgas-Strandja mining region[12]. Numerous traces of mining activities were found in that region. In the Burgas sub-region there are more than 250 ancient ore mines (**fig. 16**). The antique metallurgy in the region of Burgas was mentioned by O. Davies[13]. The inclined shafts are especially notable. At the Varli Briag and »Lenko« vein, the inclined shafts reach a depth of 100 m, at the »Rossen« mine the depth is 75 m, while at Meden rid, the inclined shaft depth is 72 m. The numerous piles of slag or traces of them are evidence of metallurgy in ancient times. It is not possible to say with certainty what exactly the copper and iron furnaces were, or what the metallurgical and chemical processes in those furnaces were. We can only judge them from their by-product – the slag. Remains of furnaces were found near the Gradishteto (a ruined furnace with metal parts around it) and on other sites in the Strandja mountains, such as Balgare, Slivarovo and near Ahtopol. There were furnaces in the Mishkova niva place near the village of Delchevo – Municipality of Malko Tarnovo. Crucibles were found near the »Rossen« mine[14].

We do not know the exact composition of the copper and the destination of the hundreds of thousands of kilograms produced in those furnaces. We can judge for the type and scale of the ancient metallurgy from the multiple piles of copper slag, some of them huge even in modern terms. The weight of the pile of slag near the »Rosen« mine is calculated to be 300 000 tonnes. This slag contains 0.3-1.04 % copper and about 30 % iron. At the Tyasna Barchina River near Gramatikovo, there is a whole hill of slag, some 1000 m long and 50 m high. The slag deposits near the »Iglika« ore field take up an area of 18 000 m² and has an average depth of 2 m. They contain 0.44 % copper and 0.50 % zinc. The investigations made on the work of the ancient geologists, miners and metallurgists ascertain that work continued without interruption from 1000 BC to AD 1000, i. e., through Classical, Roman, Late Antiquity and the early Middle Ages[15]. The traced histogram in the distribution of the concentration of the elements in the ores from these and other ancient ore developments are the starting point for the current observations (**fig. 17**)[16].

Geochemical copper ores are homogeneous and practically appear monometallic. From micro impurities, only lead, zinc, bismuth, silver, nickel, and some others are found in hundredths of percent. The chemical composition of the slag confirms the assumption that ore was melted here. If we rely on the chemical composition of local malachites and azurites,

11 Agricola, De re Metallica 439-490.
12 Konjarov, Prinos 126.
13 Davies, Roman.
14 Konjarov, Prinos 29-30.
15 Georgiev, Polezni 49.
16 Chernih, Gornoe.

