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Jewellery in the 13th-17th Centuries in Vilnius Based on Archaeological Data

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INTRODUCTION

From the earliest times the variety of forms and decor of jewellery artefacts as an expression of aesthetics and perception of the world view reflects aspects of a person's individuality, or converesly, belonging to a certain culture or community.

In the Middle Ages and later periods, in cities where trade routes intersected and cultural intentions reached people of different social strata more quickly, jewellery leveling, syncretism and general trends in types, forms and decor across vast regions spanning hundreds or thousands kilometers, were observed.

Now jewellery is defined as "a branch of applied decorative art: creation of ornaments from precious and non-ferrous metals, their alloys and gemstones"[1]. In earlier periods, goldsmithing and jewellery were often identified with goldsmiths and jewellers. Only in the 16th century in the lists of Vilnius residence craftsmen of the Polish Kings and the Grand Dukes of Lithuania Sigismund I the Old and Sigismund II Augustus, masters of narrow specializations, such as gem carvers and jewellers, were mentioned for the first time, but that was rather an exception, not the rule. Until the mid 17th–18th centuries, historical sources related to Vilnius mention only goldsmiths who produced tableware, bridles, book mounts, candlesticks, votives, belts, crosses, buckles, chains, gold threads, coffin fittings, saddle decorations, copper vessels, drinking horn covers, insignia, repaired old items, gilded, etc.[2] From the mid 17th–18th centuries jewellers have been distinguished from goldsmiths (sometimes both terms are used – a goldsmith and a jeweller), who are mentioned as producing rings, bracelets, earrings with diamonds, silver belts with gemstones, signets, buttons, votives, as well as dishes[3].

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1 *Dailės žodynas*, sudarė J. Mulevičiūtė, G. Jankevičiūtė ir L. Šatavičiūtė, Vilnius: VDA leidykla, 1999, p. 177.

2 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 183, 193.

3 Ibid, p. 183-184, 193.

Until the end of the 15th century, historical resources did not contain more detailed information about ornaments, the activity of goldsmiths - usually it was limited to sporadic general information about goldsmiths who worked at the time, jewels given as gifts and this information was only related to descriptions of the persons of the highest social status – the ruler and his environment. The artefacts themselves have not survived in the treasures (with the exception of the Cathedral Treasury, museums and private collections abroad), as well as detailed descriptions of the jewellery artefacts. Therefore, archaeological finds - jewellery artefacts and tools used by craftsmen, as well as sites related to the processing of non-ferrous metals, provide the data about the jewellery at the second half of the 13th–the end of the 15th centuries. Until now, this material has not been fully studied and systematized.

The aim of this study is interpretation of the 13th–17th centuries jewellers' activities and jewellery artefacts in the context of archaeological, published historical data and laboratory research in Vilnius. To achieve the aim, the following tasks have been set: to discuss the sites that could be associated with the processing of non-ferrous metals, jewellers' workshops and tools used by craftsmen in the data of archaeological research, supplementing them with historical knowledge data and identify the used materials, technologies and their changes based on the laboratory research.

1. ARCHAEOLOGICAL ARTEFACTS AND METHODS

1.1. Artefacts

The object of the study is jewellery artefacts - ornaments and jewellers' work tools found in Vilnius during archaeological research and sites associated with the possible activities of jewellers. Due to the large number (over a thousand) and, in some cases, unspecified dating, the fragmentary nature of the artefact, there were no opportunities to present each artefact, but only the more precisely dated, more fully

preserved, more exclusive and researched finds and the outcomes of their study in this work.

The chronology of the study covers the 13th–17th centuries. The first date is associated with jewellery found in dendrochronologically dated cultural layers (the oldest date is 1259, at the place of the lift to the Castle Hill), but individual artefacts can be dated to a wider period and include the entire 13th century. The end date is chosen between 1655–1661 years (muscovite occupation in Vilnius), when Vilnius was devastated: on the territory of the Old Bishops' Palace (now the Presidency) the former craftsmens' workshops burned down (not rebuilt), the residence in the Lower Castle, near which the craftsmen gathered, was robbed and plundered, craft activity was suspended – some crafstmen (and goldsmiths/jewellers) were forced to emigrate from the city, others were forcibly taken to Moscow, some were killed. During the occupation, works of goldsmithing and jewellery were also taken away or destroyed.

1.2. Methods

Empirical descriptive, typological and comparative methods were used in this study, dividing the finds into types according to groups, materiality and chronology, as well as experimental, when the possibilities of sealing rings in wax were tested, but the most important was laboratory research: archaeological finds were studied applying geological, gemological and chemical science methods, the obtained results were supplemented with the context of historical material. The author initiated and carried out 355 such studies.

In most cases, non-destructive tests were applied to the archaeological finds obtained during the archaeological excavations of Vilnius. They were studied in six laboratories by identifying alloys of precious and non-ferrous metals, where possible – solders, enamels, gemstones or glass, rock, crucible mass, metal droplets on crucibles and stones of casting molds.

XRF. The XRF method is most often used for the study of metal alloys in archaeological finds.[4] This method was used to study the composition of metal alloys, solders and enamels found in archaeological finds. It was used as an additional method to identify glass or gemstones.

SEM-EDX. This method was used to study metal alloys, solders, enamel, composition of metal droplets in crucibles, composition of ceramics, pigments, etc.[5]

Microchemical analysis was used more often in previous years to identify the composition of metal alloys, metal droplets on crucibles and solders.

Gemological method. The goal of gemological method in archaeology is to determine which jewellery materials were used to decorate the finds. The outcomes of gemological research allowed to confirm or deny the initial guesses of archaeologists, to specify gemstones/glass identified by geologists and other researchers long ago, or to identify them for the first time.

Geological method. The goal of geological method was to identify casting mold stones and rock jewellery. Petrographic studies were carried out. The SEM-EDX method was also applied to one casting mold, specifying an atypical artefact made of volcanic rock (lava).

Radiography. X-ray was used for research of stone casting molds and crucibles by recording the locations of metal alloys' droplets. On casting molds and crucibles, very small droplets of metal are not al-

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4 Lukšėnienė V., Rentgenografijos taikymas archeologiniams radiniams tirti, In *Metodai Lietuvos archeologijoje*, sudarytojas A. Merkevičius, Vilnius, 2013, p. 224-226.

5 Tautkus S., Beganskienė A., Žarkov A., Merkevičius A., Kareiva A. Archeologinių dirbinių tyrimas atominės absorbcinės spektrokopijos (AAS), rentgeno spindulių difrakcinės analizės (XRD), infraraudonosios spektroskopijos (IR), termogravimetrinės analizės (TG) ir skenuojamosios elektroninės mikroskopijos (SEM) metodais, In *Metodai Lietuvos archeologijoje*, sudarytojas A. Merkevičius, Vilnius, 2013, p. 166-178.

ways visible for the naked eye and sometimes it appears that the crucibles or molds have not been used, but if these artefacts have been used, such droplets appear as dark spots on X-ray. These recordings help to identify the locations of metal accumulations during other investigations and to determine the elemental composition of metal alloys using the SEM-EDX method.

Radiography was also used to examine the shapes, ornaments and fittings made of metal in casting molds, as well as pearls – in order to determine whether they are real pearls or imitations.

2. RESULTS

2.1. Jewellers' workshops

During archaeological research, jewellers' workshops were localized according to the locations of unfinished (preparations), defective artefacts, their scrap, working tools (casting tools, matrices, crucibles and tools) clusters, as well as by sites of metal melting furnaces and castings.

There were found 22 sites (25 with suburbs), related to non-ferrous metal processing and the activities of jewellers (goldsmiths) in the late 13^{th}–17^{th} centuries.

According to the historical resources of the 16^{th}–17^{th} centuries, there were 40 places related to the activities of goldsmiths mentioned in Vilnius (often they were not precisely specified). There were 9 more precisely specified places, where there were or could have been workshops, and 7 places where could have been shops. The archaeological and historical data juxtaposed in the study allow to form a possible distribution network of former places related to non-ferrous metal processing in Vilnius.

One of such places was Vilnius Lower Castle. The intensification of craft activity and the increase in the quantity of handicrafts (both local and imported) could be related to the strengthened fortified set-

tlement in the territory of the castle in the second half of the 13th century – Early Castle.[6] The wooden buildings in the Arsenal courtyard, now the sight of the lift to Castle Hill (years 1259 and 1271), the wooden buildings in the castle territory (8-9th decades of the 13th century), and the sites of craftsmen's tools and artefacts in the territory were dated by the dendrochronological method, indicating the activity of goldsmiths and jewellers from the end of the 13th century onwards, which has especially expanded in the 14th–early 15th centuries. The finds included crucibles, stone and metal molds, matrices, copper and other metal alloys and casting fragments, jewellery artefacts and their workpieces, and other artefacts associated with jewellers' activities and workshops. Droplets of gold, silver and non-ferrous metal alloys were found in crucibles. Artefacts were made of both precious and non-ferrous metals, some decorated with gemstones and glass. Finds related to amber processing were also discovered – there was an amber workshop here at the end of the 14th century. Historical sources also mention goldsmiths who worked on the lord's estate, and record payments for work from the end of the 15th century.[7]

Parts of metal melting furnace and other finds dating from the late 14th century to the early 15th century were found in St. Mykolas St. 6, Vilnius[8]. The archaeological excavations at Pranciškonų St. 4A have uncovered slag, copper alloy tin and other finds, which indicate that in the second half of the 14th century craftsmen and jewellers lived and worked there.[9] A crucible excavated in the area, together with finds from the 17th century, was examined and found to contain melted sil-

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6 *Lietuvos didžiųjų kunigaikščių rūmai Vilniaus žemutinėje pilyje. Istorija ir rinkiniai. Albumas*, sudarytojai D. Avižinis, V. Dolinskas, Ė. Striškienė, Vilnius, 2010, p. 36-37, 67.

7 *Lietuvos didžiojo kunigaikščio Aleksandro Jogailaičio dvaro sąskaitų knygos (1494–1504)*, parengė D. Antanavičius, R. Petrauskas, Vilnius, 2007.

8 Katalynas K., *Vilniaus plėtra XIV–XVII a*., Vilnius, 2006, p. 40.

9 Veževičienė V., Brazaitis D., Dargytė N., Pranciškonų gatvė 4A, In *Archeologiniai tyrinėjimai Lietuvoje 2015 metais*, Vilnius, 2016, p. 377.

ver and gold. A part of the ceramic duct of crucible and metallurgical furnace of the 15th–16th centuries was found in the Augustijonu St.[10].

