

Organization of production and trade of minor metal items at Nowy Targ (New Market) Square in medieval Wrocław in the light of the production waste

K organizaci výroby a prodeje drobných kovových předmětů
na náměstí Nowy Targ ve středověké Vratislavi
podle analýzy výrobního odpadu

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This paper aims to describe the production of minor items, mostly dress accessories, from non-ferrous metals on a market square to understand how the organization of space looked like and to get an insight of chaînes d'opérateurs. Base for this research are numerous production waste finds from excavations which were conducted in Wrocław at New Market Square – a place which fulfils a role of a market square since the 2nd half of the 13th century to this day. The paper focus on spatial analysis of finds based on proposed 'typology' of metal scraps in relation to organization of similar production in the whole medieval city.

Late Middle Ages – Poland – markets – colour metals – production – dress accessories

Článek se zabývá drobnými artefakty (především oděvními aplikacemi) z neželezných kovů, jež pocházejí z prostoru náměstí Nowy Targ ve Vratislavi. Předmětem výzkumu je početný soubor výrobního odpadu z druhé poloviny 13. a ze 14. století. Článek se zaměřuje na prostorovou analýzu různých typologických skupin kovového odpadu ve formě odstřížků a úlomků, a to s přihlédnutím k dokladům obdobné produkce v rámci celého města. Vypracovaná typologie předmětů slouží jako východisko studia funkčního uspořádání tržního prostranství a tzv. operačního řetězce výroby.

středověk – Polsko – náměstí – neželezné kovy – produkce – oděvní aplikace

1. Introduction

Archaeologists traditionally pay much attention to metal production, focusing especially on iron. Non-ferrous metals production remainings, represented usually by scrap metal and pieces of slag, is seldom the concern of scholars, especially those focusing on medieval towns. This might be due to the way in which excavations in the cities are conducted. Rescue excavations are usually in places where older buildings and citizens plots were located, so in places where mostly domestic life was happening.¹ By contrast, Wrocław's New Market Square was a public part of a medieval city ever since a market had been located there – and remained as such throughout the Modern Era (*fig. 1*) to the present day. Due to its size and character, this area allows us to gain a broader perspective on production and trade

¹ For instance, a large area was excavated in Greifswald (Germany), but of a different character than those from New Market Square in Wrocław. When comes to non-ferrous metal manufacturing a *Grappen* production was evidenced there (see *Enzeberger 2007*).



Fig. 1. Wrocław, New Market Square. View on a south-western corner of a New Market Square and on a crowd. Photograph dated to year 1892. Source: Wratislaviae Amici: <https://dolny-slask.org.pl/830159,foto.html?idEntity=586821>.

Obr. 1. Wroclaw, Nowy Targ. Záběr do jihovýchodního kouta náměstí během trhu, 1892. Zdroj: Wratislaviae Amici: <https://dolny-slask.org.pl/830159,foto.html?idEntity=586821>.

exclusively on the medieval market, by tracing not only features but also material culture – remains of production and final products.

Not much research has been conducted on that field yet. There are general works about crafts² (among others see *Winter 1904*; *Blair – Ramsay 1991*; *Reith 1990*) or organization of the craft in the whole cities (among others *Müller 2000*; *Gläser 2006*; *Rębkowski 2007*), but not many of them focus on production made of non-ferrous metals. There are some publications concerning the location of workshops of bronze workers (*Carver 1980*, 174), especially where large features for casting bells were found (see also *Vyšohlíd 2007*) or *Grappen* (*Enzberger 2007*, 99). However, the majority of research focused on final products themselves (see among others *Egan – Pritchard 1991*; *Krabath 2001*; *Lungershausen 2004*; *Sawicki 2017*) or on the technological processes of production, especially casting (*Berger 2006*; 2012). There are also analyses aimed at techniques and process of reconstructing dress accessories step by step (*Baráčková 2014*). One of the essential works in this field is *Schedula diversarum artium* (*Kobielus ed. 1998*) by Teophilus, the 12th century monk. It contains instructions on how to work with metal and prepare a workshop.

² For general introduction to the issue of craft in archaeology, based mostly on American and English literature, see works of *C. L. Costin* (e.g. 1991; 2005).