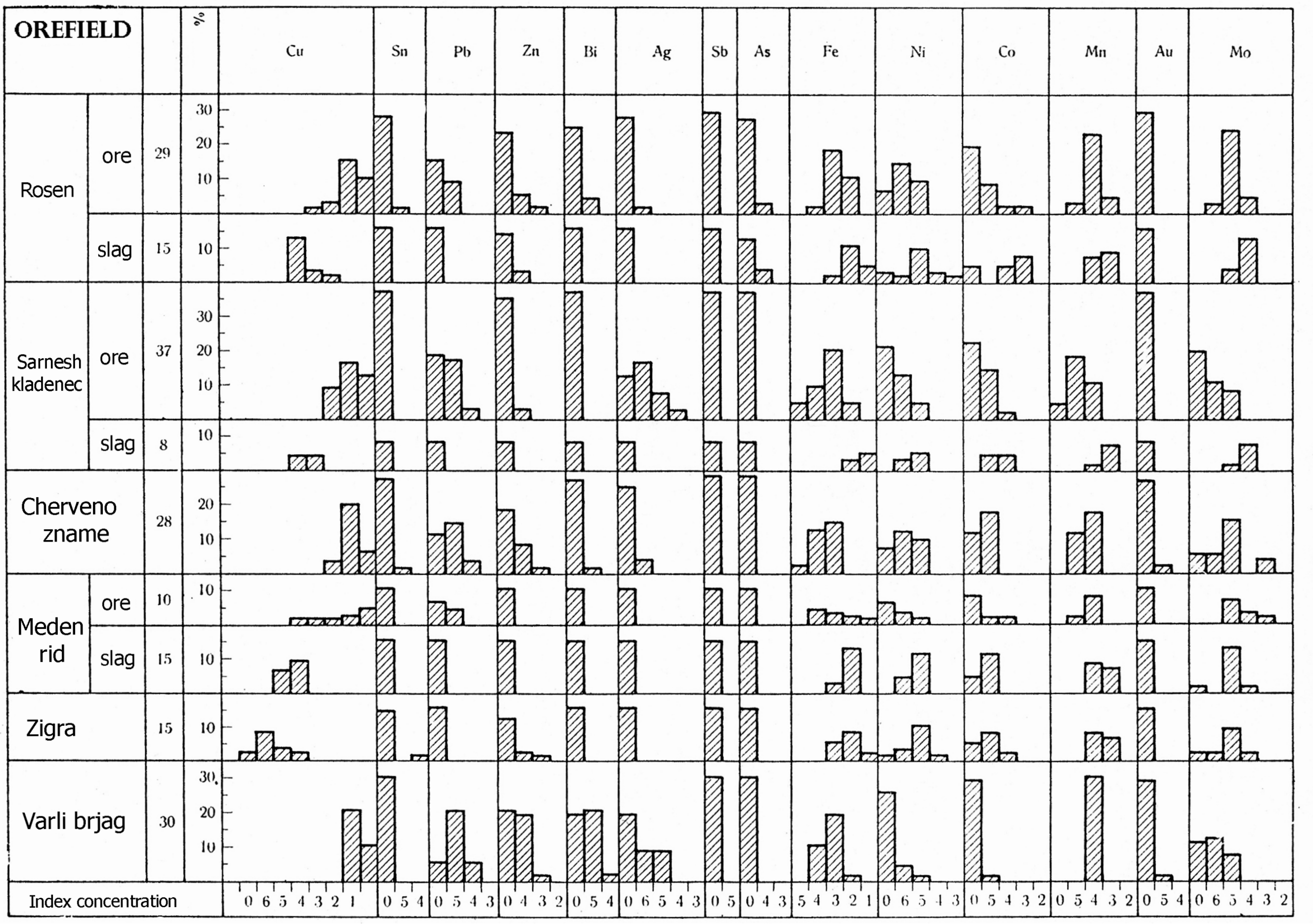


Fig. 17 Histogram of the concentration of the elements in the ores from Burgas, Strandza region – (After Chernich 1987).

copper of considerable purity, with small amounts of micro impurities of silver, nickel and possibly bismuth, gold, arsenic, is to be expected. Analysis has proven a connection between this metallurgical group and the products found at the metalwork centres. Therefore, in view of the above facts, we can assume that the Burgas-Strandja mining region continued functioning during the Early Bulgarian Middle Ages, when the need for metal was significant.

Lead extraction was linked to the areas of silver extraction and the presence of copper-zinc ores. The most prominent mining and metallurgy has existed during the Middle Ages. Since then, there has been much evidence of this activity. The main metallogenic provinces are Rhodope and Balkan metallogenic zones[17], where the ore is mainly silver-lead-zinc. They are represented by hydrothermal stems and metasomatic bulks. Typical of these are the metals Pb, Ag, Zn (Cd, Cu, W, Mo, Fe). There are 42 old mines from Antiquity and the Middle Ages. Rhodope Polymetal ore province is remarkable, not only in Bulgaria, but also in the Balkan Peninsula and Europe. There are numerous ore veins, some of which are hundreds of metres in length, with a breadth of up to 20-30 m. In the Sakar ore region, which is part of the Burgas-Strandzha ore region and relatively close to Preslav, there are 12 hydrothermal polymetal ore veins. The main ore minerals are galena and sphalerite; the secondary ones are pyrite, chalcopyrite, etc. Old mining galleries have been identified with a height of 1.6 m and a width of 1.4 m. Tools and piles of slag from the Middle Ages were found.

