

Non-ferrous metalworking of the Upper Kyiv in the 10th-13th centuries

Key words: Kyiv Rus, Upper Kyiv, non-ferrous metals, bronze casting and jewelry workshops, metalworking smith and locksmith workshops, raw materials and production wastes, crucibles and smelting ladles, casting molds and tools.

Cuvinte cheie: Rusia kieveană, Kievul de Sus, metale neferoase, ateliere de turnare a bronzului și bijuterii, ateliere de fierărie și lăcătușerie, materii prime și deșeuri de producție, creuzete, matrițe și unelte de turnare.

Viacheslav Kryzhanovskiy

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The Upper Kyiv is the oldest part of the city, where the administrative center with princely palaces, church estates, and boyar residences was located. The inhabitants of these complexes required a significant number of items made from non-ferrous metals. Between 1907 and 2013, excavations were conducted at 20 areas, where 83 specialized objects and 1363 artifacts were discovered and studied, including materials from 14 cultural layers that may have originated from nearby production structures. Among the identified features were 6 bronze casting workshops, 22 jewelry workshops, 6 smithy/locksmithy workshops, and 23 dwelling-workshops. Most of these objects date to the 12th – the beginning of the 13th century. Some of them were combined with ironmaking/ironworking and/or glassmaking/glassworking crafts. Numerous production structures formed five specialized craft centers in the Upper City, covering areas from 0.5 to 6 hectares. Within their fillings, 12 marketable metals, 503 semi-finished products, 690 casting vessels, 15 casting molds, 34 tools, and 112 examples of production waste were found.

The emergence of a significant number of non-ferrous metalworking facilities in Upper Kyiv is explained by their proximity to the grand princely courts with their palace complexes, the estates of the boyar elite, the marketplace square, and religious buildings.

Viacheslav Kryzhanovskiy

Prelucrarea metalelor neferoase în Kievul de Sus în secolele X-XIII

Kievul de Sus – este cea mai veche parte a orașului, unde se afla centrul administrativ cu palate cneziale, edificii bisericești și reședințe boierești, ai căror locuitori aveau nevoie de o cantitate semnificativă de produse din metale neferoase. În perioada 1907-2013, pe teritoriul a 20 de sectoare de săpătură au fost descoperite și cercetate 83 de complexe și 1363 de artefacte, inclusiv materiale din 14 straturi culturale, care ar fi putut ajunge acolo din cele mai apropiate ateliere de producție. Printre complexe au fost identificate 6 ateliere de turnare a bronzului, 22 de ateliere de bijuterie, 6 ateliere de fierărie/lăcătușerie și 23 de locuințe-atelier. Majoritatea complexelor datează din secolele al XII – începutul secolului al XIII-lea. Unele dintre ele erau asociate cu prelucrarea fierului și/sau cu meșteșugul topirii/prelucrării sticlei. O serie de complexe de producție au format cinci centre meșteșugărești specializate ale Orașului de Sus, cu suprafețe cuprinse între 0,5 și 6 hectare. În umplutura complexelor au fost înregistrate 12 tipuri de metale comerciale, 503 semifabricate, 690 de vase de turnare, 15 forme de turnare, 34 de unelte și 112 exemplare de deșeuri de producție.

Apariția unui număr semnificativ de complexe de prelucrare a metalelor neferoase pe teritoriul Kievului de Sus se explică prin apropierea de curțile marelui cneaz cu complexele lor palatine, de curțile nobilimii, de piața centrală și de edificiile de cult.

The Upper Kyiv (“Upper City,” and its components: Kyiv Dytynets or “city of Volodymyr,” “city of Yaroslav,” “city of Iziaslav-Sviatopolk”) – the upper part of the city, located on Starokyivska and Mykhailivska Hills – was concentrated state, princely, feudal-manorial, and church-monastic crafts (fig. 1).

At different times, the territory of the Upper Kyiv was researched by such scientists as V. Khvoika, F. Movchanivski, V. Bogusevich, M. Karg-

er, V. Goncharov, S. Kilievich, P. Tolochko, G. Ivakin, M. Sahaidak, Ia. Borovs’kii, I. Movchan, A. Kozlovs’kii, and others. The generalizing work on the study of ancient Kyiv craft monuments in the Upper City was the monograph of S. Kilievich “Dytynets of Kyiv of the 9th – the first half of the 13th centuries” [Kilievich 1982], in which, among other things, known at that time production workshops in the oldest Kyiv part – Dytynets – related to the processing of non-ferrous metals

were listed and described. Since then, many similar objects have been researched in its territory and in the rest of Upper Kyiv, expanding the idea of the development of this branch of the craft.

Materials and methods

This article analyzes 83 archaeological objects, including materials in cultural layers of ancient Rus time, from 20 excavation areas of the Upper Kyiv (table 1, fig. 1, fig. 2). The excavations are presented chronologically, beginning with the earliest and ending with the latest. Some of these objects are represented here for the first time.