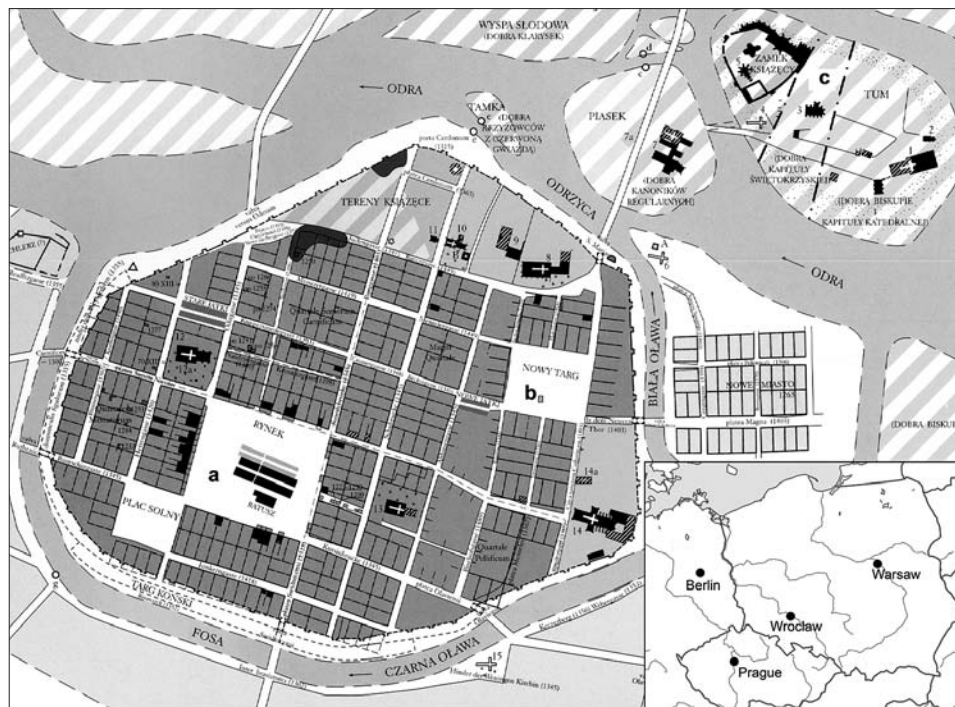


Fig. 2. Map of Wrocław in the 2nd half of the 13th century: a – Market Square (Rynek); b – New Market Square (pl. Nowy Targ); c – Cathedral Island (Ostrow Tumski). Source: *Młynarska-Kaletynowa – Czachranowski 2001*, map 3.

Obr. 2. Urbanistická struktura Vratislavi ve 2. polovině 13. století: a – hlavní náměstí (Rynek); b – Nowy Targ; c – ostrov s katedrálou (Ostrow Tumski). Zdroj: *Młynarska-Kaletynowa – Czachranowski 2001*, plán 3.

The following study is based on finds derived from New Market Square (Nowy Targ Square) in Wrocław which is one of the most important medieval sites that was excavated in this city (*fig. 2*). Large archaeological rescue works took place in 2010–2012, covering the area of approximately 0.4 ha, and recording more than 4 m of stratified deposits. The remains of an early medieval settlement (from the 12th century) as well as the remains of a settlement with timber-framed buildings and wooden communication paths, dating back to the mid-13th century, were recorded. As stated in historical sources and confirmed during excavations works by the find of layer with sand used for levelling which covered almost the whole area, the market square was located in this area in the 2nd half of 13th century – probably more precisely in 1266 (*Mackiewicz – Marcinkiewicz – Piekalski 2014; Marcin-kiewicz – Piekalski in print; Goliński in print*).

The aim of this paper is to discuss finds of non-ferrous scrap metal and raw material lumps, as well as other metal production remainings from the New Market Square in Wrocław in the context of organisation of local production (on the micro-scale – on the market itself) and the question which craftsmen (domestic or professional) might have benefited from them and what items they might have produced.

2. Non-ferrous metals and craftsmen

The list of craftsmen who worked using mostly non-ferrous metals is extensive. According to Nurnberg's 'Zwölfbrüderbücher' (see also *Reith 1990; Blair – Ramsay 1991*) it contains, among others: *Drahtzieher* (drawn-wire), *Messingschlagler* (metal sheets), *Rinkelshmied/Schnallenmacher* (buckles), *Taschenbügelmacher* (bag frames), *Knopfmacher* (buttons), *Gürtler* (girdles), *Heftelmacher* (hooks and eyes) and *Nestelmacher* (aiglets – lace chaps). Some of those were associating in guilds, although in many places specializations of craftsmen were less narrow, especially in smaller cities (see *Winter 1904; Blair and Ramsay 1991; Goliński 1997*). According to the Wrocław's tax register from year 1403 (which applies to New Market Square phase 7, see about that later) we know of following craftsmen working primarily (?) with non-ferrous metals (in brackets names from original sources – see *Goliński 1997*): 33 belt-makers (*gürtler*), 21 needle-makers (*acufex*), 1 tin-caster (*czengisseryne*), 2 founders (*rotgiesser*), 2 brass beaters (*messingsloer* – possibly *schlager?*), 2 coppermiths (1 *beckinsloer* – possibly *shlager?* and 1 *koppirsmed*), 6 sheet-makers or bottle-makers (*flaschener*) and also 12 pewterers (*kannengisser*) and last, but not least 1 lace chaps-maker (*neslter*). Regardless of that specialisation, there must have been demand for the items of non-ferrous alloys. Furthermore, copper alloys also had wide usage between different craftsmen and even comb-makers (working mostly with bone and antler) or knife-makers (working mostly with iron) needed copper-alloy rivets, which are evidenced by archaeological finds.