In the Balkan metallogenic zone, the Etropole ore region with Dolna Kamenitsa deposit should be mentioned. There are two types of ores: first, lead-zinc with major ore minerals galena, sphalerite, chalcopyrite. Old galleries were found here. Perhaps it was not only lead extraction, but also silver extraction; second, golden polymetallic ore, represented by galena, sphalerite and golden pyrite. Gold is located in the oxidation zone, where the galena and pyrite are oxidised. More than 50 overground developments have been found from the surface mining of gold.

17 Georgiev, Polezni 85. 98.

Elemental Composition of the Found Items

Some investigated bronze items give us an idea of the huge variety of copper alloys used by the medieval jewellers in the first half of the tenth century. Among them there are such made of leaded copper, lead-tin bronze and tin-lead bronze, brass, arsenic copper bronze, multi-component alloy. The first type of items has a lead-copper (Pb/Cu) relation, the second type has a lead-tin (Pb/Sn) correlation and the third type has a tin-lead (Sn/Pb) correlation (**fig. 18**). One can distinctively note the threshold of artificial lead insertion (alloying): the concentration of 0.5 % can be taken as a threshold value between naturally occurring impurities and artificial alloy. The higher lead content is an indicator of a deliberate addition to the alloy, as is the case with lead bronze. Adding lead to the alloy makes it more maleable and forgeable.

The remaining artefacts have a low arsenic content, which was obviously not intentionally introduced by the craftsmen, but resulted from the melting of arsenic bronze ingots (**fig. 19a-b**). The arsenic bronzes contain from 0.5-5 % of arsenic (As) and usually have increased nickel content. We can assume that the threshold for artificial introduction of arsenic in copper alloys is 0.5 %. The lower concentrations might have resulted from introduction of arsenic bronze to the copper.

The arsenic content suggests that the craftsmen used old or scrapped items containing arsenic. When the arsenic content reaches more than about 5 wt% the item produced resembles that of silver. Such methods were used in the Hellenistic period (second to first centuries BC), especially by alchemists[18]. The arsenic was probably introduced through sulphide ores that had not been subjected to sulphur extraction by roasting and the sulphides had not been transformed into oxides. The correlation between arsenic (As), cobalt (Co), nickel (Ni), antimony (Sb) and lead (Pb) shows that the arsenic might have been introduced through minerals. The close values of bismuth (Bi) and nickel (Ni) confirm the similar origin of the used metal. The analysis clearly demonstrated that there is a positive relationship between the tin-lead complex copper alloys and arsenic-antimony concentrations (**fig. 20**).

Copper alloys containing lead have been known since the Bronze Age and were only found in the second phase of the Iron Age in connection with the lead extraction technique, i.e., cupellation[19]. The main advantage of these alloys is to improve their flowability, which makes well filling moulds possible. During Antiquity, another notable advantage was the fact that the presence of lead causes a significant decrease in the melting temperature of the whole alloy, which is of great importance, given the difficulties involved in achieving the necessary reduction conditions. The main disadvantage is the impossibility of forging such alloys. This is because the granules formed by lead, which are insoluble in the copper, create fractures on the surface of the metal. Ancient craftsmen were familiar with all these alloy manifestations. That is why only alloys with a lead content of less than 1-2 % Pb were used for forged items. As a rule, objects made of foil (plates) do not contain lead. Regardless of the lead content in copper, it has a significant impact on the technological properties of the metal. It is known that lead is insoluble in copper; its addition improves the casting properties of copper, but the plasticity of the metal is reduced from 6 % Pb onwards. If lead levels are above 3 % Pb, then it has been added to the copper alloy. If the correlation coefficient between the silver and lead concentrations is high, then this means that the silver (Ag) did not come from copper ore, but from lead (Pb) through a process of cupellation.