During archaeological excavations at Didžioji St. 24 and 26, crucibles from the first half of the 15th–16th centuries were found[11]. In 1580, there was mentioned the house of the goldsmith Leonas Pavlovičius in Pilies-Didžioji Street (estate No. 76) here. Next to it there was the house of the goldsmith Lorenz.[12] During archaeological excavations at Didžioji St. 10 there was found a mould for casting bullets (mid-17th century)[13] and a pair of pliers for making bullets[14]. In 1636, in Didžioji Street (part of the estate No.75) it was written: "downstairs of the house, by the gates, in front of the pantry there is a goldsmith's marketplace"[15]. The brick house belonged to Jonas Kliučata (not a goldsmith).

The address Didžioji St. 3 (part of the estate No. 198) mentions the brick house of Štrunkas: "downstairs of the brick house, by the gates, there is a shop, which is now occupied by the goldsmiths"[16]. Some documents show that the house which was in the estate No. 202 (now Didžioji St. 11), belonged to the goldsmith Jurgis Kovzanas in 1633.[17].

During archaeological excavations at Trakų St. 2, near the city's defensive wall, inside the building, there were found crucibles dating

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10 Katalynas K., *Vilniaus plėtra XIV–XVII a*., Vilnius, 2006, p. 42.

11 Katalynas K., *1986-1987 m. archeologinės priežiūros ir archeologinių tyrimų M. Gorkio g. Nr. 66, 68 (Didžioji gt. 24, 26) ataskaita*. I dalis, Vilnius, 1988, LIIR, F. 1, b. 1341.

12 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 96.

13 Nr. 753, Poška T., *Archeologiniai tyrimai Vilniuje, Didžioji g. 8, 10*, 1993, LIIR, F. 1, b. 2162, 2163.

14 Poška T., Archeologinių tyrimų Vilniuje, Didžioji g. Nr. 8, 10 rezultatai, In *Archeologiniai tyrinėjimai Lietuvoje 1992-1993 metais,* Vilnius, 1994, p. 238-241.

15 Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006, p. 92.

16 Ibid, p. 102.

17 Ibid, p. 103-104.

to the second half of the 16th century[18]. Copper, lead, zinc and iron were melted in the crucible. A former goldsmith's shop was mentioned in the brick house of Mstislav's castellan Jonas Oginskis in Trakų St. (possibly estate No. 400)[19].

A metal melting furnace, crucible and tweezers were found during the archaeological excavations at Stiklių St. 3[20], and a metal melting furnace tube for blowing air was found at Stiklių St. 5[21]. The wooden house of the goldsmith Albrecht was mentioned in the estate No. 227 (Stiklių Str.) It is likely to be the house of the goldsmith Albrecht Schneider.[22] In this house "downstairs, on one side, there is a store with workshops"[23]. In the second half of the 17th century, the goldsmiths Andrius Brakfeltas, Heidė and Juozapas Barčinskis lived in Stiklių St.[24]. In 1685, there was mentioned the house of Matas Greiteris in Stiklių St. He was a goldsmith, produced jewellery with gemstones and enamel, repaired and silver-plated jewellery artefacts[25].

During the archaeological excavations at Gaono St. 4 (estate No. 220) there were found crucibles dating back to the second half of the 17th century[26]. One of the crucibles revealed that there were tin, copper and lead melted in it. In 1663, a goldsmith from Tilsit lived in

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18 Sarcevičius S., Tyrinėjimai Vilniuje, Trakų gatvėje Nr. 2, In *Archeologiniai tyrinėjimai Lietuvoje 1996 ir 1997 metais*, Vilnius, 1998, p. 405.

19 Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006, p. 164.

20 Daminaitis V., *1998 m. Vilniuje, Didžioji gt. 32 (Jėzuitų vien.) vykdytų archeologijos tyrimų ataskaita*, Vilnius, 1999, LIIR, F. 1, b. 3063.

21 Žukovskis R., *Archeologiniai tyrimai Vilniuje, Stiklių g. 5. Ataskaita /1994 m./*, LIIR, F. 1, b. 2259.

22 Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006, p. 137.

23 Ibid, p. 140.

24 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 191-192.

25 Ibid, p. 280.

26 Daminaitis V., *Vilniuje, Gaono g.4 vykdytų archeologijos tyrimų ataskaita*, Vilnius, 1997, LIIR, F. 1, b. 2850, p. 8.

this house. In 1678, a tailor, a tinsmith and a goldsmith rented apartments and workshops there.

During excavations in Gaono St. 6[27] crucibles were found. The research revealed that copper, zinc and lead were melted in one of the crucibles. There were two estates belonging to different owners until the mid of the 17th century. In 1669, one part of it belonged to the goldsmiths' guild.

The 17th century crucibles, copper alloy fragments, moulds, slag and other artefacts were found in Dominikonų St. 4 (former Garelio St. 4)[28]. Silver and copper[29], silver and tin[30] were melted in the crucibles.

The brick house at Šv. Dvasios St. (possibly part of the estate No. 234) was probably the house of the goldsmith's Mykolas Bretšneideris widow: "upstairs there is a small room and a pantry with a goldsmith's workshop"[31]. She also possesed one more house on the other side of the street, probably at Domininkonų Str. 11, 9. It mentions a goldsmith's shop. In 1639, the house already belonged to the Zeligmachers, to whom Bretšneider was related[32]. In Šv. Dvasios St., in front of the Dominican church (estate No. 427) the house was owned by the goldsmith Jonas Senda[33].

Before it was built, on the grounds of St. Catherine's Church, were

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27 Žukovskis R., *Archeologijos žvalgymai Gaono g. 6, Vilniuje 1999 metais ataskaita*, LIIR, F. 1, b. 3322.

28 Nr. 604-605, Grišinas V., *1988. Vilnius, Garelio g.4 pastato išplėtimas. Archeologinių tyrimų ataskaita*, LIIR, F. 1, b. 1582; Grišinas V., 1989 m. archeologiniai tyrimai buvusio Dominikonų vienuolyno kieme Vilniuje, In *Archeologiniai tyrinėjimai Lietuvoje 1988 ir 1989 metais*, Vilnius, 1990, p. 136.

29 Nr. 433, Grišinas V. *1987. Vilnius, Garelio g.4 pastato išplatinimas. Archeologinių tyrimų ataskaita*. (I tomas), Vilnius, 1988, LIIR, f. 1, b. 1357.

30 Nr. 651, Grišinas V., *1988. Vilnius, Garelio g. 4 pastato išplėtimas. Archeologinių tyrimų ataskaita*, LIIR, F. 1, b. 1582.

31 Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006, p. 143.

32 Ibid, p. 157.

33 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 96.

was a metal melting workshop. During the archaeological excavations, a metal melting furnace, as well as slag, crucibles, copper alloy rings and other ornaments were found dating back to the middle and the second half of the 16th century. The photographs from the research report show that the crucibles have triangular openings with signs of use[34].

There were many goldsmiths' houses and workshops in Pilies Street. During the archaeological excavations in Pilies St. 32, crucibles with gold, silver, copper, tin droplets and a silver gilded button dating back to the end of the 16th century – beginning of the 17th century were found.[35] According to the Census of 1636, nowadays brick house at Pilies St. was mentioned as the late barber Petras Meleris' (built in 1622)[36] house, and the archaeological research has revealed that there was also a jeweller's (goldsmith's) workshop there. During the archaeological excavations in Pilies St. 42 crucibles were found[37]. The research shows that the crucibles contained molten silver and gold. They date back to the second half of the 16th – 17th centuries. The goldsmith Klemens lived in the estate No. 141 (nowadays Pilies St. 12). He worked for Bishop Andrius Šelinga (1481–1491) and built the house at the end of the 15th century – early 16th century. He had mortgaged the house to the goldsmith Peter. In the 16th century this house was rented to goldsmiths working for the Capitula. The other half of the house belonged to the goldsmith Wolfgang Staigel (estate No. 140; until 1527)[38].

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34 Nr. 207-212, 220-237, Daminaitis V., *Buv. Šv. Kotrynos bažnyčios, Vilnius, L. Giros 30 / 1 archeologinių tyrimų ataskaita*, Vilnius, 1987, LIIR, F. 1, b. 1436, p. 67-70, 117-120, pav. 60-63.

35 Vitkūnas M., Katalynas K., Pilies gatvė 32, In *Archeologiniai tyrinėjimai Lietuvoje 2012 metais*, Vilnius, 2013, p. 523, pav. 7.

36 Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006, p. 90.

37 Žukovskis R., *Archeologinių tyrimų Vilniuje, Pilies g. 42-1 ataskaita*, Vilnius, 2004, LIIR, F. 1, b. 4440.

38 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 98.

On the estate No. 129 (now part of Pilies Str. 18) there was the burgomaster Radziminovičius brick house, which was rented by the goldsmith Jonas Grekovičius. In 1636 it was recorded that on the ground floor of the house there were "two rooms, a storage room and a kitchen with a porch, where silver is melted"[39]. Adjacent to the former estate No. 128 (now part of Pilies St. 18) there was the brick house of Tomas Zeligmacher, which was rented by the goldsmith Juozapas Bogatyrovičius. The house had three floors: "a shop with a small porch by the gates and a small room for the master's workshops"[40].

It is likely that the house at the estate No. 79 (Pilies St. without a more precise indication) was listed as the brick house of the late goldsmith Jacob Moras: "the goldsmith's shop with a porch, a small storage room and a kitchen"[41]. Moras died in 1634, and the goldsmiths Jonas Grekovičius and Motiejus Jacinkevičius were appointed as guardians of his estate.

During the archaeological excavations in the territory of the Old Bishops' Palace (under the jurisdiction of the bishop) the workshop of a jeweller who worked with non-ferrous metals was found[42]. The building was of framed construction from unreinforced timber without foundations. The workshop was the size of 4x3,2 m, containing two rooms. One room was the size of 2,68x2,88 m. It must have been a production room, paved with stones, with two gutters and a furnace in the corner. The gutters led from the furnace to the exit, and another from the furnace to the the entrance of the second room. The furnace was the size of 1,2x1,2 m, only part of the background made of red bricks and clay has survived. Metal slag drips were found on the the pavement in places. Metal objects were also found. The second

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39 Ibid, p. 87.

40 Ibid, p. 87.

41 Ibid, p. 92.

42 Luchtanienė D., *Žvalgomieji archeologiniai tyrimai Vilniuje, Menininkų rūmų komplekse (ATR-45) (S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28)*, Vilnius, 1996 m. LIIR, F. 1, b. 2475, p. 31.

room was the size of 1,96x2,74 m. It could have been "a storage room for raw materials or a domestic room"[43]. The room probably had a wooden plank floor with a 5 cm thick layer of soot and ash. Slag, raw copper, chisels, crucibles, the iron anvil, etc. were also found in this area.[44]

During the archaeological excavations in Stuokos-Gucevičius St. 11 (under the jurisdiction of the bishop) a jeweller's workshop from the 17th century (after 1621), a brick furnace background (2,45x2,12 m), two casting moulds, in which were cast pendants with the motif of a Latin cross and the letters IHS and a slag of non-ferrous metal were found[45]. The description of the furnace in the 12th century by the goldsmith Theopilus helps to imagine what the furnaces might have looked like. The author also provided a reconstruction drawing of it.[46]. Goldsmiths' (jewellers) furnaces are depicted in Book VII of Agricola (the 16th century). Historical sources of Vilnius mention that workshops were sometimes located on the second floor of the building, so the furnaces might have been quite small.