Keeping this in mind, we can assume that industries (and craftsmen) producing half-products (or pre-products, like producers of sheet and wire) which were later sold or traded to other more specialized workers were essential. However, according to the tax-list from 1403, there were no workers with such specializations in Wrocław (see *Goliński 1997*). On the other hand, not all of those final products must have been produced by specialized craftsmen; some might have been manufactured by other people, not even necessarily specialized in any particular craft. There are information in written sources, that on New Market Square so called 'poor merchants' (*ubodzy kramarze*) were allowed to trade (*Markgraf 1884, 189; Goliński in print*). Thus, we can assume that at least part of production waste found on Wrocław's New Market was left there by such unspecialized (though not necessarily unskilled) craftsmen.

Furthermore, the kind of a workshop necessary for working with non-ferrous metals should be taken into consideration. It is important to observe that many craftsmen depicted in Nurnberg's books are working on a large wooden log (even in early modern times: *fig. 3*) – not on a specially prepared table. Further information about preparing a more complicated goldsmith workshop can be found in the work of Teophil (*Kobielus ed. 1998, book III, chapter II*). He advises digging a ditch in the ground for workers, covering it with wood and placing a table in such manner so that it would cover workers' knees. Among others such workspace was meant to help in recovering production waste.

In order to work non-ferrous metal one needs an anvil, hammer and cutting tools. Further works involve files and other tools for chasing, smoothing and polishing the final product. Special iron plates with holes are needed for drawing wire, while stamping into form requires soft anvils or dies-matrices and stamping tools. The preparation of a soft anvil is



Fig. 3. Bellmaker Hans Ronwald in his workshop. Picture from *Nürnbergischer Hausbücher*, dated to 1594. Source: <http://www.nuernberger-hausbuecher.de/75-Amb-2-317b-55-r/data>

Obr. 3. Pasíř Hans Ronwald ve své dílně. Vyobrazení z knihy *Nürnbergischer Hausbücher*, datováno 1594. Zdroj: <http://www.nuernberger-hausbuecher.de/75-Amb-2-317b-55-r/data>.

described in *De confectione quae dicitur tenax* by monk Teophil (*Kobielus ed. 1998*, book III, chapter LVIII).

A kiln or a furnace is not necessary for some works, but it definitely helps in production process (see *Baráčková 2014; Sawicki 2017*). Temperature gained there must be high enough to just soften the material used – not necessarily to melt it. However, such fireplaces were needed for casting, since this kind of work needs more complicated workshop and specific equipment, such as bellows, melting pots, pincers, and moulds. When it comes to non-ferrous metal industries, bell and pot casting as well as turning on lathe tools are probably the most space-consuming and tool-demanding ones.

Thus, a large part of metalwork can easily be done on a stall or even on a ground at marketplace, especially if it doesn't require casting, but even melting copper and lead alloys could have been done in simple fireplaces.

In following parts of this text I introduce the material and describe the spatial analysis of production waste, which in market phase mostly consisted of cold-working remains such as sheet metal scraps, drawn wire and tubes.



Fig. 4. Wrocław, New Market Square. Copper alloy lump; inv. 5325/11. Figs. 4–14, 17, 19–21, 23, 24 by J. Sawicki.

Obr. 4. Vratislav, Nowy Targ. Měděný slitek; inv. č. 5325/11.



Fig. 5. Wrocław, New Market Square. Lead alloy lump with traces of cutting; inv. 6508/11.



Obr. 5. Vratislav, Nowy Targ. Olověný slitek se stopami odsekávání; inv. č. 6508/11.