Different production structures were classified according to the following criteria. Workshops engaged in bronze casting, which specialized in foundry processes, are recognizable through characteristic finds, including metal raw materials and casting vessels. Their production focused on copper-based alloys (lead bronze, tin bronze, and brass) and the manufacture of finished products derived from these materials. Jewelry workshops were for the production of deco-

orative ornaments, attire fittings, sacred objects, and equestrian harnesses from non-ferrous and precious metals. They were characterized by specialized tools, casting molds, and small-volume casting vessels. Metalworking smith and locksmith workshops represent distinct functional spaces: the former for the production of colored metal items via hot or cold forging, the latter for the repair of existing objects. However, due to the similarity of artifacts recovered from these sites, a clear differentiation is challenging, and the combined classification “smithy/locksmithy” is commonly applied. Distinct from other workshops, they lack casting molds and vessels, have limited metal raw materials, and show traces of semi-finished or broken items. In dwelling-workshops, founders and jewelers were able to operate within typical residential spaces. Various types of manufacturing were conducted in universal workshops, utilizing shared facilities and thermal engineering structures. Workshops or dwelling-workshops and their surroundings featured a variety of thermal engineering structures – from production

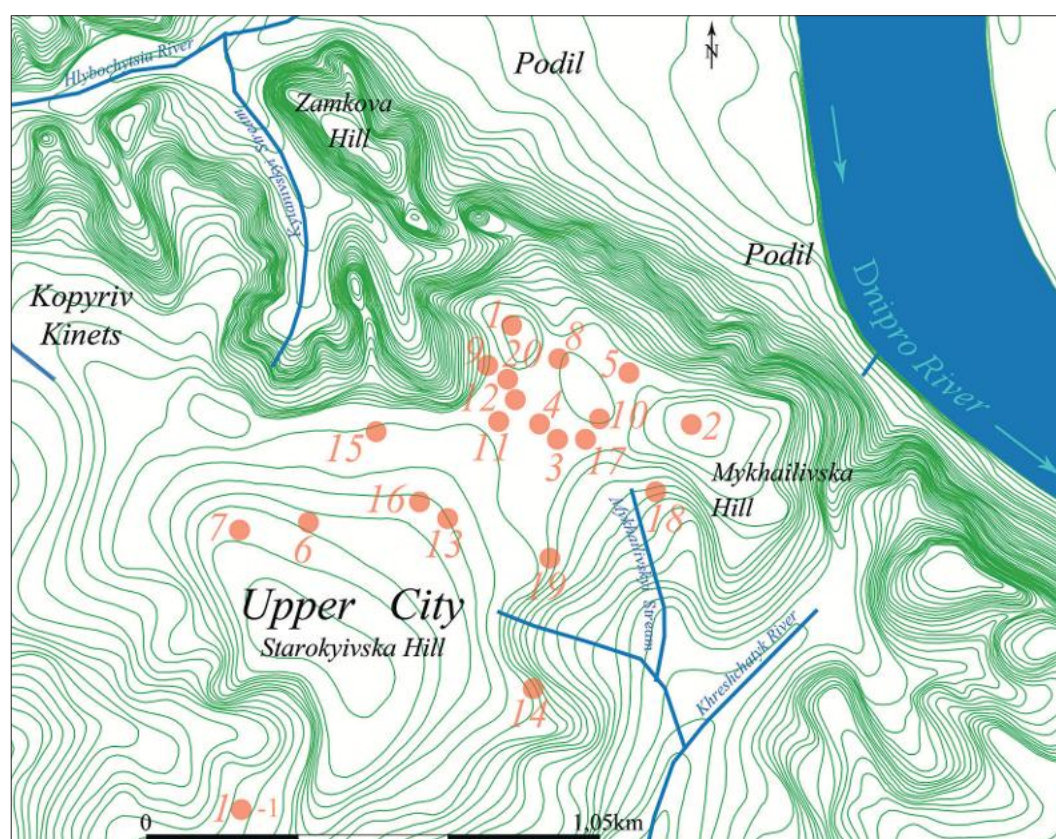


Fig. 1. Location of excavation areas of Upper Kyiv on the modern topographic map.