The oldest map of Vilnius, drawn by Hogenberg and Brown and published in their publication "Urbium praecipuarum totius mundi liber tertius" (Cologne) in 1581, contains not only a view of the city but also its description[47]. According to the researchers Vitkauskienė and Homolickis, the unmarked No. 22 (*Die Kreur kaste*) in the legend, could have been a mint or an assaying office. Vitkauskienė agrees with Homolickis presumption: "on the left side of Vokiečių St., where two houses with turrets can be seen between courtyards, there must

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43 Ibid, p. 31.

44 Nr. M154, Ibid, p. 33, 38.

45 Vainilaitis V., *Tyrinėjimai Vilniuje, L. Stuokos-Gucevičiaus g. 11*, In Archeologiniai tyrinėjimai Lietuvoje 2003, Vilnius, 2004, p. 230-233.

46 Alper G., Das Braunschweiger Handwerk im Mittelalter und in der frühen Neuzeit, In In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006, s. 160, Abb. 2.

47 *Vilniaus miesto planai*, sudarytoja R. B. Vitkauskienė, Vilnius, 2016, p. 26-27.

have been an institution related to precious metal processing because according to the document issued in 1635, the Jews bought a site with the remains of brick buildings, called *Topnica*, probably a precious metal foundry, which was located in Vokiečių St. close to the old Jewish synagogue"[48].

Thus, comparing the data of historical and archaeological sources, the locations of jewellers' (goldsmiths) workshops and other activities related to the processing of non-ferrous metals were in some cases recorded in the same places, while in other cases the data of the archaeological and historical sources did not match and artefacts found during archaeological excavations pointed to new places, where these craftsmen were working, but their activities were either not recorded or recorded in a fragmented manner in the extant sources. Such comparisons between archaeological and historical data have also been made in other countries (for example: Beverly in England and Tours in France) – the historical data do not always match archaeological and often refer to different locations of workshops [49].

2.2. Tools

Tools used by jewellers have been mentioned in historical sources only from the 17th century onwards. The earliest mention of Vilnius goldsmiths' tools dates back to 24 October 1674, when an inventory of the estate of the goldsmith Kazimieras Dygainis was drawn up (silverware and weapons were listed, but the inventory itself was not published)[50]. The inventory of the goldsmith Greiteris movable

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48 Ibid, p. 28.

49 Evans D. H., Craft and industries in Beverley and Hull from 1200 to 1700, In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006, s. 87, Fig. 16; Lorans E., Craftworking in Tours from the 12th to the 18th century, In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006, s. 106, Fig. 2.

50 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p.103.

property also reflects the working tools of the 17th century goldsmith. It includes: 7 pairs of moulds, 11 hammers of various sizes, 4 figure hammers, a special anvil, small and large scissors, files or picks, drills, special pliers for pulling the silver wire, a special press to smooth the surface of the metal, saws, weights, 5 weights for weighing gold, 2 scales, 2 presses, a heating lamp, etc.[51] The items confiscated from the goldsmith Brikmanas in the mid 17th century also provide information: tools, gold and silver alloys, wires, dozens of gemstones, jewellery artefacts[52]. The 1697 inventory of Petras Danilevičius' possessions mentions that the house contained silver, as well as pewter and copper vessels, two goldsmith's signs, books, one of which („Xiążka do odrysowania cum emlematibus") may have contained the set of ornaments. Such sets of ornaments had been known to craftsmen (and goldsmiths) of various specialities in Western Europe since the Renaissance. The most popular were those of Durer, Aldegrever, Jamnitzer and Zundt published in Nuremberg, and the collection of the late 16th–the early 17th centuries motives drawn by the Dutch artists Florio, Vredeman de Vries, also by the late 17th century German artists Schmidt and Reutimann. There are also known collections of ornaments made by goldsmiths in Gdansk and Torun in the late 16th-17th centuries. In Vilnius goldsmiths might also have had such ornament collections. The inventory of the property of aforementioned goldsmith Danilevičius also included the following tools: an assaying or stamping tool, a tool for smoothing the surface (also used by shoemakers), metal casting moulds, two large and three small hammers, special pliers for the wire, a two-armed anvil and tools for smoothing the surface of the jewellery artefact (some of the tools were not recognized from the description)[53].

The archaeological excavations have uncovered a variety of tools that could have been used by craftsmen in more than one field. One of

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51 Ibid, p.103-104.
52 Ibid, p. 192.
53 Ibid, p. 105.

these is a pair of scales. In Vilnius, parts of scales from various periods were found in Vilnius Lower Castle, in the territory of the Old Bishops' Palace, as well as in Savičiaus St. 17 / Bokšto St. 15. In the latter area, a detail of the scales dating the 17th century was found.

Hammers and chisels of various sizes were also found in Vilnius, but these items were probably not intended for goldsmiths but for other craftsmen. In the areas, where jewellers' activities were recorded – Vilnius Lower Castle[54] and the Old Bishops' Palace[55] – various shapes and sizes of chisels, hammers and others, were also found, as well as a small iron anvil[56]. Gargoyles/slag are associated with metal processing activities. They were found in various places in Vilnius: the territory of Vilnius Lower Castle, Bernardinų St. 8, Gaono St. 8, Basanavičiaus St. 15, Maironio St., Bokšto St. 21, Šv. Ignoto St. 9, etc.

The finds from the territory of the Old Bishops' Palace, where craftsmen worked in the 16th-mid 17th centuries, should be mentioned separately. Fragments of slag, lead and copper raw material were found there.

Other working tools, such as moulds and crucibles, provide more information.

More than 350 pieces (fragments and whole objects) were found in the cultural layers of Vilnius from the late 13th to the 17th centuries. The crucibles were made of different clay (grey, whitish, there were the graphite ones from the 16th-17th centuries), with different wall thickness (from 3–4 mm to more than 12 mm), usually with a triangular opening.

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54 Nr. 424, Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės pilies valdovų rūmų teritorijos 1993 m. tyrimai*, ATA 7, p. 57; Nr. 4148, Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės Pilies rūmų teritorijos tyrimai 1992 metais*, ATA 6; Nr. 1318, Nr. 1354, Tautavičius A., Urbanavičius V., *Vilniaus Žemutinės pilies rūmų teritorijos 1994 m. tyrimai*, ATA 8.

55 Nr. M 203, *Luchtanienė D., Žvalgomieji archeologiniai tyrimai Vilniuje, Menininkų rūmų komplekse (ATR-45) (S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28)*, Vilnius, 1996 m. LIIR, F. 1, b. 2476, p. 15.

56 Nr. M 154, Ibid p. 12, pav. 6.

Containers vary in size from ~10–15 ml to ~200 ml. Some of the crucibles contain obvious signs of use for melting metal: visually clearly visible droplets of metal (gold and copper), glassy mass of green and red colours (metal compounds). Other crucibles show no signs of use to the naked eye and they are often considered unused. Over 60 crucibles were radiographed to determine which ones were used for melting metals. Analyses of metal droplets of 34 crucibles were also performed using the SEM-EDX method. Artefacts from 13 archaeological objects in Vilnius, dating back to the 14th-17th centuries were selected for the analysis. The data obtained show that some crucibles were used more than once, and that they were used for melting not only precious but also non-ferrous metals: copper, tin, lead, zinc (there are some crucibles where only non-ferrous metals were recorded):

- silver, copper, zinc and tin were recorded on the crucibles from the 14th–15th centuries (the territory of Vilnius Lower Castle);
- gold and tin on the crucibles from the 16th century (the territory of Vilnius Lower Castle); copper and tin (the territory of Old Bishops' Palace);
- gold, silver, copper and tin were recorded on the crucibles from the late 16th-17th centuries (Pilies St. 32); silver (Pilies St. 42); silver, copper and tin (Dominikonų St. 4); copper, lead, zinc and tin (the territory of Vilnius Lower Castle);
- tin, copper, lead and zinc were recorded on the crucibles from the 17th century (Gaono St. 4 and 6), gold (Pranciškonų St. 4).

This research shows that the jewellers definitely worked with gold. Droplets of gold were recorded on 8 crucibles. These crucibles were found in the territory of Vilnius Lower Castle[57], Pilies St. 32[58] and

[57] Nr. 737, Nr. 738, Rackevičius G., *Vilniaus žemutinės pilies Radvilų rūmų (III oficinos) ir pilies kalno vakarinės atraminės sienos teritorijos archeologinių tyrimų 1999 m. ataskaita*, ATA 34.

[58] Nr. 149, 153, 155, 158, 159, Vitkūnas M., *Vilniaus senojo miesto vietos su priemiesčiais (25504) teritorijoje, Pilies g. 32-6, 2012 – 2013 m. vykdytų archeologinių tyrimų (1-jo darbų etapo) ataskaita*, LIIR, F. 1, b. 6087.

Pranciškonų Str. 4[59] in the 16th-17th centuries. The research material is important not only for the first-ever studies of Vilnius city crucibles which provided information about the molten metals, but also for the identification of new workshops of jewellers when historical sources do not provide data.

The crucibles of the 14th-17th centuries are different. The ones dating from the 14th-15th centuries have thicker walls, sometimes with pointed or round bottoms, some with elongated, round openings, others with triangular openings. The crucibles dating from the 16th-17th centuries are usually much thinner-walled than those of the earlier period, with triangular openings and flat bottoms. Their clay mass composition also varied.

The late 14th–15th centuries crucibles'[60] walls are thick and the clay is impure, i.e. it is full of fine quartz, mica, feldspars and other minerals. It is possible that the pure clay (made up of clay minerals) was mixed with crushed rock powder (probably granite). However, it is quite likely that the clay used was not perfectly clean clay, but natural loam, sandy loam or "Lithuanian" clay (illitic, with a high admixture of mica and feldspars). Silica sand was used as a leaning agent. The only difference is the size and number of grains. Some contain finer quartz grains, others more. It is likely that a certain proportion of clay and lean was maintained. Even finer sand or larger grains were split, and mica was also mixed in. Mica is fire-resistant and a good insulating material. Organic material could also been added, as there are seen cracks that could have been left when the material burned or crumbled. Almost all the crucibles have droplets of copper and other

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59 Nr. 2224, Veževičienė V., *Vilniaus senamiesčio (16073) teritorijos, Pranciškonų g. 4a 2015 m. detaliųjų archeologinių tyrimų ataskaita*, Vilnius, 2016, LIIR, F. 1, b. 7679.