3. 'Typology' of metal scraps

The proposed 'typology' is based mostly on macroscopic observations of given items, but as already mentioned in the introduction, the main purpose of this paper is to describe the organization of craft and market space rather than providing a specialist analysis and a deeper insight into metal waste itself. Thus, I decided to leave out the precise identification of metal alloys used, and to focus on shape and (possible) purpose of given items in the production process keeping only the basic distinction between the lead and copper alloys.

More specific analysis of alloys used in medieval industries, covering distinction between bronze, brass, gunmetal, pewter etc., in comparison with written sources can be found in works of *G. Egan* and *F. Pritchard* (1991) and also *J. Blair* and *N. Ramsay* (1991). Moreover, some finished products from New Market square were published by *B. Miazga* (2014).

Metal scraps found on New Market square can be divided into four basic groups: lumps of raw material, sheet metal scraps, tubes and wire. Some subgroups in chosen categories will also be distinguished (see below). Altogether, 1003 specimens of different production waste were found.

Lumps of raw material

Out of 251 lumps found only 17 were made from copper alloy. The primary 'function' of lumps, both from lead and copper alloys (*fig. 4*), is hard to be identified. They could have



Fig. 6. Wroclaw, New Market Square. Remains of lead alloy casting – canal from a mould; inv. 2936/11c.

Obr. 6. Vratislav, Nowy Targ. Fragment olověného odlitku do formy – pozitiv licích kanálků; inv. č. 2936/11c.



Fig. 7. Wroclaw, New Market Square. Remains of copper alloy casting (?), possible canal from a mould, half-product or an ingot; inv. 1087/11.

Obr. 7. Vratislav, Nowy Targ. Torzo olověného odlitku (?), přípustné interpretace: pozitiv licích kanálků kadlubu, polotovár, popř. ingot; inv. č. 1087/11.

been production remains, material used for re-melting and re-use or even items for trade. On some lumps traces of cutting can be seen. One specimen from lead alloy (*fig. 5*) was cut with sharp tool, and that part was probably used for re-melting or to create solder (*Sawicki 2017, 28*).

Among formless lumps of raw material 19 artefacts can be distinguished as casting canals. However, only one of them is from lead alloy and have form of a typical mould canal used for spilling liquid metal into the mould (*fig. 6*). The remaining lumps have a shape of a joined, long thin, rod (*fig. 7*). Their function is unknown, but they might have been used as pre-products for further sheet (or wire production), as they could have been later hammered into thin sheet. It is also possible that they were small ingots. Brass and copper was often transported in such form (*Ossowski 2014, 242*). Bar-shaped ingots were found on the ‘Shipwreck of Gnalic’ (*Cassitti 2016, 287*), but they were much larger than possible examples from New Market square, as they measured almost 60 cm.

Sheet metal

A large part of the assembly from New Market square is sheet metal (*fig. 8*) and it counts 255 specimens. Among different sizes and shapes of sheet metal scraps I decided to distinguish three different ‘types’ of sheet metal based of their form and size.

First, there are ‘stripes’ – ca. 1–2 cm wide and usually rectangular in shape. Second, there are ‘ribbons’, much narrower than the previous type and usually 0.3–0.7 cm wide. On the plans used for spatial analyses they were grouped together.



Fig. 8. Wrocław, New Market Square. Part of an assemblage of copper-alloy sheet metal scraps from square 82, phase 6; inv. 1087/11.

Obr. 8. Vratislav, Nowy Targ. Výběr plechových odštěžků ze slitin mědi, nalezeno ve čtverci 82, 6. sídelní fáze; inv. 1087/11.

Also, there are ‘plaques’ – rectangular or oval in form, some of which were probably used for producing belt mounts. Remaining pieces are referred to simply as sheet metal scraps. They are rectangular or oval in form, some of which were probably used for producing belt mounts, however most of them are just formless scraps.

In production of dress accessories, sheet metal was used mostly for strap ends, buckle frames and mounts. One half-product of a buckle plate was found among other scraps (inv. 1058/11 – *fig. 9*). It is a simple plate, cut from a piece of sheet metal, but un-carved, unfinished and not yet ornamented.

Moreover, even buckle frames were made out of sheet metal, especially folding strap clasps (*fig. 10*; see *Sawicki 2017*). Sheet metal could have been also hammered on a special matrice (stamped into shape). This technique was used mostly in manufacturing belt mounts (see *Sawicki 2017*). Possibly two matrices used for producing such items were found on New Market square (*Lisowska in print, fig. 7. h, j*).