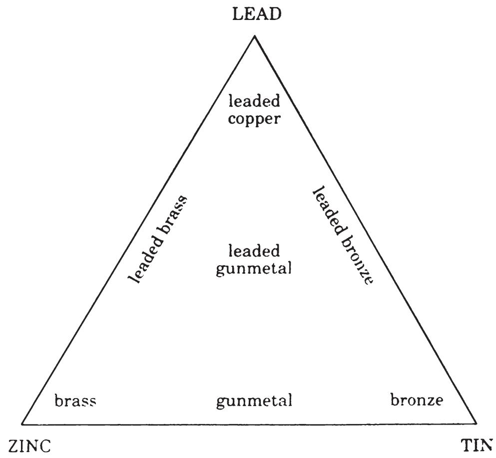


Fig. 18 Distribution of copper-alloy definitions in the ternary graph of Pb, Sn, and Zn. – (After Bayley/Butcher 2004).

Lead can be referred to as artificial impurity when it is within the range of 0.3-1 % Pb. Therefore, low-lead products refer to the group of natural alloys resulting from the penetration of this element from the ores or as a result of the melting of lead copper. The tin and lead content in a large part of the objects below a certain limit indicates their alloy as a result of the transition from the ores. The influence of lead on the copper structure resembles that of bismuth (Bi). Lead, as well as bismuth, forms an eutectic. As the lead content increases, the morphology changes to a droplet shape. At lead concentrations of up to 0.05 % Pb, a marked decrease in the plasticity of copper is observed.

Some of the items are made of multi-component alloys, which, in addition to the tin and lead, contains all remaining elements in just fractions of a percent. The admixtures were either introduced through the source ores, or as a result of adding old bronze items to the mix. Thus, some metals were introduced to the alloy accidentally by using scrap.

18 Puasson, Teorii 75-89.

19 Pernicka, Sastojanie 37.

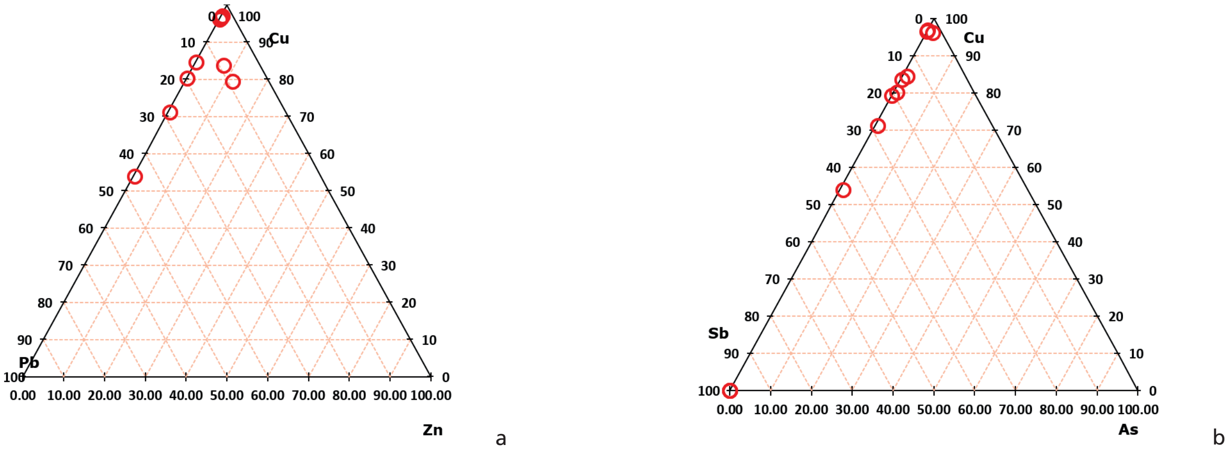


Fig. 19 **a** Ternary graph of copper, zinc, and lead concentrations measured in the artefacts. – **b** Ternary graph of copper, antimony, and arsenic concentrations measured in the artefacts. – (Copyright S. Doncheva).