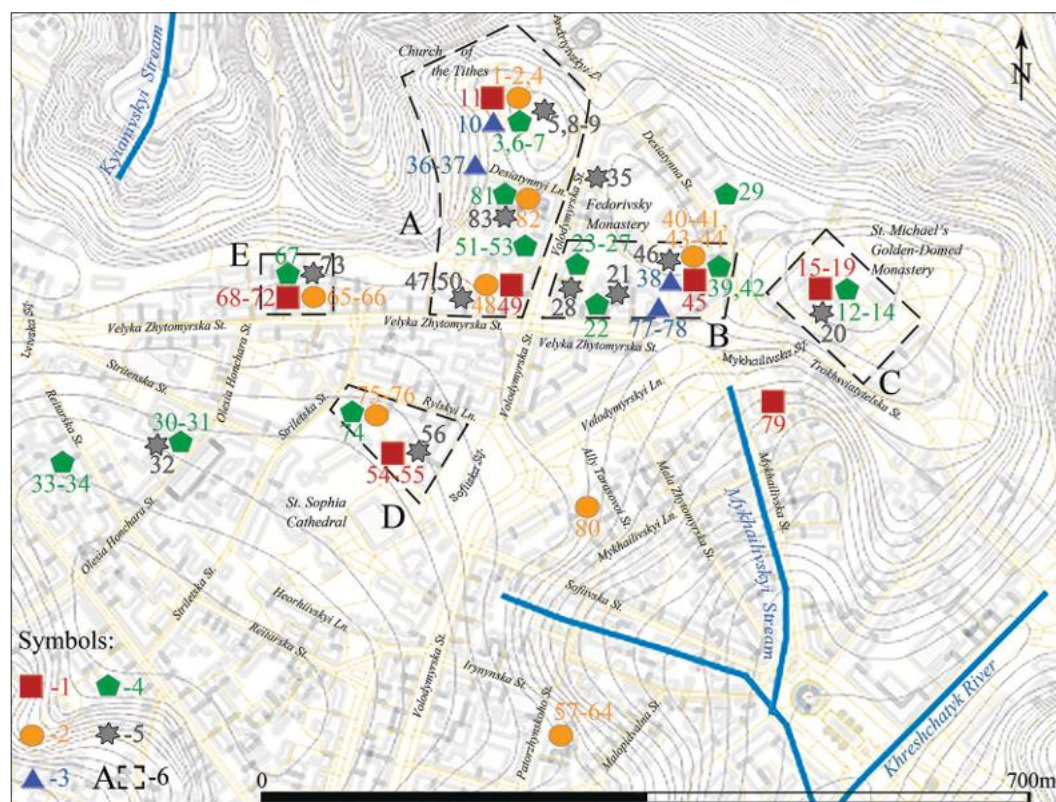


Fig. 2. Location of objects and craft centers, related to the processing of non-ferrous metals of Upper Kyiv on the modern map: 1 – bronze casting workshops; 2 – jewelry workshops; 3 – metalworking smithy/locksmithy workshops; 4 – dwelling-workshops; 5 – cultural layers; 6 – areas of the production centers.

kilns to ordinary cooking ovens and open hearths – all able to reach temperatures high enough to melt some metals. Warehouses, pits, and cellars used for storing raw materials, finished goods, or production wastes might also have formed part of the workshops. The planigraphic and stratigraphic measurements of archaeological objects may not accurately reflect their original dimensions, due to preservation conditions affected by modern urban development.

Artifacts from ancient Rus cultural layers were analyzed, which, to one degree or another, identify the presence of specialized non-ferrous metal production in a certain territory. Some such finds were accidentally found in some objects.

Identification of workshops was made possible through specialized artifacts unearthed in the fillings of objects: metal raw materials (ore, marketable metals, blanks, unfinished and broken items – semi-finished products), tools of labor (casting vessels – crucibles and smelting ladles, casting molds, tools), and production waste (scraps and spatters of metal, slags). Documented amounts of various ar-

tifacts are provided, though they might differ from the true values, since many scientific reports and papers lack exact numerical details. Lacking laboratory analysis of the non-ferrous metal artifacts described in the article, the metal was provisionally classified through paired name variants – “copper/bronze” and “tin/lead.” The paired name “crucible/smelting ladle” was used to denote casting vessels, the exact type of which could not be established. Most of the crucibles/smelting ladles were covered with non-ferrous glassy slags or crust and also had pieces of glass-like mass adhered to the inside of them. Some non-ferrous metal products from the fillings of archaeological objects were intended for repair or had been scrap, which accumulated for subsequent remelting. Fragments of enamel, smalt, glass threads, and amber were used in jewelry production. Domestic pottery fragments, covered with non-ferrous metal or glassy slags, may indicate a high intensity of casting processes in production workshops.

Typological, statistical, cartographic, and chronological methods formed the core of the re-

search methodology. Analysis of the ceramics in the fills provided the basis for dating the objects. The artifacts used in the article are currently preserved in the Archaeological Museum of the Institute of Archaeology of the National Academy of Sciences of Ukraine, the collections of the National Museum of the History of Ukraine, and the Kyiv History Museum.