Metal tubes

A total of 222 metal tubes were found on New Market Square. They are made out of thin sheet metal and are similar to wires. Part of them might have been pre-products for wire – sheet metal pulled through hole in special die used for drawn-wire production. On all specimens a seam running along the whole tube is visible (*fig. 11*). Furthermore, some could



Fig. 9. Wrocław, New Market Square. Half-product of a buckle plate from copper-alloy; inv. 1087/11.
Obr. 9. Wrocław, Nowy Targ. Polotovar plechové součásti přezky ze slitiny mědi; inv. č. 1087/11.



Fig. 10. Wrocław, New Market Square. Copper-alloy folding clasp with a plate; inv. 345/11.
Obr. 10. Wrocław, Nowy Targ. Klapková spona ze slitiny mědi; inv. č. 345/11.

Fig. 11. Wrocław, New Market Square. Copper-alloy metal tubes with visible seam; inv. 1058/11.

Obr. 11. Vratislav, Nowy Targ. Trubičky ze slitiny mědi, detail přehnutých okrajů plíšku; inv. č. 1058/11.



Fig. 12. Wrocław, New Market Square. Copper-alloy metal tubes which might have been used as lace chaps – *aiglets*; inv. 1087/11.

Obr. 12. Vratislav, Nowy Targ. Ze slitiny mědi zhotovené trubičky, jimiž mohly být zakončeny tkanice, inv. č. 1087/11.



have been lace-chaps (*aiglets*, *nestelhulsen*; fig. 12) – metal tubes used as laces points for lacing clothes (see Egan – Pritchard 1991; Krabath 2001; Cymbalak – Svatošová 2015). *Nestelhulsermacher* or *nestler* (germ.) were craftsmen specializing in production of those items, which were widely used in medieval and early modern Europe (Cymbalak – Svatošová 2015). Other tubes might have been used as rivets (for knife handles etc.) or as a half-product of drawn wire.

Wire

Another large part of the assembly are wires (fig. 13) – with 241 specimens found on the New Market Square. They have different diameter in section, but all seems to be drawn wire or strip drawn wire. The history and development of this technology was described by J. Wolters (1991), while W. A. Oddy (2004) presented practical methods of identifying as well as producing different kinds of wire. He distinguished methods used since Bronze Age as hammered wire, swaged wire, block-twisted wire, strip drawn and strip twisted wire, cast wire, folded wire, and finally drawn wire, which appears first in the early-medieval period (Wolters 2001, 205; Oddy 2004, 265).

Those different types might have been, in fact, part of a whole *chaînes d'opérateurs* (see next part of the text) of producing drawn wire (see also Wolters 2001; Oddy 2004). Such production involved the following steps: first, metal lumps were cast into rods, which might have been later hammered into sheet-metal tapes. Those rods or tapes were later pulled through special dies with holes to form tubes which were again later thinned down through more and more pulling into thin wire. If tapes are drawn through hole, the finished



Fig. 13. Wrocław, New Market Square. Part of copper-alloy assemblage from square 82, phase 6 containing mostly wire and tubes, inv. 1058/11.

Obr. 13. Vratislav, Nowy Targ. Výběr artefaktů (především drátky a trubičky) ze slitin mědi ze čtvorce 82, 6. sídelní fáze, inv. č. 1058/11.

wire have characteristic seam (*Oddy 2004, 262*). Even though there are finds from every step of production in the same area (part 4, 5), it cannot be said with absolute certainty if all of those finds stem exactly from this particular production process. We also need to remember that all the outcomes of every production step could have served completely different purposes and been used by other people.

4. Spatial analysis of finds

On New Market Square eight phases of development were distinguished on the basis of analyse of over 600 stratigraphic units, pottery, coins and other finds, and were further 'calibrated' by dendrochronology dating. The whole description of every phase, and the full discussion, can be found in a separate paper (*Mackiewicz – Marcinkiewicz – Piekalski 2014*) and in a full monography (*Piekalski – Wachowski in print*). For the purpose of this paper I only present summarized dating of every phase (*tab. 1*).

The phase-dependant distribution of different scrap metals can be seen on a graph (*fig. 14*). First 3 phases were connected to the settlement that existed in times before the demarcation of the market square. For the purpose of this paper, those three phases will be treated as one 'pre-market' phase.