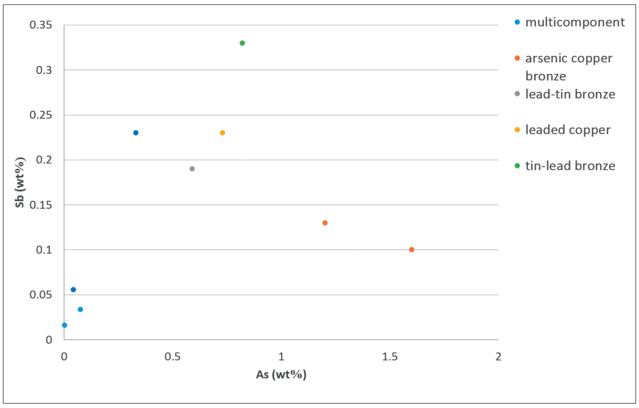


Fig. 20a Scatter-graph of copper and lead concentrations measured in the artefacts from the 10 c. AD production centres near Preslav, north-eastern Bulgaria. The separation of three main compositional groups within the assemblage is presented – lead, brass, and a broader cluster of various multi-component copper alloys. Note the logarithmic scale of the lead values. – (Copyright S. Doncheva).

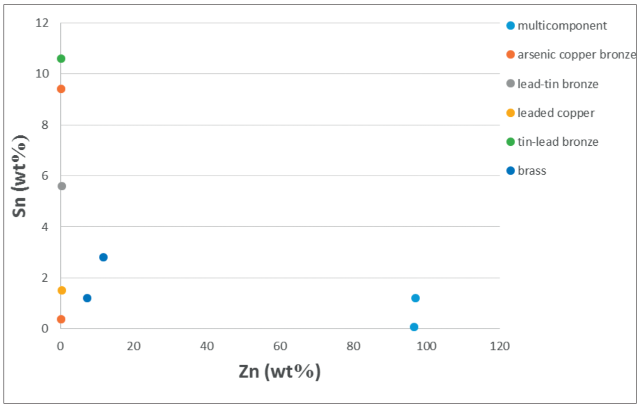


Fig. 20c Scatter-graph of arsenic and antimony concentrations measured in the artefacts from the tenth-century production centres near Preslav, north-eastern Bulgaria. – (Copyright S. Doncheva).

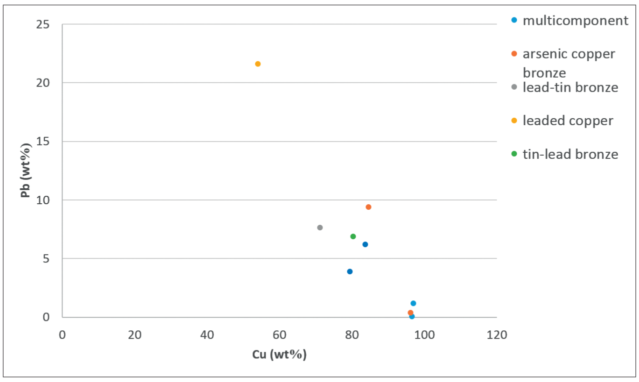


Fig. 20b Scatter-graph of zinc and tin concentrations measured in the artefacts from the tenth-century production centres near Preslav, Northeastern Bulgaria. – (Copyright S. Doncheva).

Analysis of most items found on centres of metalwork demonstrate low percentage of trace elements (Co, Ni, As, Sb, etc.) in alloys, which is an indicator of the high level of metal refinement achieved by the Bulgarian craftsmen. The average iron Fe content of 0.1-0.3 % in items is an evidence of highly effective reduction in the process of smelting[20].