Objects and finds

Over a long period, various archaeological objects have been researched at the excavation areas of Upper Kyiv, in the fillings of which, artifacts related to the processing of non-ferrous metals were found [Khvoika 1913, 63-75; Gushchin 1936, 23; Karger 1945, 10-14, fig. 7-13; Karger 1948; Rybakov 1948, 262, 361, 381, fig. 104,1; Karger 1949, 8-9; Korzukhina 1950, 229-231, fig. 4,1; Karger 1951, 15-35, fig. 6-23; Karger 1952, 7-10; Goncharov *et al.* 1955, 9; Korzukhina 1956, 323, 326, fig. 2,2-5, fig. 4,1-3, fig. 5; 328, 339, №11; Goncharov 1957, 126, 128, 130-132, 134, fig. 4,4; Karger 1958, 307-316, 320-328, 383, 385, 393-395, 399, 401, fig. 62-64, table XXXV, fig. 86,1-2, fig. 89,1, fig. 91,1, fig. 92, table LVIII; Tolochko, Kilievich 1965, 6, 9; Tolochko, Kilievich 1966, 6; Tolochko, Kilievich 1967; Kilievich 1969; Tolochko, Kilievich 1971, 237; Kilievich 1972, 290-291; Borovs'kii 1973; Kilievich 1973, 6-9; Kilievich 1975; Borovs'kii 1976, 104-107, fig. 8-10; Kilievich 1976, 199, 211; Tolochko 1976, 161-162; Kilievich 1977, 94-97, 99, 126-135; Sagaidak 1979, 19; Borovs'kii, Sagaidak 1980, 3; Kilievich, Braichevskaia 1981, 1-4; Tolochko 1981, 271; Kilievich 1982, 97-98, 121-122, 124, 160, 168-169; Kilievich, Orlov 1985, 61-62, 64-65, 67, fig. 2, fig. 4,1-3,5, fig. 6,1-2; Borovskii *et al.* 1989, 11-13, 16-18, 20, 27-30; Borovs'kii, Kaliuk 1993, 16, 27-28; Ivakin *et al.* 1997, 73, table 120,2, fig. 6,34; Ivakin *et al.* 1998, 39-40, 108-110, 115-116, 136-137, 153, 199, 201-204, fig. 142,10, fig. 183-184, fig. 186; Movchan *et al.* 1998a, 16, 19-23, 32-34, fig. 16-20, sheet 8; Movchan *et al.* 1998b, 117-118; Ivakin *et al.* 1999, 10-11, 52, 91, fig. 14,5,7; Movchan *et al.* 1999a, 3-4, 6-8, 11-13, 23-26, 28-36; Movchan *et al.* 1999b, 3, 16-17; Movchan *et al.* 1999c, 27; Movchan *et al.* 1999d, 125; Movchan *et al.* 1999e, 126; Movchan *et al.* 2000, 3, 34-36; Movchan *et al.* 2001; Movchan *et al.* 2002a, 7, 16-23, 27-28, 42-44; Movchan *et al.* 2002b, 5-7, 19-21;

Movchan, Klimovs'kii 2002, 10-18, 62-84, 88-91, 100-104, 115-116; Ivantsov 2003, 283, 289-290, 324-328, fig. 213, fig. 216-217; Klimovs'kii 2003; Movchan *et al.* 2003a, 4-11, 15-18, 23-25, 29, 31, 42-44; Movchan *et al.* 2003b, 9-11; Movchan *et al.* 2003c, 188; Movchan *et al.* 2003d, 194; Movchan *et al.* 2003e; Movchan 2004, 6, 9-14; Ievlev, Kozlov's'kii 2009, 139-150; Kozlov's'kii *et al.* 2009, 143; Kozlov's'kii, Ievlev 2010, 303-304; Zotsenko, Ievlev 2010, 371; Kozlov's'kii *et al.* 2013, 9-12, 34-39; Ievlev, Kozlov's'kii 2014, 227-228, 232; Ievlev *et al.* 2016, 79-81; Krizhanovs'kii 2020; Ivakin *et al.* 2023, 34-35, 69, 168-169, 207-209, fig. 70,2b, fig. 197,7, fig. 198,11-12, fig. 200, 3,8, fig. 241, fig. 244; Koziuba 2023, 74; Koziuba 2024, 18-21, 23, fig. 8,4, fig. 12,2, fig. 19]. Their main results are summarized in Table 1.

Among the presented materials, it is worth singling out those that previously received insufficient attention or have not yet been published.

⁷¹ The remains of a log house – object 33² (dwelling 1³), preserved to a height of four courses of logs with a diameter of 15-18 cm, constructed in a shallow pit (about 60 cm deep) – were discovered. The thermal engineering structure was located in the northern corner. Near this dwelling-workshop, where specialized non-ferrous metal casting could be, object 34 (pit) was found, with dimensions of 1.2 m in width and 1.4 m in depth. In its filling, a piece of tin/lead weighing 4.45 kg was found (table 1, fig. 1, fig. 2) [Sagaidak 1979, 19]. These objects could have been components of a non-ferrous metalworking complex.

¹¹ The object 48 was the remains of the thermal engineering structure [Movchan *et al.* 1999c, 27] – a part of an iron-working complex, and could have been used for processing non-ferrous metals. The object 49 (object 3 – pit) – almost complete and fragmentary, heavily oxidized/corroded copper/bronze products (so-called “treasure” of dishware) were found in its filling [Movchan *et al.* 1998a, 32-34, fig. 16-17, fig. 19-20, sheet 8]. The “treasure” consisted of a bowl, an aquamanile, and fragments of a large riveted vessel or vessels – in total, 376 fragments

1. Numbering of excavation areas where objects and finds related to non-ferrous metalworking were located.

2. Numbering of the archaeological objects and ancient Rus cultural layers, which are related to non-ferrous metalworking.