60 Nr. 8, 6, Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Pietinio, rytinio ir vakarinio korpusų prieigų 2002 m. archeologinių tyrimų ataskaita*, ATA 44; 2, 5(2), Ožalas E., Montvilaitė E., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų vidinio kiemo archeologiniai tyrimai 2006-2008 m.*, ATA 62.

metal alloys. Local clay (at least in theory) could also have been used for these crucibles.

The whole mass of the later crucibles dating from the 16th–17th centuries is layered, i.e. mica plates are spread out and stacked. Very fine, possibly crushed quartz sand was used for leaning. It is quite abundant – more than 50% of the total mass. Some features (e.g. quartz grains surrounded by mica plates) would suggest that fine quartz sand and finely divided mica plates were added to thin layers of clean (e.g. kaolithic) clay, then the clay was laid down again and the mass was kneaded. Some crucibles contain pieces of rock (mica intergrowth with quartz and iron metal (probably magnetite)).

From the second half of the 16th century to the 17th century, light grey clay was used for crucibles with quartz, acting as a filler of about or more than 50% (predominantly), rounded grains of feldspars, and 10 to 15% mica slabs. Some crucibles also show isolated, probably sand grains, pores with burnt organic material or carbonate fill.[61] These crucibles used a different firing technique to the early crucibles. The late crucibles could have been produced outside Lithuania, as the clay used for them had to be imported – no such pure clay outcrops were known in Lithuania. More precise answers would require chemical analyses of the clay.

It can be assumed that the clay mass of the two crucibles found during the archaeological excavations at Pilies st. 32, was of montmorillonite[62], which would indicate that this clay was imported. These crucibles were used for melting of precious metals: gold, silver, copper and tin. The crucibles date from the late 16th century to the early 17th century.

Graphite crucibles were also used in the 16th-17th centuries. Graphite is an imported material, with deposits in Germany, Austria, the Czech

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61 Nr. 11, Ibid.

62 Nr. 153, Nr. 159, Vitkūnas M., *Vilniaus senojo miesto vietos su priemiesčiais (25504) teritorijoje, Pilies g. 32-6 2012–2013 m. vykdytų archeologinių tyrimų (1-jo darbų etapo) ataskaita*, LIIR, F. 1, b. 6087.

Republic, Russia, the southern part of Poland on the German border, etc. Examination of several crucibles made of graphite revealed that the crucible found in Gaono St. 6, was made of light grey clay containing up to 40% of quartz, feldspars and up to 20% of graphite plates[63]. Graphite plates are arranged in planes (layers). Copper, zinc and lead were melted in the crucible. Graphite plates were also used in another crucible found in the territory of Vilnius Lower Castle[64].

Two graphite crucibles with marks and initials on the bottom (possibly the chapter mark and initials PZ and PS I) were also found in Vilnius from the research of Vilnius Lower Castle territory[65]. This could be crucibles belonging to the goldsmiths Jan Pigułka Zaleski and Sebastyan Pigułka. Sebastyan Pigułka worked in Vilnius from the end of the 15th century until 1619. Jan Pigułka Zaleski studied in Poznan, worked as a goldsmith in Vilnius from 1566 to 1572 and was also mentioned in 1628, when he worked for the Vilnius Capitula[66].

Two slight, unidentified marks were seen on the bottom of another crucible found in the territory of Vilnius Lower Castle[67].

Casting moulds. During the archaeological excavations in Vilnius there were found 33 stone and 2 casting moulds made of copper alloy, dating back to the 14th–17th centuries. The moulds were usually composed of two parts, but only one of two parts was found during the archaeological excavations. The two parts were joined by means of large metal (tin-lead alloy) fittings, one or more at each end or side.

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63 Nr. AV 59:1, Žukovskis R., *Archeologijos žvalgymai Gaono g. 6, Vilniuje 1999 metais ataskaita*, LIIR, F. 1, b. 3322.

64 Nr. 1688, Steponavičienė D., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija ploto pietryčių kampe 1998 m. tyrimai (perkasa Nr. 4) ataskaita*, ATA 29.

65 Nr. 1688, 1689, Steponavičienė D., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija ploto pietryčių kampe 1998 m. tyrimai (perkasa Nr. 4) ataskaita*, ATA 29.

66 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 255.

67 Nr. 109, Ožalas E., Montvilaitė E., *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso prieigų archeologiniai tyrimai į rytus nuo valdovų rūmų (trasa III) 2004-2006 m*., ATA 59.

In Vilnius there were found 10 double-sided, only 1 three-sided, and remaining 22 single-sided casting moulds. Buttons, mountings, hooks, rings, crosses and other small artefacts, as well as bullets were cast in the moulds. The only pieces of moulded artefacts found in the territory of Vilnius Lower Castle were two moulds (made of different stones: dolomite and limestone) with two rings cast at the same time, and 11 rings possibly cast in these moulds. The rings were made of tin-lead alloys (tin content was 42,5–82%, lead content was 19,7–53,8%).

Nineteen stone moulds and two metal moulds dating from the 14th-15th centuries were found in Vilnius. Most of them – 11 – were made of dolomite, 2 of lava, the remaining 5 of limestone, and one is unexplored. 10 of them are two-sided, 1 three-sided and 8 one-sided. The two-sided and three-sided moulds were made from both dolomite and limestone, as were the one-sided moulds. The lava moulds are double-sided. Mountings, a cross, rings, buttons and other small items were cast in the moulds. A round ring-shaped artefact and four mountings were cast in metal one-sided moulds. Tin-lead alloy mountings of a similar style were found in the territory of Vilnius Lower Castle, but they are not identical to those in the mould. Metal casting moulds were recorded in the historical sources: in the inventory of the goldsmith Danilevičius in 1697[68].

Two two-sided moulds made of lava are special and are the only ones of their kind in Vilnius. They were imported. One of them could be used to cast three mounting pieces at the same time: an eight-petalled flower, a seven-petalled flower and an eight-petalled flower in the circle, and 21 small pieces – possibly pins - on the other side.[69]

Quite a lot of tin oxide grains were found on the surface of the mould, which could have come from the surface of the mould. It is likely that a tin alloy was used to cast the artefacts.

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68 Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001, p. 105.

69 Nr. Ad 47, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63.

There were found fourteen casting moulds from the 16th-17th centuries. Almost all of them were made of dolomite (11), 2 of limestone and 1 was unexamined. The moulds are similar to those of the earlier period, except that in this later period dolomite rather than limestone predominates and there were no moulds made of lava. The cast artefacts included two rings at a time, mountings, brooches, drop-shaped pendants with the letters IHS and cross motifs, etc. One mould contains the craftsman's sign. All moulds except one are one-sided.

Since there is no information whether there were dolomite quarries in Lithuania in the 13th-17th centuries, dolomite should have been brought either as a raw material, or as already manufactured moulds. The limestone could have been brought from the same source as the dolomites. Dolomites and limestone could have been imported from the Holy Cross Mountains in the Kielce region of Poland. The exceptional finds are casting moulds made of volcanic rock (lava). Volcanic rocks of various compositions had been used for production of various artefacts in Italy since ancient times, but they could have also been brought to Lithuania from Germany and other countries.

Matrices are small metal artefacts with a convex or concave image, distinguished by a thicker, sturdier base, and are intended for the production of ornamental tinware. Such finds are rarely found during archaeological excavations. In Vilnius 7 matrices were found, all from the territory of Vilnius Lower Castle, made of copper alloys. Six of them date back to the late 13th–early 15th centuries, one to the late 17th–early 18th centuries.

The earliest matrices date back to the late 13th century – the first quarter of the 14th century. One of them is triangle, intended for the production of mountings (possibly for the production of headbands)[70], the other is a rectangular matrix found in the same place, intended for the production of mountings with a plant ornament. It depicts a pal-

[70] Nr. M 272, Blaževičius P., *Vilniaus pilių teritorijos su įtvirtinimais, pastatais ir jų liekanomis (u. k. 1791) (Vilniaus m.) detaliųjų archeologinių tyrimų 2019 m. ataskaita,* ATA 75.

mette[71]. Four matrices date from the second half of the 14th century to the early 15th century. One of them was used for the production of a pentagonal plate with a palmette motif[72], the other for the production of a rectangular plate with the motif of the letter S[73]. The third was a circular matrix used for the production of a tin ornamented brooch[74], the fourth was a diamond-shaped matrix with profiled edges[75]. It depicts a zoomorphic ornament of an animal walking to the right side but with its head turned to the left side.

The oval shaped matrix for production of small medallions is dated from the late 17th century to the first half of the 18th century[76]. It depics Saints Paul and Anthony the Hermit.

2.3. Metal alloys of jewellery artefacts

During the archaeological excavations jewellery artefacts made of gold, silver, copper, tin-lead and tin alloys were found in Vilnius.

Artefacts of gold alloys. 24 gold jewellery artefacts (or a golden detail used as an additional element) dating from the end of the 13th century to the 17th century were found in Vilnius. They are made of gold, alloyed with silver and copper.

Gold content in gold-silver-copper alloys				
	end of the 13th century	**the 14th–15th centuries**	**end of the 15th–16th centuries**	**the 16th–17th centuries**
Gold %	91,57	92-50	98-55	93-70

71 Nr. 3019, Ibid.

72 Nr. M 1075, Blaževičius P., Bugys P.,*Vilniaus žemutinės pilies teritorija. Rytinio ir šiaurinio korpusų prieigų 2006-2008 m. tyrimų ataskaita*, ATA 63.

73 Nr. M 719, Ibid.

74 Nr. 563, Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės pilies valdovų rūmų teritorijos 1993 m. tyrimų ataskaita*, ATA 7.

75 Nr. 562, Ibid.

76 Nr. 88, Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Šiaurinio korpuso ir rūmų vidinio kiemo tyrimai 2001 m.*, ATA 40.

In the cultural layers of the late 13th-17th centuries, 24 gold jewellery ornaments and decorative details were found in Vilnius, as well as gold used for the decoration of precious stones (pearls). 18 jewellery artefacts (10 rings, 5 mountings and decorative details, a chain, a tassel, and a pearl with a gold wire) were found during the archaeological excavations in the territory of Vilnius Lower Castle, where artefacts made of precious metals concentrated from the late 13th century to the late 16th centuries. Other 6 finds were discovered in the territory of Vilnius Old Town: 3 gold rings from the 16th–17th centuries Calvinist and Lutheran cemetery near the present-day Vilnius St. and Liejyklos St., a pendant from the Bastion, a pearl with a gold wire from St. Ignoto St. and an emerald in a gold setting from the territory of the Old Bishops' Palace.