20 Craddock/Meeks, Iron 187-190.

Conclusion

The sophisticated organisation of metalwork production was the result of government policy. Only the government could have had a clear idea of the formation and realisation of such a large corporation specialising in the serial production of metalwork items. In this situation, the question arises as to whether it was necessary to introduce such a manufacture, that combines high artistic criteria with mass production. An important part of this is the extremely varied forms and rich repertoire of bronze objects.

The tenth century was a period of great popularity for this type of accessory, which became the dominant fashion trend. The foremost market for their consumption was the capital, where the refined tastes of the aristocracy created demand. It is very likely that these objects were made by the craftsmen and traders themselves, as was the common practice in neighbouring Byzantium, where the jeweller and the trader were one and the same person[21]. The combination of these two activities – the production and marketing of finished products – is the basis of the word *ergasteriion*, *ergasteria*, which has been used since the seventh or eighth century to describe both the workshop itself and the point of sale[22]. The meaning of this concept is rooted in the economic tradition in which the craftsmen tried to reconcile different types of activitiy, including dealing with trade. Actually, the manufacturers, *vanavsi* (*banausoi*), were separated from the market traders (*agoraios anthropoi*), but that did not always prevent trade being closely involved with production[23]. Craftsmen (*technites*) were often both sellers of their products and owners of the workshops in which they worked. Comment: There is no reference to the Chronicon Paschale, and there is nothing in the text, both a colleague and I looked it up. Hagiographical sources from the seventh to tenth centuries contain examples indicating that craftsmen traded what they produced[24].

The combination of the jeweller and the trader in one and the same person is a characteristic feature of these different activities. Such dependence existed, not only in Byzantium, but undoubtedly in the neighbouring countries influenced by it. In this respect, it must be assumed that such an organisation existed in the early to middle Bulgarian metalworking centres, especially here, given the proximity to the capital Preslav. Some of the goods would have reached the market through intermediaries and resellers, but, when making jewellery and small metalwork objects, it is more likely that the craftsmen themselves took care of the placement of their produce. It is clear that the exercise of a commercial activity implies the continuous movement of produce to market.

In the tenth century, the fashion for ornamental metal belts was widespread, and the large population of the medieval city centre required a constant supply of such items in the marketplace. It is no coincidence that the metalwork objects discovered sporadically in various places in Preslav were the same as those made in the production centres around the town and obviously originated from these places. In addition, there are several other settlements, some of considerable size, in the vicinity of the production centres. With the growing interest in metalworking products, especially those related to belt and garment decorations, their inhabitants must also have been among the potential users of these products.

Under these circumstances, we must conclude that in the middle of the tenth century, the capital of Preslav was surrounded by settlements whose inhabitants had different livelihoods, including the manufacture of jewellery. The picture sketched above implies intense contact between people and a sufficient and secure road network. Routes are difficult to establish, but archaeological surveys show that life in the area was uninterrupted from the tenth century to the present day, and that the inhabited places underwent only minor changes. Significantly, the settlement area is still densely populated today.

According to this brief overview of the research on the two metalworking centres near Preslav (Novosel and Zlatar), it is clear that issues related to the organisation and individual stages of production and the connection with nearby settlements are only part of their essence. Their location in the vicinity of the capital and their trade links with it are a much broader issue, involving economic relations and political power.

21 Bonev/Doncheva, Centarat 382-389.
22 Sorochan, Vizantia 116.
23 Gurevich, Iz ekonomicheskoj 135. – Suzumov, Remeslo 31.
24 Moschos, Spiritual Meadow chap. 114. 194. – Rudakov, Ocherki 150.