3. The original name of researching archaeological objects.

Excavation areas: Numbers & location (years of research)	Object numbers	Dimensions (m)	TES in objects	Dating (centuries)	Notes	Marketable metals	Semi-finished products	Casting vessels	Casting molds	Tools	Trimings/Spatters (Melts)/Slags
1 Volodymyrska St., 2 (1907-1908, 1936-1937, 1948, 1965-1966, 1969, 1975)	1 JW	L-3.4	1-0.6×0.4; 2-W-1.18	11-13	vestibule W-1.4				+		-/-/+
	2 JW	4.8×3.6; 4.6×3.6; 3.8×3.6	1-L-1.7; 2-2.8×1.35	11-13	L-shape & 3 rooms			1		2	
	3 DW	3.1×2.75		12-13				1	+		
	4 JW	A- ≈ 5m ²	D-0.15	11-12				200	+		-/-/+
	5			11-13	CL				+	+	
	6 DW		+	11-13			+		1		+/-/-
	7 DW		+	11-13							+/-/-
	8			10-12	CL			1			
	9			10-12	CL			1			
	10 SW		1-D-0.6; 2-+	10-11							-/-/+
	11 BW	2.8×2.8	D- ≈ 0.5- 0.6	11-13							-/-/+
2 Trokhsviatytska St., 8 (1938, 1949, 1997-1999)	12 DW	3.2×3.1- 3.6	1.5×1.17	12-13	"Artist's dwelling"		7			1	
	13 DW	2.9×2.45		10-13	stairs L-1.15	1	+				+/-/-
	14 DW	3.5×2.4		12-13			+			5	
	15	3.15- 3.3×2.6- 2.7		12-13	*			3			
	16			12-13	*						-/-/1
	17 BW	4.35×4		12-13		2	10	7			
	18			12-13	*						-/-/3
	19			12-13	*			2			
	20			11-13	CL	5	1	18		1	+/-/-
3 Velyka Zhytomyrska St., 4 (1946)	21			11-13	CL		+		1		
	22 DW			13						1	

4 Volodymyrska St., 7-9 (1955)	23 DW	4×3.3	1.4×1.3	13	entrance W-0.8		+				
	24 DW	L-3.2&4	1-+; 2-+	11	** hoard of jewelry						
	25 DW	D-0.9		12-13	TES			1			
	26 DW	2×3		12-13	TES						
	27 DW	1.4×1.2		12-13	TES			+			
	28			10-13	CL			1			
5 Desiatynna St., 2 (1973)	29 DW	≈ 4×3	+	12-13					1		
6 Olesia Honchara St., 10 (1973)	30 DW	4.2×2.8	1.5×1.4	12-13	**						
	31	0.8×0.6		13	*** TES						
	32			12-13	** CL						-/-/+
7 Reitarska St., 35 (1979)	33 DW	L-4.2	+	12							
	34	W-1.2		12	*** pit	1					
8 Volodymyrska St., 3 (1980)	35			10-11	CL		+				
9 Desiatynnyi Ln., 10 (1981)	36 SW	L-4.3& 1.65& 0.35	A- ≈ 1m ²	10-11	entrance 1.2×1.3		1				-/-/+
	37 SW			10-11					3		
10 Velyka Zhytomyrska St., 2 (1988-1989, 2001-2002)	38 SW	D- ≈ 3		11	cellar	+	+	3		1	
	39 DW	L-3.1& 2.7&2.8		12-13				2	1	3	
	40 JW	1.8×1.2- 1.6		11	TES		2	426	4	1	-/+1
	41 JW	2.8×2.8		11-13			+			2	
	42 DW	4.4× 4.25	1.75×1.5	13		+	1			1	
	43 JW	2.25×2.1		13		+					
	44 JW	D-2-2.2		11			1	+			
	45 BW	D-2.3		11	pit			+			
	46			13	CL	+		2			

11 Volodymyrska St., 12 (1993, 1998)	47			10-11	CL				1		
	48 JW			10-11	TES						
	49 BW	1.15×1.1		12-13	pit; “treasure” of dishware		378				
	50			12-13	CL					1	
12 Volodymyrska St., 8 (1999)	51 DW	2.7×2.5		13	entrance W-1.35	+	20	1		2	+/-/-
	52 DW	L-3.1		12-13		1					
	53 DW	$\approx$ 2.5×2.5	+	13						2	
13 Volodymyrska St., 20-22 (1999)	54	A- $\approx$ 6m ²		11	*						-/-/+
	55	6×5		11	*						
	56			11	CL			+			-/-/+
14 Patorzhynskoho St., 14 (2000)	57 BW	0.37× 0.37		13	*** TES						
	58 BW	0.6×0.43		13	*** TES						-/2/-
	59 BW			13	*** TES						
	60 BW	0.48× 0.35		13	*** TES						
	61 BW	0.44× 0.32		13	*** TES						
	62 BW	D-0.32		13	*** TES						
	63 BW	0.32× 0.39		13	*** TES						
	64 BW	0.22× 0.15		13	*** TES						
15 Velyka Zhytomyrska St., 20 (2001-2002)	65 JW	2.6×2.5		11			1	1		1	-/-/+
	66 JW	2×2		10-11			+			1	-/+/+
	67 DW	2.5×1.2	$\approx$ 1×0.7	11-12				1			-/3/-
	68 BW	0.55×0.3		11	pit		+	+			-/+/+
	69	D- $\approx$ 1		11	* pit					1	
	70	$\approx$ 5×4	1- A- $\approx$ 1m ² ; 2-1.3×1.2	12-13	*			6			
	71	3.5×2.5		11	*			1			
	72			10-13	* small ditch	+	50				-/+/-
	73			10-13	CL		+			1	+/-/-