A gold-silver-copper alloy was used for the production of artefacts, with gold content ranging from 98% to 50%, silver from 32% to 1,5%, and copper from 0,5% (with zinc) to 18%. It is likely that it was dependent on the quality of the alloy available to the goldsmith or the customer, rather than the period, and had remained variable over the centuries. Easily moulded almost pure gold (98-94%) or a good quality alloy of 88% was used for the gold wires (a tassel, pearl wires, the 16th century).

Artefacts (mountings, decorative details) were also made of very thin gold sheet, sometimes the gold plates of a lower purity than the piece itself were used to fix the reverse. Gold-silver-copper solder, which was of a lower purity than the piece itself, was used to cast the gold pieces.

The oldest gold artefact found during the archaeological excavations is a banded ring[77]. It was found in the territory of Vilnius Lower Castle.

The ring was made of good quality gold – the amount of gold in the alloy reaches 91,57%. It is decorated with a recessed floral ornament, which had previously been filled with blue enamel.

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77 Nr. M 1316, Kuncevičius A., *Vilniaus Žemutinė pilis. Lietuvos Didžiosios Kunigaikštystės valdovų rūmų Rytinio korpuso Šiaurinio priestato archeologinių tyrimų 2014-2015 m. ataskaita*, ATA 69.

Artefacts of silver alloys. The archaeological sources provide data about silver artefacts. During the archaeological excavations in Vilnius, there were found more than seventy silver artefacts, 57 of which were examined. The artefacts of late 13th-14th centuries were made of silver alloys of various quality. A two-element alloy (silver-copper) was used, with a silver content of 98,8–30,1% and copper 0,54–46%. Silver artefacts were often gilded (amalgam was also used, i.e. mercury was found).

Silver content in silver-copper alloys					
	the 13th century	**end of the 13th–14th centuries**	**the 14th–15th centuries**	**15th–16th centuries**	**the 17th century**
Silver %	95-92	40	98,8-30,1	98,3-50	96-51,9

Silver purity was regulated in 1495 and was allowed to get progressively poorer in later periods, but the outcomes of interdisciplinary studies of metal alloys show that the artefacts both before and after the end of the 15th century were made of various alloys of silver, and that this was independent of the period and the workshop regulation.

In Vilnius the following found jewellery artefacts were made of silver: headband plates, temple ornaments, earrings, decorative pins, brooches, a bracelet and rings.

Silver jewellery artefacts were made of 98,8–30,1% silver and 0,54–46% copper alloys, with some cases of 0,08–2,6/7% lead (more commonly up to 0,7%), up to 3% tin (more commonly up to 0,5%), 0,2–1,3% zinc, 0,5–45,51% gold (coating). Most artefacts were made of good quality silver (more than 90% in the alloy).

Artefacts of tin and lead alloys. Jewellery artefacts made of tin and lead alloys were rare and they were typical of the late 14th–early 15th centuries, with only one tin-lead alloy ring from the 17th century identified. 23 ornaments and two mould fittings were examined in total. Rings, pendants, a temple ornament and temple ornaments' beads, a detail of a horseshoe-like brooch, a brooch and mountings were

made of tin-lead alloy. The artefacts found in Vilnius were made of alloys of three elements (tin-lead-copper), with tin content of 50,7–95%, lead of 0,1–34,8% and copper of 0,1–6,6%. This alloy composition was recorded in jewellery and mould fittings from the late 14th to the early 15th centuries. The tin content in these alloys ranged from 50,7% to 82%. A lead-tin-copper alloy was used less often. The lead content in these jewellery ornaments ranged from 53,8% to 85,5%.

A braided ring dating from the mid of the 13th century stands out[78]. It was made of only two elements: a tin-lead alloy (70% of tin and 30% of lead)[79].

Some of the jewellery artefacts from the late 14th century to the early 15th century were also made of almost pure, which was available to extract at that time, tin (with a tin content of 94,8–99%), e.g. a temple ornament[80], a temple ornament bead[81], rings with a widened front[82].

The rings that may have been cast in stone moulds found in Vilnius Lower Castle should be mentioned. These are the rings with a widened front having a grid or an openwork ornament. 9 out of 11 rings were examined. In seven cases the dominant element was tin[83], in one

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78 Nr. 2574, Striška G., *Vilniaus pilies teritorija. Keleivinio keltuvo aikštelių Arsenalo kieme ir Pilies kalne 2003 m. archeologinių tyrimų ataskaita*, ATA 48.

79 Nr. 2574, Ibid.

80 Nr. M 10, Ožalas E., *Vilniaus žemutinės pilies teritorija. Vakarinio korpuso prieigų archeologiniai tyrimai 2007-2010*, ATA 66.

81 Nr. 1286, Ibid.

82 Nr. M 1634, Nr. M 1530, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63; Nr. 9334, Rackevičius G., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Šiaurinio korpuso prieigų archeologinių tyrimų 2002 m. ataskaita*, ATA 43; Nr. 910, Ožalas. E., *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso išorės ir prieigų archeologiniai tyrimai (plotai 9-11, trasa I, II) 2004-2006 m.*, ATA 58.

83 Nr. M 754, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63; Nr. M 1011, Nr. M 1202, Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Pietinio, rytinio ir vakarinio korpusų prieigų 2002 m. archeologinių tyrimų ataskaita*, ATA 44.

case – lead[84], one ring was made of pure tin (tin content in alloy is 99%)[85]. So different alloys were used to cast the same type of rings.

Rings made of almost pure tin were found in the territory of Vilnius Lower Castle (98,5% of tin[86], 95%)[87].

Thus, jewellery ornaments made of tin-lead, lead-tin or tin alloys represent only a small part of the total jewellery ornaments and are more typical of the late 14th–early 15th centuries, and some of them were undoubtedly cast by local jewellers in moulds in the workshops in the territory of Vilnius Lower Castle. The mountings with floral motif could also have been cast there, as grains of tin were found on the casting mould.

Several fragments of formless lead were found in the cratsmen's quarter of the Old Bishops' area[88]. They were found to contain 98,63–98,89% of lead. In Vilnius Lower Castle, a wand-shaped object with a bite mark which was made of 99% of lead was found[89].

Casting moulds fixings were made of tin-lead alloys, with a tin content of 84,6–93,7%, lead content of 4,4–13,2% and copper content of 0,5-1%[90].

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84 Nr. M 114, Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Pietinio, rytinio ir vakarinio korpusų prieigų 2002 m. arheologinių tyrimų ataskaita*, ATA 44.

85 Nr. 910, Ožalas E., *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso išorės ir prieigų archeologiniai tyrimai (plotai 9-11, trasa I, II) 2004-2006 m.*, ATA 58.

86 Nr. M 1634, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63.

87 Nr. M 1530, Ibid.

88 Nr. M 214, M 215, Luchtanienė D., *Archeologiniai tyrimai Vilniuje Reprezentacinių rūmų teritorijoje (AtR-45) S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28 ataskaita*, Vilnius, 1997, LIIR, F. 1, b. 2743.

89 Nr. 1621, Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės pilies valdovų rūmų teritorijos 1993 m. tyrimai*, ATA 7.

90 Nr. 8737, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63; Nr. 9334, Rackevičius G., *Vilniaus Žemutinės pi-*

Artefacts of copper alloys. Most non-ferrous metal jewellery ornaments were made of copper alloys. These include headbands' plates, earrings, pins, brooches, bracelets, rings and mountings.

Composition of artefacts made of copper alloys in the 13th–17th centuries (Vilnius)					
Alloys	**Number of examined artefacts**	**Cu %**	**Zn %**	**Sn %**	**Pb %**
copper-zinc-tin-lead	50	92-54,44	14,2-0,36	0,5-6	33,01-0,2
copper-zinc-lead (without tin)	19	86,9-54,52	32,0-19,17	-	18,56-0,36
copper-tin-lead (without zinc)	5	97,8-66	-	16-0,2	17,57-0,7

Analysis of the copper alloys of more than 70 artefacts found during the archaeological excavations was carried out. The outcomes revealed that most of the artefacts were made of copper-zinc-tin-lead alloy (more than half of all analyzed artefacts and such an alloy was used in the 13th-14th centuries). Such alloys were used to make pendants, earrings, pins, bracellets, rings, neck-rings, horseshoe and plate brooches, a cross, a clasp, buttons, a locket and a mounting.

Copper-zinc-lead (without tin), copper-tin-lead (without zinc) alloys were also used.

The working tools – matrices – were made of a four-element alloy of copper-zinc-tin-lead[91]. The castings left over from the stone moulds were made of the same elements[92].

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lies Valdovų rūmų teritorija. Šiaurinio korpuso prieigų archeologinių tyrimų 2002 m. ataskaita, ATA 43; Nr. Ad 47, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63.

91 Nr. 719, Nr. 1075, Blaževičius: P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63.

92 Ožalas E., Montvilaitė E., Žvirblys A., *Vilniaus žemutinės pilies teritorija.*

Fragments of formless copper were also found[93]. Analysis showed that they were composed of the pure copper – 99,5%.

According to the research data of metal alloys, the composition of alloys was the same in the 13th–17th centuries.

2.4. Solders

Solder was used to join or attach parts of an artefact. Solder was identified using the exact sciences methods, such as XRF and SEM-EDX.

Gold-silver-copper solder used for the gold artefacts was of the same composition as an artefact, but of a lower quality.

Also silver-copper solder used for the silver artefacts was of a similar composition as an artefact, but of a lower quality. Silver artefacts sometimes contained small amounts of tin, lead and zinc (often up to 1% of the total composition of the alloy). Zinc was also found in some solders – 2%[94] and 0,4%[95].

Lead-copper-tin, lead-tin-copper or tin-lead solder was used for copper alloys (the dominant element varied from lead to tin).

2.5. Coatings/Amalgam

Jewellery artefacts were sometimes covered with coatings – since the Middle Ages amalgams have been used almost exclusively. In Lithuania, amalgam gilding was found on two bow-shaped brooches

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Valdovų rūmų Šiaurinio ir Vakarinio korpusų bei šiaurinio rūmų priestato archeologiniai tyrimai 2007-2009 m., ATA 66.

93 Nr. 1100, Blaževičius P., Gendrėnas G., Steponavičienė D., *Vilniaus žemutinės pilies valdovų rūmų teritorija. II oficinos (dvariškių rūmų) 2003-2005 m. archeologinių tyrimų ataskaita*, ATA 53.

94 Nr. 1263, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies LDK valdovų rūmų teritorija (u.k. 141 ir u.k. 24705). Ploto į pietus nuo I oficinos archeologinių tyrimų 2005–2009 m. ataskaita,* ATA 65.