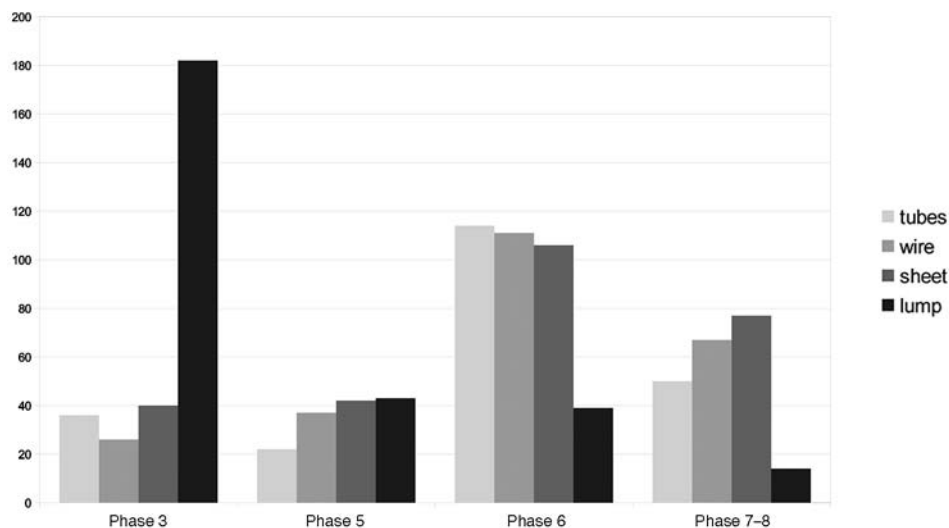


Fig. 14. Wrocław, New Market Square. Production waste distribution across phases.

Obr. 14. Vratislav, Nowy Targ. Výrobní odpad v rámci jednotlivých sídelních fází.

In pre-market phase relics of wooden houses and other constructions, such as wooden roads were discovered. However, the most scrap metal finds were not in objects fills, but in space between features – in paths and squares of the settlement. In this phase a total of 285 items was found and only 16 were from fills/layers of features.

Most of finds from pre-market phase are lumps of raw material, amounting to 182 specimens. They make up 63 % of all finds from the pre-market phase, and almost 73 % of all raw material fragments found on the market square. Only seven lumps are from copper alloy, the rest is from lead alloy and they weight together over 7.7 kg. They were found in close proximity of features identified as relics of houses, particularly in phase 3 (*fig. 15* – black squares are lead lumps from phase 3, and light grey from phase 2). Lead alloy lumps of raw material might be remains of domestic or even professional production, since lead alloys don't require very high temperature to melt.

This presumption might be proven by finds of eight mould fragments from the pre-market phase. Three of them come from phase 2 and were found in places on the market not strictly related to production waste finds or objects. Further five moulds are related to features from phase 3 (see *Lisowska in print*). The most remarkable are two moulds found in

Phase	1	2	3	4	5	6	7	8
Chronology (century)	11–12	end of 12 – beginning of 13	1 st half of 13 to 60's–70's of 13 th	2 nd half of 13; 60's – 70's	2 nd half of 13– 1 st third of 14	1 st half of 14	2 nd half of 14 – beginning of 15	15–18
years (ca.)	1000–1190	1180–1220	1220–1270	1260–1270	1270–1330	1300–1350	1350–1430	1430–1800

Tab. 1. Wrocław, New Market Square. Estimated chronology of phases.

Tab. 1. Vratislav, Nowy Targ. Přibližná periodizace sídelních fází.