16 Ryl'skyi Ln., 5 (2001-2002)	74 DW	3×1.7- 1.8		11-12				2			
	75 JW	3×0.76		11-12			1		1		
	76 JW	1.8×1.3		11-12	pit				1	1	
17 Velyka Zhytomyrska St., 2A (2002-2003)	77 SW	A- 24.5m ²		12-13	cellar	1	6			1	
	78 SW	3.2×3	1.2×1.2	11-12	**						
18 Mykhailivska St., 24A (2003)	79	D-0.7- 1.25		11-12	* pit						-/+/-
19 Ally Tarasovoi St., 1-5 (2004)	80 JW	≈ 3.8× 1.5	≈ 0.95×0.6	12-13							-/2/-
20 Desiatynnyi Ln., 3A-B, 5D (2008-2013)	81 DW	5×4.5	1-D- ≈ 0.8; 2-0.9×0.82	11-12	its pit ≈ 6×5; TES 2-outside				1	4	17/-/ 32
	82 JW	D-0.9		11-12	pit		24	2			
	83			11-12	CL	1		7		1	12/ (14)/ 26
Total	83					12	503	690	15	34	29/6 (14)/63

Table 1 Excavation areas where specialized objects and artifacts related to the processing of non-ferrous metals are located.

BW – Bronze casting workshops and their components; JW – Jewelry workshops and their components; SW – Smithy or locksmithy workshops and their components; DW – Dwelling-workshops and their components; TES – Thermal engineering structures; CL – Cultural layer; “+” – There are certain objects or artifacts here, but specific numerical data is lacking; “*” – Non-production objects where specialized finds were accidentally found; “**” – Non-ferrous metal products; “***” – Objects that, despite the absence of specialized artifacts in their fillings, may have been components of non-ferrous metalworking complexes.

were collected [Movchan *et al.* 1998a, 33-34, fig. 18-20]. All these items showed certain damage. It can be assumed that, besides the version of a hidden cache of valuable vessels that might have been used for washing or liturgical purposes [Movchan *et al.* 1998a, 34], they were broken and could have been stored in a pit for future repair or accumulated as scrap metal. In the cultural layer, object **50**, an iron jeweler's tweezer, was found (table 1, fig. 1, fig. 2) [Movchan *et al.* 1998a, 16, sheet 8].

14 The eight small thermal engineering structures – objects **57-64** for casting non-ferrous metals – were discovered (table 1, fig. 1, fig. 2). Near the second structure – object **58** – two splatters of white-colored high-tin bronze were found. [Movchan *et al.* 2000, 3, 34-36; Klimov's'kii 2003]. In these objects, apparently built for single use,

maybe for remelting, both precious metals and copper/bronze could have been used to produce ingots of marketable metals. They could well have been dated to the 13th century, as they could have been located in the part of the ancient Rus cemetery that had ceased to function (following the example of the cemetery in Kopyriv Kinets) [Kozlov's'kii, Krizhanov's'kii 2019, 22].

15 The object **65** (object 89) – the jewelry workshop. Along its perimeter ran a step 50-70 cm wide, onto which a wooden log house was lowered during the construction of the structure. Two small storage shelves were found in the eastern and western walls of the structure. In its filling, at the floor level, a gold wire over 7 cm long, and 0.3 mm in cross-section, along with copper/bronze scales, a fragment of a crucible wall, and glass-like slags,

were found [Movchan, Klimovs'kii 2002, 65-68]. The object **66** (object 95) – the jewelry workshop. Two large and deep pits were recorded in the floor. In its filling, splatters of a tin-bronze alloy, copper/bronze plates, and fragments of melted and deformed objects made of non-ferrous metals, as well as glass-like slags, were found. And in the filling of the lower layer, a curved ceramic nozzle was found [Movchan, Klimovs'kii 2002, 68-70]. The object **67** (object 75) – the dwelling-workshop. The thermal engineering structure fell into it from the above-ground part; it was located about 1 m from the northern wall of the structure and was built on a bedding of white kaolin clay. The thickness of the three recorded bottoms of the thermal engineering structure ranged from 7 to 12 cm; fragments of pottery, mainly pot walls, were used for their repairs. In its filling, a crucible wall fragment, and three splatters of non-ferrous metals were found [Movchan, Klimovs'kii 2002, 102-104]. The object **68** (object 69) – an oval pit for production waste. In its filling, numerous fragments of crucibles, coated with glass-like slags, some of which had remains of non-ferrous metal fused to their inner surfaces, were found. Similar residues were also recorded on fragments of domestic pottery walls. Together with these finds, casting (copper/bronze) slags, splatters of non-ferrous metals, and large pieces of glass-like slags or masses were found. Plates of non-ferrous metal (copper/bronze) were also found here [Movchan, Klimovs'kii 2002, 115-116].