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Summary / Zusammenfassung / Résumé

Archaeology and Metalwork in Early Medieval Bulgaria

The discovery of tenth-century centres of metalwork in the vicinity of the capital of Preslav, i.e., near the villages of Novosel (Šumen municipality) and Zlatar (Preslav municipality), has led to a new trend in medieval Bulgarian archaeology. Both centres were specialised in metalworking, i.e., in the casting of non-ferrous metals and the manufacture of fine metalwork. There was no smeltable ore here, so there were no remains of smelting furnaces, from the ore itself or the accompanying waste. The excavations at Novosel and Zlatar could clarify some issues concerning the production locations and role of a large number of metal items found there in the past two decades. A total of 3000 artefacts have been found at these two sites so far. Most of them are belt decorations (mounts, strap ends, buckles), cult objects (crosses and medallions), jewellery (rings and earrings), and single- and double-sided stamps. Typical ceramics and folles of Leo VI (866-912), Romanos I Lakapenos (920-944), Constantine VII and Romanos II (945 -950) date the activity of the metalwork centres to the tenth century.

Archäologie und Metallverarbeitung im frühmittelalterlichen Bulgarien

Die Entdeckung von Metallverarbeitungszentren des 10. Jahrhunderts in der Nähe der Hauptstadt Preslav, d.h. in der Nähe der Dörfer Novosel (Gemeinde Šumen) und Zlatar (Gemeinde Preslav), hat zu einem neuen Trend in der bulgarischen Mittelalterarchäologie geführt. Beide Zentren waren auf die Metallverarbeitung spezialisiert, d.h. den Guss von Nichteisenmetallen und die Herstellung von Feinmetallarbeiten. Da es hier kein Schmelzerz gab, fanden sich auch keine Überreste von Schmelzöfen, weder vom Erz selbst noch von dem damit verbundenen Abfall. Die Ausgrabungen in Novosel und Zlatar konnten einige Fragen klären bezüglich der Produktionsorte und die Rolle einer großen Anzahl von Metallgegenständen, die dort in den letzten zwei Jahrzehnten gefunden worden sind. An beiden Standorten wurden bisher insgesamt 3000 Artefakte gefunden. Es handelt sich überwiegend um Gürtelverzierungen (Beschläge, Riemenenden, Schnallen), Kultgegenstände (Kreuze und Medaillons), Schmuck (Ringe und Ohrringe) sowie ein- und zweiseitige Stempel. Typische Keramik und Folles von Leo VI. (866-912), Romanos I. Lakapenos (920-944), Konstantin VII. und Romanos II. (945-950) datieren die Tätigkeit der Metallverarbeitungszentren in das 10. Jahrhundert.

Archéologie et travail des métaux en Bulgarie au haut Moyen Âge

La découverte de centres de métallurgie du X^{e} siècle près des villages de Novosel (municipalité de Šumen) et de Zlatar (municipalité de Preslav), c'est-à-dire près de la capitale Preslav, a fait émerger un nouveau champ de l'archéologie médiévale bulgare. Ces deux centres étaient spécialisés dans la métallurgie, plus précisément dans la fonte de métaux non ferreux et la fabrication d'objets en métal fin. Dans ces espaces, il n'y avait pas de minerai de fonte, et donc pas de vestiges de fours de fonte, ni du minerai lui-même, ni des déchets qui l'accompagnent. Les fouilles de Novosel et de Zlatar ont permis de clarifier certaines questions concernant ces lieux de production et le rôle d'un grand nombre d'objets métalliques trouvés dans ces centres au cours des deux dernières décennies. À ce jour, 3000 objets ont été découverts sur les deux sites. La plupart d'entre eux sont des décorations de ceinture (montures, extrémités de sangle, boucles), des objets de culte (croix et médaillons), des bijoux (bagues et boucles d'oreilles) et des tampons à une ou deux faces. Les céramiques typiques et les follès de Léon VI (866-912), Romain I^{er} Lécapène (920-944), Constantin VII et Romain II (945-950) permettent de dater l'activité de ces centres métallurgiques au X^{e} siècle.