95 Nr. 1145, Ibid.

from the Lazdininkai cemetery (Kretinga district) dating from the late 5th century to the early 6th century.

In Vilnius 14 artefacts made of silver and copper alloys, which were gilded by amalgam, were found. The XRF method and in one case the SEM-EDX method were used to identify this element. Mercury was found on the 13th-14th centuries' artifacts: silver beads, decorative details, buttons, an earring and a copper alloy icon. The amount of mercury ranged from 0,36% to 9,82%. The majority of the amalgamated gilded artefacts were made of silver and 3 out of 14 were made of copper alloy.

2.6. Enamel

Jewellery artefacts decorated with enamel were found in Vilnius Lower Castle. These include rings, crosses and mountings. The enamel comes in a variety of colours: various shades of blue, green, yellow, red, white and black. The composition of the enamel was analyzed using XRF and SEM-EDX methods.

Blue enamel was found on the gold ring dating to the 9th decade of the 13th century; red, white, yellow and green in the 14th-15th centuries; black and white in the 16th century; black and blue in the 17th century. The blue enamel was used to decorate crosses in the 17th century and later.

There were recorded chemical elements and compounds that allowed to identify the element that determined the colour. Copper compounds provided the green and cyan colours, lead and antimony compounds provided yellow, copper provided red, tin and antimony provided white and manganese and iron compounds provided black colour.

2.7. Niello

The niello technique became more widespread from the 3rd century in the Antiquity. The niello composition consisted of copper, silver and sulphur. From the 9th century onwards, there was used silver-

copper-lead-sulphur niello which melted in lower temperature[96] and silver-tin-copper-sulphur niello in later periods[97].

A gold ring dating from the late 14th–early 15th centuries, which broadened part was decorated with the niello technology[98], was found during the archaeological excavations in the territory of the Lower Castle. The niello was found left in the ornament. Its composition was identified as follows: 45,7% of copper, 40% of lead, 12% of silver and 0,2% of sulphur.

Only one artefact, which was found in Vilnius in the late 14th–early 15th centuries, a gold ring, was decorated with niello and its composition corresponds to the niello compositions described and identified in artefacts found in other regions.

2.8. Gemstones

Gemstones are stones and organic materials (amber, coral, pearl, gagate, etc.) used in jewellery. *Gemology* is the study of the materials used to decorate jewellery.

Gemstones were *enhanced* and *enriched*. This is the process of enhancing and improving a stone's appearance and value without altering its chemical and essential physical properties, e.g. highlighting and improving its appearance, increasing its value by brightening or weakening its colour, removing small chips, etc. Gemstones were "enriched" by dyeing them, using alkalis, acid, heat, immersion in oils, resins, etc.[99]. There were identified fillings in the gold artefact's

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96 Babenskas E., Metalų apdirbimo technologijos. Spalvotųjų metalų dirbiniai, In *Muziejinių eksponatų priežiūra. IV dalis. Archeologinių radinių konservavimas. Nuo lauko darbų iki saugojimo muziejuose*, 2 knyga, Straipsnių rinkinys, Vilnius, 2015, p. 764.

97 Laucevičius E., Vitkauskienė R. B., *Lietuvos auksakalystė XV–XIX amžius*, Vilnius, 2001, p. 29.

98 Nr. M 1707, Blaževičius P., Bugys P. *Vilniaus Žemutinės pilies Valdovų rūmai. LDK valdovų rūmų rytinio ir šiaurinio korpusų prieigų archeologinių tyrimų 2006–2008 m. ataskaita*, ATA 63.

99 Duda R., Luboš R., *Brangakmenių žinynas*, Vilnius, 1998, p. 15.

emerald eyelet found in the territory of the Old Bishops' Palace in the 16th century[100]. These fillers were natural or artificial oils and resins. In the old jewellery they were traditionally used to bring out the quality of the emerald – to *enhance* the gemstone[101].

Another method of falsification was the use of doublets and triplets, where two stones were glued together instead of a single gemstone in a jewellery artefact. The weight and dimensions of the stone were falsified and the glued gemstone was not of the same high quality and price as the real one. Doublets and triplets have been known since the Antique times and were made from a wide variety of materials: cheaper mineral, painted glass, etc. After the gemological examination of the archeological artefacts found in Vilnius, there was one doublet or a matrix-rock, identified in a gold ring with turquoise from the territory of Vilnius Lower Castle[102]. The ring was either decorated with turquoise and a matrix-rock, with which it was excavated on the site, or the jeweller made a doublet himself by gluing the lower part of the rock to the turquoise.

During the archaeological excavations there were found 25 gemstones and 2 artefacts with rocks: rings (with garnet, chalcedony, possibly pearl, turquoise, diamond, ruby and serpentinite), gemstones (rock crystal, chalcedony, carnelian, turquoise and agate), necklaces (with carnelian, pearl, gagate, coral and jasper), decorative elements (with garnet, pearls and emerald), an earring (with coral) and a pendant (with stannite).

In Vilnius there were found thirty amber artefacts (necklaces of various shapes, a ring, etc.) and more than half a thousand amber fragments. There was an amber workshop in the territory of Vilnius Lower Castle in the 9th and 10th decades of the 14th century.

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[100] Nr. A 986, Luchtanienė D., *Archeologiniai tyrimai Reprezentacinių rūmų ansamblio (ATR-45) teritorijoje 1998 metais,* Vilnius, 1999, LIIR, F. 1, b. 3231, 3233.

[101] Anderson B. W., *Gem testing*, London, 1983.

[102] Nr. 459, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies LDK valdovų rūmų teritorija (u.k. 141 ir u.k. 24705). Ploto į pietus nuo I oficinos archeologinių tyrimų 2005-2009 m. ataskaita*, ATA 65.

Artefacts with gemstones from the late 13th–14th centuries were concentrated in the territory of Vilnius Lower Castle and in the 16th–early 17th centuries in the territory of the Old Bishops' Palace.

Eight pearls from the 14th–16th centuries were studied in detail: one from Šv. Ignoto St.[103], others from the territory of Vilnius Lower Castle[104] (Fig. 102:5–7). All the 7 studied pearls are of natural origin. The 14th century and 16th century pearls found during the archaeological excavations of Vilnius Lower Castle are river freshwater pearls. Only the pearl found during the archaeological excavations in Šv. Ignoto St. is of marine origin.

Exceptional ruby and diamond rings with a ruby[105] and a diamond[106] were found in the same territory. The ruby is in the shape of a rectangular baguette. This was a particularly popular form of a gemstone cutting in the 16th century and such gemstones were not only used to decorate rings, but also to decorate clothing and head ornaments, as well as massive pendants[107]. Rings similar to the ruby ring date back to the 16th century. It should be pointed out that such a quadrangular base for a gemstone (with four arches) was typical of the 16th century[108].

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103 Nr. 235, Ušinskas V., *1983 m. archeologinių tyrinėjimų Vilniuje, K. Giedrio g. 8 ataskaita*, Vilnius, 1983, LIIR, F. 1, b. 1390.

104 Nr. 1263, Nr. 1708, Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63; Nr. 801–804a, Steponavičienė D., *Vilniaus Žemutinės Pilies Valdovų rūmų teritorija. Rūmų pietinių vartų bokšto tyrimai 1996 m.*, ATA 18.

105 Nr. M 210, Ožalas E., Montvilaitė E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Vakarinio korpuso ir jo prieigų 2004 m. archeologinių tyrimų ataskaita*, ATA 52.

106 Nr. 9023, Striška G., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Šiaurės ir rytų korpuso prieigų 2003–2004 m. tyrimai*, ATA 49.

107 Scarisbrick D., *Rings, Jewelry of Power, Love and Loyalty*, London, 2013, s. 226, pic. 305.

108 Ibid, s. 244, pic. 334.

All artefacts with gemstones were made of precious metals, except for one ring from the Čiurlionis Str. old cemetery, i.e. a copper alloy ring with a turquoise, but this is rather an exception[109].

Amber was also used in jewellery, which is classified as a gemstone according to the current gemological classification. Over thirty amber artefacts (2 crosses, 1 ring, 2 sculptures, the rest – beads and their fragments) and over 500 amber fragments were found in Vilnius. Most of the artefacts were concentrated in the territory of Vilnius Lower Castle and date back to the late 13th–early 15th centuries. In this area, a horizon of the wooden buildings has been recorded, above which a cultural layer with amber sand was formed, which has been dendrochronologically dated to 1383–1384 and 1384–1385. In the researcher's opinion, the amber workshop probably remained in the unexplored area and was dated to the 9th-10th decades of the 14th century.[110] Amber beads of various shapes and sizes were mainly found in Vilnius.

Some of the jewellery artefacts from the 13th-14th centuries were decorated with glass rather than gemstones: rings, mountings and glass eyelets. In the 17th-19th centuries, non-ferrous metal rings became common: they were of simple designs, usually without ornamentation and with colourless glass eyelets. These rings were produced in greater numbers, were cheaper and were intended for a wider market. Often such rings were imprecisely made.

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[109] Nr. 14, Daminaitis V., *2005 m. Vilnius, Čiurlionio g. 3, Archeologijos tyrimų ataskaita*. Vilnius, 2006. LIIR, F. 1, b. Nr. 4463.

[110] Nr. 5829, 5830, 5831, 5832, 5833, Striška G.,*Vilniaus Žemutinės pilies teritorija. Valdovų rūmų šiaurinio ir rytinio korpusų prieigų archeologinių tyrimų 2003–2004 m. ataskaita*, ATA 49.

CONCLUSIONS

1. Casting moulds, crucibles, matrices, unfinished or defective and manufactured artefacts, metal alloys and other artefacts associated with the processing of non-ferrous metals, and in some cases – workshop locations, indicate the activity of jewellers in the 13th-17th centuries, in Vilnius. According to the archaeological data, two definite jewellery workshop sites with preserved furnaces have been recorded, but there are more than two dozen sites associated with metalworking activities.

2. In Vilnius there were found 24 gold jewellery artefacts, dating from the 9th decade of the 13th century to the 17th century. During this period, a three-element alloy was used: gold-silver-copper, with gold content of 98–50%, silver 32–1,5% and copper 18–0,5%.
   Gold wires were made of almost pure gold (98–94%) or a good-quality alloy with gold content of 88% (a tassel dating back to the 16th century, pearl wires).
   Gold-silver-copper solder was used to cast the parts of the gold artefacts. It had a lower gold content than the artefact itself.
   At the end of the 13th-16th centuries gold artefacts were concentrated in the territory of Vilnius Lower Castle.
   They were made using complex technologies, decorated with gemstones, enamel (light blue, white, black, dark green, red), niello (rings and mountings). The artefacts are characteristic, especially those from the 16th century, of the jewellery style of forms and decoration of that period which was widespread in Europe. Jewellery artefacts were intended for representatives of a high social class.