Within this excavation area, several other structures, into which specific items related to the processing of non-ferrous metals were discovered. In the filling of object **69** (object 105), a copper/bronze matrix in the form of the Tree of Life, used for embossing an image on the central part of barms, was found. In the filling of object **70** (object 38), the remains of a crucible consisting of six fragments, including a handle and a wall fragment with a hole, were found. In the filling of object **71** (object 58), a fragment of a crucible wall was found. In the filling of a small ditch (in front of the entrance to one of the estates) – object **72**, splatters of non-ferrous metals, and heavily oxidized non-ferrous metal items that could not be identified, as well as small fragments of tin/lead (≈ 50) – were found.

In the cultural layer, object **73** was found: splatters of metal, a fragment of a ceramic nozzle,

and fragments of various copper/bronze products, some of which – such as plates, rivets, trimmings, etc. – may have been used as non-ferrous scrap (table 1, fig. 1, fig. 2) [Movchan, Klimovs'kii 2002, 10-18, 62-84, 88-91, 100-101].

18 In the filling of the object **79** (circular grain pit 3), splatters of tin/lead were found (table 1, fig. 1, fig. 2) [Movchan *et al.* 2003b, 9-11]. These items could have come from a nearby non-ferrous workshop.

19 The object **80** (object 8) – the jewelry workshop. In its filling, two pieces of opaque green and black smalt were found, which may have been used in jewelry production. At a distance of 0.7 m from the western wall of this structure, in its central part, the collapsed remains of the thermal engineering structure were discovered. At a distance of 0.25 m from it, a shallow stoke pit was recorded. During the dismantling of the thermal engineering structure's bottom, two melts of tin/lead mass that had the characteristic shape of drips accidentally spilled during melting were found (table 1, fig. 1, fig. 2) [Movchan 2004, 6, 9-14].

Discussion

Between 1907 and 2013, archaeological excavations conducted across 20 areas in the Upper Kyiv discovered and studied 83 objects and 1363 artifacts associated with the processing of non-ferrous metals (table 1, fig. 1, fig. 2).

Bronze casting workshops and their components – objects **11**, **17**, **45**, **49**, **64**, and **68** (a total of 6) – were located within excavation areas **1-2**, **10-11**, and **15** (a total of 5). *Jewelry* workshops and their components – objects **1-2**, **4**, **40-41**, **43-44**, **48**, **57-66**, **75-76**, **80**, and **82** (a total of 22) – were located within excavation areas **1**, **10-11**, **14-16**, and **19-20** (a total of 8). *Smithy* or *lock-smithy* workshops and their components – objects **10**, **36-38**, and **77-78** (a total of 6) – were located within excavation areas **1**, **9-10**, and **17** (a total of 4). *Dwelling-workshops* and their components – objects **3**, **6-7**, **12-14**, **22-27**, **29-30**, **33**, **39**, **42**, **51-53**, **67**, **74**, **81** (a total of 23), were located within excavation areas **1-7**, **10**, **12**, **15-16**, **20** (a total of 12). The objects **22**, **30**, **33**, **67** likely belonged to smiths-founders, while those of jewelers were objects **3**, **6-7**, **12-14**, **23-27**, **29**, **39**, **42**, **51-53**, **74**, **81**.

Within one or several workshops, there could be multidisciplinary production – a com-

bination of non-ferrous metalworking, primarily with ironmaking/ironworking and glassmaking/glassworking crafts. The objects **10, 17, 22, 26-27, 32-33, 36-38, and 48-49** (a total of 12) likely functioned as *universal workshops* or their components. In these, the processing of non-ferrous metals was combined with ironmaking/ironworking operations [Pan'kov 2012, 42-51]. The objects **12-13, 17, 33-34** (a total of 5) additionally specialized in glassmaking/glassworking operations [Karger 1958, 404; Zhurukhina 2021, 128-145].

In ancient Rus cultural layers – objects **5, 8-9, 20-21, 28, 32, 35, 46-47, 50, 56, 73, and 83** (a total of 14) – were located within excavation areas **1-4, 6, 8, 10-11, 13, 15, and 20** (a total of 11), there are the specialized artifacts related to the non-ferrous metal processing identify. Possibly, there were production workshops near those objects. Some finds were got from cultural layers or production objects to some non-production objects: **15-16, 18-19, 31, 34, 54-55, 69-72, 79** (table 1, fig. 1, fig. 2).

All of these objects can be conventionally divided into the following chronological periods, based on the duration of their existence (table 1).