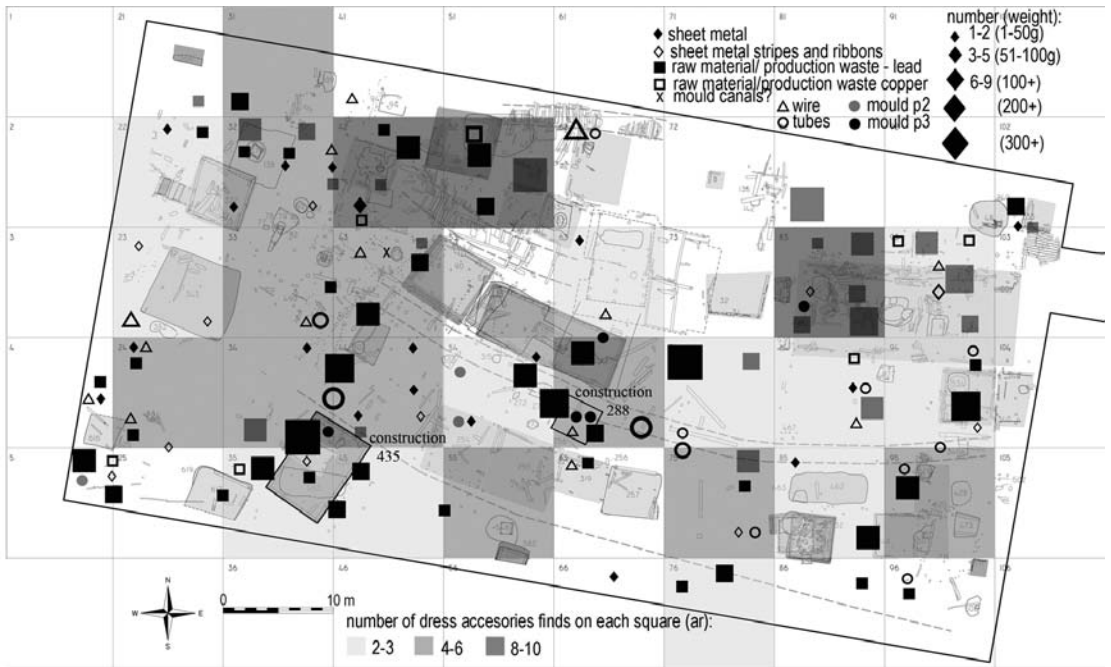


Fig. 15. Wrocław, New Market Square. Map of distribution of production waste from phases 1–3. Background colour of each square indicates number of finished dress accessories found. Figs. 15, 16, 185, 22 by J. Sawicki and M. Mackiewicz.

Obr. 15. Wrocław, Nowy Targ. Plánek distribuce výrobního odpadu v rámci 1.–3. sídelní fáze. Barevná škála jednotlivých čtverců vyjadřuje rozdílné množství nálezů finálních výrobků oděvních aplikací.

a construction no. 288, which was hardly visible in the field, and was discovered only on the basis of the intersections with surrounding visible features. This house (?) or stall, measuring 3.0 x 3.9 m, probably had plaited walls, and might have been used by a craftsman specialised in casting (*Lisowska in print*). Both moulds are well manufactured. Based on finds of lumps in the area, first one was used for casting lead alloy rings (*Lisowska in print*, fig. 7g, inv. 359/11), while second one was used for producing unidentified mounts (*Lisowska in print*, fig. 7b, inv. 6186/11). Further finds include a quite large piece of thick wire (inv. 6075/11) and a piece of lead lump weighting over 36 g (inv. 6073/11) with further lumps found in close proximity: one piece weighting over 130 g, and twelve pieces weighing together 684 g, as well as one bronze alloy lump. Although in the house itself 36 g of production waste or raw material were found, it is not enough to prove that in that place was a professional or domestic production; it remains a topic for discussion.

Furthermore, substantial lead lumps were found in building no. 435–645 g and over 550 g in close proximity of it, although the mould from that house was probably used as a die – a matrice for stamping thin sheet (*Lisowska in print*, fig. 7j). Three such sheets were found inside the construction no. 435. The rest of moulds found in features from phase 3 (for description of context and moulds see *Lisowska in print*; *Piekalski – Wachowski in print*) seems not to be strictly connected to finds of raw material or production wastes (see fig. 15).

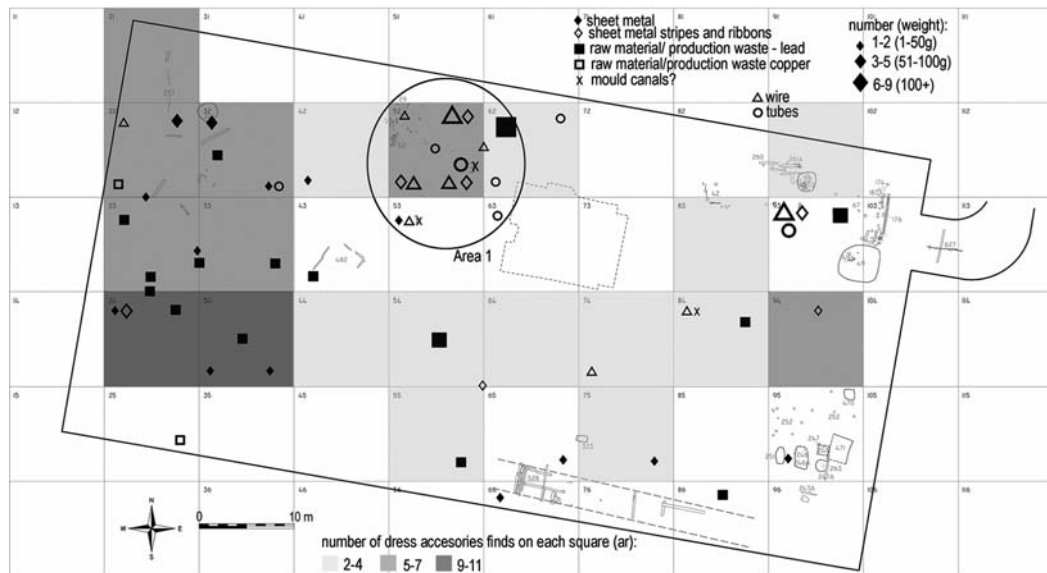


Fig. 16. Wrocław, New Market Square. Map of distribution of production waste from phase 5. Background colour of each square indicates number of finished dress accessories found.