3. Over 70 pieces of silver artefacts were found in Vilnius. They were made of two-element silver-copper alloy, with a silver content of 98,8–30,1%, copper of 0,54–46% (in some cases also 0,08–7% of lead (more often up to 0,7%) and 3% of tin (more often up to 0,5%) and 0,2–1,3% of zinc.

Although the fineness of silver was regulated in 1495, but interdisciplinary studies of metal alloys from the artefacts show that the artefacts made both before the end of the 15th century and afterwards, were made from silver of varying quality.

The solder used for the production of silver artefacts was of a similar composition, but from a lower-quality silver-copper alloy, with occasional minor impurities of tin, lead and zinc (often up to ~1% of the total alloy composition).

Most of the silver artefacts were gilded. Gilding was done using amalgam, i.e. mercury was found on the artefacts.

Silver alloys were mainly used for the production of rings, also earrings, decorated pins, new types of brooches, pendants, decorative details, mountings, etc. Some of these jewellery artefacts were decorated with gemstones, produced using sophisticated techniques and are distinguished by their ornate design, while others had simpler shapes, ornamentation and were not unique.

Some of the jewellery (brooches, some types of rings, mountings) reflect the European jewellery tendencies of the 14th-17th centuries. Silver artefacts could belong to representatives of various social classes.

4. Jewellery ornaments made of tin and lead alloys are typical of the mid 13th–early 15th centuries. Several dozens were found. They are mainly rings made of alloys of three elements (tin-lead-copper), with tin content of 50,7–95%, lead 0,1–34,8% and copper 0,1–6,6%, as well as tin-lead and tin alloys.

   Some jewellery artefacts were made in jewellery workshops in Vilnius, and may have been cast in stone moulds found in Vilnius Lower Castle. There were found 11 rings made of tin and lead alloys, analogous to the rings cast in the two moulds (late 14th–early 15th centuries). Tin was also identified on the surface of one mould. Of the later periods, only one ring was made of lead-tin alloy (the 17th century), and this is rather an exception.

5. Most jewellery artefacts were made of copper alloys (rings, earrings, pendants, pins, bracelets, etc.). The predominant alloy composition (more than half of all the examined artefacts) is: copper-lead-zinc-tin, with copper content 92–54,44%, lead 33,01–0,2%, zin 14,2–0,36% and tin 6–0,5%. There were also several dozen artefacts made of copper-zinc-lead alloys, with copper content 86,9–54,52%, zinc 32,01–9,17% and lead 18,56–0,36%. Five artefacts were made of copper-lead-tin with copper content 97,8–66%, lead 17,57–0,7% and tin 16–0,2%.

   Lead-copper-tin, lead-tin-copper or tin-lead alloys were used to cast copper alloys (the predominant element varied from lead in some cases to tin in others).

   Copper-alloy jewellery was made using simple technologies, decorated with glass eyelets (except for one ring, which was decorated with a turquoise eye). Most were mass-produced (band rings, certain types of brooches, crosses) for a wide range of consumers.

6. Two copper alloy and 33 stone casting moulds were found in Vilnius: 22 were made of dolomite, 7 of limestone, 2 of volcanic rock (lava), which were imported. Limestone moulds were more common in the 14th-15th centuries.

   There were 22 one-sided, 10 two-sided and one three-sided mould. Artefacts of various shapes, such as ornamented mountings, probably pins, rings (two in each), a cross, pendants with religious signs – a Latin cross and the *IHS* inscription, buttons, small round and oval mountings, a stick-shaped artefact and bullets were cast in the moulds.

   The mould fixing parts were made of tin-lead alloys.

7. Seven copper alloy matrices were found in Vilnius, all from the territory of Vilnius Lower Castle. 6 matrices were used for the production of mountings, headbands' plates and brooches and date from the late 13th to the early 15th centuries. One matrix was used

for the production of a locket and dates from the late 17th to the 18th centuries.

8. Over 350 crucibles and their fragments were found in Vilnius, dating to the late 13th–17th centuries. Their capacity ranged from 10–15 ml to 200 ml, the openings were round or triangular, the bottoms were round or flat and the walls were 1,2–3 mm thick.
   The walls of the late 14th–15th centuries crucibles were thick and the clay contained a lot of fine quartz, mica, feldspars and other minerals. It is likely that natural loam, sandy loam or local clay (ilite, with a high admixture of mica and feldspars) was used. Their bottoms were round or flat and their openings were round or triangular.
   The crucibles of the second half of the 16th-17th centuries were made of light grey clay, with about or more than 50% of the fill consisting of quartz (dominating), feldspar grains and 10–15% of mica plates. A few crucibles might have been made of montmorillonite, an imported clay, while the clay of other crucibles could also be imported. Graphite crucibles were also used (up to 20% of the graphite plates were found). A different firing technique was used for these crucibles that of the previous period.
   Gold, silver, copper, tin and lead were cast in crucibles. 8 crucibles contained drops of gold on them. The data obtained show that some crucibles were used more than once, casting not only precious but also non-ferrous metals.

9. In Vilnius there were found 25 artefacts with gemstones and 2 artefacts with rocks: 5 gemstone eyelets, 8 necklaces, 4 decoration details, 8 rings, an earring and a pendant. The rings were decorated with gemstones – garnet, chalcedony, probably pearl, turquoise, diamond, ruby and serpentinite. The beads were made of carnelian, pearl, agate, coral and jasper; the eyelets were made of rock crystal, chalcedony, carnelian, turquoise and agate; the details of the decorations were made of garnet, pearl and emerald; the ear-

ring was decorated with coral and the pendant was decorated with stannite.

Thirty amber artefacts (necklaces of various shapes, a ring, etc.) and more than half of a thousand amber fragments were found in Vilnius. There were amber workshops in the territory of Vilnius Lower Castle in the 9-10th decades of the 14th century.

Artefacts with gemstones from the late 13th–16th centuries were concentrated in the territory of Vilnius Lower Castle and from the 16th - the first half of the 17th centuries in the territory of the Old Bishops' Palace.

REFERENCES

Manuscripts

Blaževičius P., Bugys P., *Vilniaus žemutinės pilies LDK valdovų rūmų teritorija (u.k. 141 ir u.k. 24705). Ploto į pietus nuo I oficinos archeologinių tyrimų 2005–2009 m. ataskaita,* ATA 65.

Blaževičius P., Bugys P., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų rytinio ir šiaurinio korpuso prieigų 2006-2008 m. archeologinių tyrimų ataskaita*, ATA 63.

Blaževičius P., Gendrėnas G., Steponavičienė D., *Vilniaus žemutinės pilies valdovų rūmų teritorija. II oficinos (dvariškių rūmų) 2003-2005 m. archeologinių tyrimų ataskaita*, ATA 53.

Blaževičius P., *Vilniaus pilių teritorijos su įtvirtinimais, pastatais ir jų liekanomis (u. k. 1791) (Vilniaus m.) detaliųjų archeologinių tyrimų 2019 m. ataskaita,* ATA 75.

Daminaitis V., *1998 m. Vilniuje, Didžioji gt. 32 (Jėzuitų vien.) vykdytų archeologijos tyrimų ataskaita*, Vilnius, 1999, LIIR, F. 1, b. 3063.

Daminaitis V., *2005 m. Vilnius, Čiurlionio g. 3, Archeologijos tyrimų ataskaita*. Vilnius, 2006. LIIR, F. 1, b. Nr. 4463.

Daminaitis V., *Buv. Šv. Kotrynos bažnyčios, Vilnius, L. Giros 30 / 1 archeologinių tyrimų ataskaita*, Vilnius, 1987, LIIR, F. 1, b. 1436.

Daminaitis V., *Vilniuje, Gaono g. 4 vykdytų archeologijos tyrimų ataskaita*, Vilnius, 1997, LIIR, F. 1, b. 2850.

Grišinas V. *1987. Vilnius, Garelio g.4 pastato išplatinimas. Archeologinių tyrimų ataskaita*, Vilnius, 1988, LIIR, f. 1, b. 1357.

Grišinas V., *1988. Vilnius, Garelio g. 4 pastato išplėtimas. Archeologinių tyrimų ataskaita*, LIIR, F. 1, b. 1582.

Katalynas K., *1986-1987 m. archeologinės priežiūros ir archeologinių tyrimų M. Gorkio g. Nr. 66, 68 (Didžioji gt. 24, 26) ataskaita*. I dalis, Vilnius, 1988, LIIR, F. 1, b. 1341.

Kuncevičius A., *Vilniaus Žemutinė pilis. Lietuvos Didžiosios Kunigaikštystės valdovų rūmų Rytinio korpuso Šiaurinio priestato archeologinių tyrimų 2014-2015 m. ataskaita*, ATA 69.

Luchtanienė D., *Archeologiniai tyrimai Reprezentacinių rūmų ansamblio (ATR-45) teritorijoje 1998 metais,* Vilnius, 1999, LIIR, F. 1, b. 3231, 3233.

Luchtanienė D., *Archeologiniai tyrimai Vilniuje Reprezentacinių rūmų teritorijoje (AtR-45) S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28 ataskaita*, Vilnius, 1997, LIIR, F. 1, b. 2743, 2744, 2749, 2750.

Luchtanienė D., *Žvalgomieji archeologiniai tyrimai Vilniuje, Menininkų rūmų komplekse (ATR-45) (S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28)*, Vilnius, 1996 m. LIIR, F. 1, b. 2476.

Luchtanienė D., *Žvalgomieji archeologiniai tyrimai Vilniuje, Menininkų rūmų komplekse (ATR-45) (S. Daukanto a. 3 / 8, Universiteto g. 6, Totorių g. 28)*, Vilnius, 1996 m. LIIR, F. 1, b. 2475.

Ožalas E., *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso išorės ir prieigų archeologiniai tyrimai (plotai 9-11, trasa I, II) 2004-2006 m.*, ATA 58.

Ožalas E., Montvilaitė E., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų vidinio kiemo archeologiniai tyrimai 2006-2008 m.*, ATA 62.

Ožalas E., Montvilaitė E., *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso prieigų archeologiniai tyrimai į rytus nuo valdovų rūmų (trasa III) 2004-2006 m*., ATA 59.

Ožalas E., Montvilaitė E., Žvirblys A., *Vilniaus žemutinės pilies teritorija. Valdovų rūmų Šiaurinio ir Vakarinio korpusų bei šiaurinio rūmų priestato archeologiniai tyrimai 2007-2009 m.*, ATA 66.

Ožalas E., Montvilaitė E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Vakarinio korpuso ir jo prieigų 2004 m. archeologinių tyrimų ataskaita*, ATA 52.