The objects **10, 35-37, 47-48, and 66** (a total of 7) date to the second half of the 10th century – the first half of the 11th century. The objects **24, 38, 40, 44-45, 54-56, 65, 68-69, and 71** (a total of 12) date to the 11th century. The objects **4, 67, 74-76, 78-79, 81-83** (a total of 10) date to the end of the 11th century – the first half of the 12th century. The objects **33-34** (a total of 2) date to the 12th century. The objects **3, 12, 14-19, 25-27, 29-30, 32, 39, 49-50, 52, 70, 77, and 80** (a total of 21) date to the second half of the 12th century – the beginning of the 13th century. The objects **22-23, 31, 42-43, 46, 51, 53, and 57-64** (a total of 16) date to the first half of the 13th century. The objects **1-2, 5-9, 11, 13, 20-21, 28, 41, and 72-73** (a total of 15) have a broad dating range from the 10th to the 13th (10th-12th, 10th-13th, and 11th-13th) century, as it was not possible to determine their exact time of existence more precisely (table 1).

Most of the object's date to the 12th – the beginning of the 13th centuries. During that chronological period, Kyiv reached its greatest economic prosperity due to the city's numerous trade connections, which were reflected in the popularity of non-ferrous metal crafts.

In the fillings of the objects were found 12 marketable metals, 503 semi-products, 690 casting vessels, 15 casting molds, 34 tools, and 112 production wastes (table 1).

The concentration of a significant number of bronze casting workshops, jewelry workshops, smith or locksmith workshops, and dwelling-workshops in certain districts of the city created craft centers, where the processing of non-ferrous metals took place. Thus, on the territory of the Upper Kyiv during the 10th – the first half of the 13th century, five such centers (fig. 2) were formed [Kilievich 1982, 168-170; Krizhanovs'kii 2020].

The craft center A was located in the northern part of the Starokyivska Hill, in the territory of Dytynets ("city of Volodymyr"), and its total area may have reached about 6 hectares. At six excavation areas, 17 specialized archaeological objects were discovered and researched, two of which were related to bronze casting, 11 to jewelry, and 4 to smithy/locksmithy businesses. The workshops in this center likely served the Grand Prince's court with its palace complexes, catered to the needs of the boyar nobility, the clergy from the Church of the Tithes, and the nearby marketplace "Babyn Torzhok" [Aseev 1982, 23-24; Kilievich 1982, 57-70, 153-155; Ivantsov 2003, 154].

The craft center B was also located in the territory of Dytynets, to the southeast of the center A, with a total area of approximately 1.3 hectares. At four excavation areas, 16 specialized archaeological objects were discovered and researched. One of them was associated with bronze casting, 11 with jewelry, and 4 with smithy/locksmithy businesses. The workshops in this center likely served the estate of the Fedorivsky Monastery and served the princely court of Mstislav Volodymyrovych, which was located nearby [Goncharov 1957, 134-135; Aseev 1982, 116-117].

The craft center C was located on the Mykhailivska Hill, in the territory of the "city of Iziaslav-Sviatopolk," with a total area of approximately 2 hectares. At one excavation area, 4 specialized archaeological objects were discovered and researched. One of them was associated with bronze casting, and 3 with jewelry businesses. The workshops in this center likely served the estate of the St. Michael's Golden-Domed Monastery [Ivakin *et al.* 2023].

The craft center D was located on the Starokyivska Hill, in the central part of the territory of the “city of Yaroslav”, with a total area of approximately 1 hectare. At two excavation areas, 3 specialized archaeological objects associated with jewelry businesses were discovered and researched. The workshops in this center likely served the estate of the St. Sophia Cathedral [Ievlev, Kozlovs’kii 2009].

The craft center E was located in the territory of the “city of Yaroslav,” to the west of the center A and to the north of the center C. Its total area was approximately 0.5 hectares. At one excavation area, 4 specialized archaeological objects were discovered and researched. One of them was associated with bronze casting, 2 with jewelry, and 1 with smithy/locksmithy businesses. The workshops in this center likely catered to the needs of the local boyar estates and the ordinary urban population [Movchan, Klimovs’kii 2002].

Conclusions

During the 10th – the first half of the 13th century, from 20 excavation areas of the Upper Kyiv, 83 objects and 1363 specialized artifacts were

found within their fills. There were discovered 6 bronze casting workshops, 22 jewelry workshops, 6 smithy/locksmithy workshops, 23 dwelling-workshops, and specialized artifacts from 14 cultural layers, which could have gotten there from nearby workshops. In some cases, they combined with ironmaking/ironworking and/or glassmaking/glassworking crafts that used similar equipment, tools, and technologies for the primary processing of raw materials. Most objects date to the 12th – the beginning of the 13th century, which reflects the political, socio-economic, and cultural development of Kyiv during those periods.

The emergence of these objects was influenced by their proximity to the Grand Prince’s courts with their palace complexes, boyar nobility estates, religious buildings – Church of the Tithes, Fedorivsky Monastery, St. Michael’s Golden-Domed Monastery, St. Sophia Cathedral – and marketplace “Babyn Torzhok”.

Some objects formed five specialized craft centers. Its territory could have ranged from 0.5 to 6 hectares.

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