Ožalas E., Ožalas. Egidijus, *Vilniaus žemutinės pilies valdovų rūmų teritorija. Pietinio korpuso išorės ir prieigų archeologiniai tyrimai (plotai 9-11, trasa I, II) 2004-2006 m.*, ATA 58.

Ožalas E., *Vilniaus žemutinės pilies teritorija. Vakarinio korpuso prieigų archeologiniai tyrimai 2007-2010*, ATA 66.

Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Pietinio,*

rytinio ir vakarinio korpusų prieigų 2002 m. archeologinių tyrimų ataskaita, ATA 44.

Ožalas E., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Šiaurinio korpuso ir rūmų vidinio kiemo tyrimai 2001 m.*, ATA 40.

Poška T., *Archeologiniai tyrimai Vilniuje, Didžioji g. 8, 10*, 1993, LIIR, F. 1, b. 2162, 2163.

Rackevičius G., *Vilniaus žemutinės pilies Radvilų rūmų (III oficinos) ir pilies kalno vakarinės atraminės sienos teritorijos archeologinių tyrimų 1999 m. ataskaita*, ATA 34.

Rackevičius G., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija. Šiaurinio korpuso prieigų archeologinių tyrimų 2002 m. ataskaita*, ATA 43.

Steponavičienė D., *Vilniaus Žemutinės Pilies Valdovų rūmų teritorija. Rūmų pietinių vartų bokšto tyrimai 1996 m.*, ATA 18.

Steponavičienė D., *Vilniaus Žemutinės pilies Valdovų rūmų teritorija ploto pietryčių kampe 1998 m. tyrimai (perkasa Nr. 4) ataskaita*, ATA 29.

Striška G., *Vilniaus pilies teritorija. Keleivinio keltuvo aikštelių Arsenalo kieme ir Pilies kalne 2003 m. archeologinių tyrimų ataskaita*, ATA 48.

Striška G., *Vilniaus Žemutinės pilies teritorija. Valdovų rūmų šiaurinio ir rytinio korpusų prieigų archeologinių tyrimų 2003–2004 m. ataskaita*, ATA 49.

Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės pilies valdovų rūmų teritorijos 1993 m. tyrimai*, ATA 7.

Tautavičius A., Urbanavičius V., Kuncevičius A., *Vilniaus Žemutinės Pilies rūmų teritorijos tyrimai 1992 metais*, ATA 6.

Tautavičius A., Urbanavičius V., *Vilniaus Žemutinės pilies rūmų teritorijos 1994 m. tyrimai*, ATA 8.

Ušinskas V., *1983 m. archeologinių tyrinėjimų Vilniuje, K. Giedrio g. 8 ataskaita*, Vilnius, 1983, LIIR, F. 1, b. 1390.

Veževičienė V., *Vilniaus senamiesčio (16073) teritorijos, Pranciškonų g. 4a 2015 m. detaliųjų archeologinių tyrimų ataskaita*, Vilnius, 2016, LIIR, F. 1, b. 7679.

Vitkūnas M., *Vilniaus senojo miesto vietos su priemiesčiais (25504) teritorijoje, Pilies g. 32-6, 2012–2013 m. vykdytų archeologinių tyrimų (1-jo darbų etapo) ataskaita*, LIIR, F. 1, b. 6087.

Žukovskis R., *Archeologijos žvalgymai Gaono g. 6, Vilniuje 1999 metais ataskaita*, LIIR, F. 1, b. 3322.

Žukovskis R., *Archeologiniai tyrimai Vilniuje, Stiklių g. 5. Ataskaita /1994 m./*, LIIR, F. 1, b. 2259.

Žukovskis R., *Archeologinių tyrimų Vilniuje, Pilies g. 42-1 ataskaita*, Vilnius, 2004, LIIR, F. 1, b. 4440.

Publications

Alper G., Das Braunschweiger Handwerk im Mittelalter und in der frühen Neuzeit, In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006.

Anderson B. W., *Gem testing*, London, 1983.

Babenskas E., Metalų apdirbimo technologijos. Spalvotųjų metalų dirbiniai, In *Muziejinių eksponatų priežiūra. IV dalis. Archeologinių radinių konservavimas. Nuo lauko darbų iki saugojimo muziejuose*, 2 knyga, Straipsnių rinkinys, Vilnius, 2015.

Dailės žodynas, sudarė J. Mulevičiūtė, G. Jankevičiūtė ir L. Šatavičiūtė, Vilnius: VDA leidykla, 1999.

Duda R., Luboš R., *Brangakmenių žinynas*, Vilnius, 1998.

Evans D. H., Craft and industries in Beverley and Hull from 1200 to 1700, In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006.

Grišinas V., 1989 m. archeologiniai tyrimai buvusio Dominikonų vienuolyno kieme Vilniuje, In *Archeologiniai tyrinėjimai Lietuvoje 1988 ir 1989 metais*, Vilnius, 1990.

Katalynas K., *Vilniaus plėtra XIV–XVII a*., Vilnius, 2006.

Laucevičius E., Vitkauskienė B. R., *Lietuvos auksakalystė XV–XIX a.*, Vilnius, 2001.

Lietuvos didžiojo kunigaikščio Aleksandro Jogailaičio dvaro sąskaitų knygos (1494–1504), parengė D. Antanavičius, R. Petrauskas, Vilnius, 2007.

Lietuvos didžiųjų kunigaikščių rūmai Vilniaus žemutinėje pilyje. Istorija ir rinkiniai. Albumas, sudarytojai D. Avižinis, V. Dolinskas, Ė. Striškienė, Vilnius, 2010.

Lorans E., Craftworking in Tours from the 12th to the 18th century, In *Lübecker Kolloquium zur Stadtarchäologie im Hanseraum V: Das Handwerk*, von Manfred Gläser, Lübeck, 2006.

Lukšėnienė V., Rentgenografijos taikymas archeologiniams radiniams tirti, In *Metodai Lietuvos archeologijoje*, sudarytojas A. Merkevičius, Vilnius, 2013.

Paknys M., *Vilniaus miestas ir miestiečiai 1636 m.: namai, gyventojai, svečiai*, Vilnius, 2006.

Poška T., Archeologinių tyrimų Vilniuje, Didžioji g. Nr. 8, 10 rezultatai, In *Archeologiniai tyrinėjimai Lietuvoje 1992-1993 metais,* Vilnius, 1994.

Sarcevičius S., Tyrinėjimai Vilniuje, Trakų gatvėje Nr. 2, In *Archeologiniai tyrinėjimai Lietuvoje 1996 ir 1997 metais*, Vilnius, 1998.

Scarisbrick D., *Rings, Jewelry of Power, Love and Loyalty*, London, 2013.

Tautkus S., Beganskienė A., Žarkov A., Merkevičius A., Kareiva A. Archeologinių dirbinių tyrimas atominės absorbcinės spektrokopijos (AAS), rentgeno spindulių difrakcinės analizės (XRD), infraraudonosios spektroskopijos (IR), termogravimetrinės analizės (TG) ir skenuojamosios elektroninės mikroskopijos (SEM) metodais, In *Metodai Lietuvos archeologijoje*, sudarytojas A. Merkevičius, Vilnius, 2013.

Vainilaitis V., *Tyrinėjimai Vilniuje, L. Stuokos-Gucevičiaus g. 11*, In Archeologiniai tyrinėjimai Lietuvoje 2003, Vilnius, 2004.

Veževičienė V., Brazaitis D., Dargytė N., Pranciškonų gatvė 4A, In *Archeologiniai tyrinėjimai Lietuvoje 2015 metais*, Vilnius, 2016.

Vilniaus miesto planai, sudarytoja R. B. Vitkauskienė, Vilnius, 2016.

Vitkūnas M., Katalynas K., Pilies gatvė 32, In *Archeologiniai tyrinėjimai Lietuvoje 2012 metais*, Vilnius, 2013.

LIST OF PUBLICATIONS

1. Kisielienė V., Valatkevičienė R., Brangakmeniai, rasti per Vilniaus Žemutinės pilies Lietuvos didžiųjų kunigaikščių rūmų archeologinius tyrimus. 2 dalis / Gemstones Found During Archaeological Research of Palace of the Grand Dukes of Lithuania in Vilnius Lower Castle. Part 2, In *Chronicon Palatii Magnorum Ducum Lithuaniae*, vol. 4, sudarytojas Gintautas Striška, Vilnius, 2018, p. 428-437.
2. Valatkevičienė R., Vilniaus Žemutinės pilies Lietuvos didžiųjų kunigaikščių rūmų papuošalų tyrimai / Research of Jewellery Found at Palace of the Grand Dukes of Lithuania in Vilnius Lower Castle, In *Chronicon Palatii Magnorum Ducum Lithuaniae,* 2018, vol. 4, sudarytojas Gintautas Striška, Vilnius, p. 345-351.
3. Valatkevičienė R., XIV–XVII a. signetinių žiedų problematika / Issues with the 14th–17th Centuries Signet Rings*,* In *Ženklai, simboliai, prasmės: Lietuvos Didžiosios Kunigaikštystės tyrimai pagalbinių istorijos mokslų aspektu,* sudarytoja Rūta Čapaitė, Vilnius: Lietuvos istorijos institutas, 2019, p. 331-358.
4. Valatkevičienė Rasa, Kisielienė Violeta, Brangieji akmenys archeologijoje: gemologinių tyrimų galimybės ir rezultatai /Gemstones in Archaeology: Gemological Research Opportunities and Outcomes In *Metodai Lietuvos archeologijoje II*, sudarytojas A. Merkevičius, Vilnius, Vilniaus universiteto leidykla (to be published).
5. Gliebutė Rasa, XIII a. pab.–XVII a. auksiniai juvelyriniai dirbiniai archeologinių tyrinėjimų Vilniuje duomenimis / Gold Jewellery Artefacts in the late 13th–17th Centuries Based on Archaeological Data, In *Chronicon Palatii Magnorum Ducum Lithuaniae*, vol. 5 (to be published).
6. Gliebutė Rasa, Apgalvių plokštelės ir antsmilkiniai Vilniaus žemutinės pilies archeologinių tyrimų duomenimis (XIV–XV a. pr.) / Headbands' Plates and Temple Ornaments in the 14th–early

15th Centuries Based on Archeological Research Data of Vilnius Lower Castle, In *Chronicon Palatii Magnorum Ducum Lithuaniae*, vol. 5 (to be published).

7. Gliebutė Rasa, Lietuvos Viduramžių juvelyrika / Lithuanian Jewellery of the Middle Ages, In *Acta Academiae Artium Vilnensis*, sudarytoja G. Mickūnaitė, Vilnius, VDA leidykla (to be published).

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