Obr. 16. Vratislav, Nowy Targ. Plánek distribuce výrobního odpadu v rámci 5. sídelní fáze. Barevná škála jednotlivých čtverců vyjadřuje rozdílné množství nálezů finálních výrobků oděvních aplikací.

It is also worth to note, that lead alloy lumps found in the buildings or in the close proximity of them might be connected to house or roof construction.

Other metal scraps, which are mostly sheet metal parts (40), drawn wire (26) and metal tubes (36) seems to be randomly located on the market square (fig. 15). This is in contrast to spatial distribution of dress accessories finds from that phases (Sawicki 2017, 12). They seem to be distributed fairly even, but at the closer look, most of them seems to be located on the paths and routes which were going through the settlement and they might have been just randomly lost in its more crowded parts (see Sawicki 2017, 15, fig. 2; 41, fig. 16, 17). However, it is impossible to state if those metal scraps were domestic production waste, as except the aforementioned examples, there are no finds of tools or features that might clearly indicate their purpose.

Next phase – 4, is connected to the creation of the market space and is characterized by layers of river sand used probably for levelling the space and the absence of artefact finds and features (see description of stratigraphic unit 11, Mackiewicz – Marcinkiewicz – Piekalski 2014; Piekalski – Wachowski in print). It should be also noted that there is no evidence of intentional backfilling and levelling the area in question in other phases, therefore it is most possible that all artefacts were not affected by major post deposition processes.

Phase 5 is the first phase of market square (fig. 16). There were 144 total finds of metal scraps. Most of them are sheet metal scraps (42) and raw material lumps (43) and also a quite large number of wire parts (37) and tubes (22).

In phase 5 we can clearly distinguish an agglomeration of metal scraps on square 52 and in its close proximity (fig. 16) which I will refer to as 'area 1'. It consists of 52 different items,



Fig. 17. Wrocław, New Market Square. Dress accessories finds from 'area 1', phase 5: a – folding clasp; b – brooch; c – belt buckle; d – belt mount; a, b, d – copper alloy, c – lead alloy.

Obr. 17. Vratislav, Nowy Targ. Nálezy oděvních aplikací z „areálu 1“, 5. sídelní fáze: a – klapková spona; b – spona; c – přezka; d – opasková nášivka; a, b, d – slitina mědi, c – slitina olova.

mostly wires (21), tubes (15) and sheet metal (11), 4 canals from moulds and a single lead alloy lump. This indicates that there might have been some kind of a workshop, probably more focused on the production of wire and tubes from sheet metal than other items. On square 52, 7 whole items were also found and, apart from iron and lead alloy buckles, they could have been manufactured at that place (fig. 17). Items found there are: a simple round buckle, a stamped *bordenstrecker*, a folding clasp and two buckle plates (see Sawicki 2017). What should be noted, though, is the fact, that most finds of the 'finished' metal items from that phase were located far away from the possible production 'area 1' (fig. 16). Most of them were found in western part of the market square which is true for next phases as well.

There are 370 pieces of scrap metal which were found in layers connected to phase 6 – another step of development of the market square (see Mackiewicz – Marcinkiewicz – Piekalski 2014; Marcinkiewicz – Piekalski in print). Most of them are tubes (114) and wires (114) which makes up more than 60 % of all scrap metal finds from this phase, and almost 50 % of all finds of this type found on the market square. There were also finds of sheet metal (106) and lumps of raw material (36).

In phase 6, on square 52, a pole building was raised (structure 26) which was interpreted as a stall. There are almost no metal scrap finds related to this structure, but in close proximity of it – mostly in adjacent square 62 – there are plenty of them (fig. 18). Altogether, 71 specimens were found, mostly tubes (38), wire (15) and sheet metal (16). There was only 1 lump of raw material and 1 canal cast-remain.

Although the function of structure 26 is unknown, we might guess it was used as a production point or trade stall, but not specialised – i.e. a place where very different items were sold. It seems that the raising of the stall has forced people working in 'area 1' to move their workshops slightly to the east (when compared to phase 5). The location of scrap metal

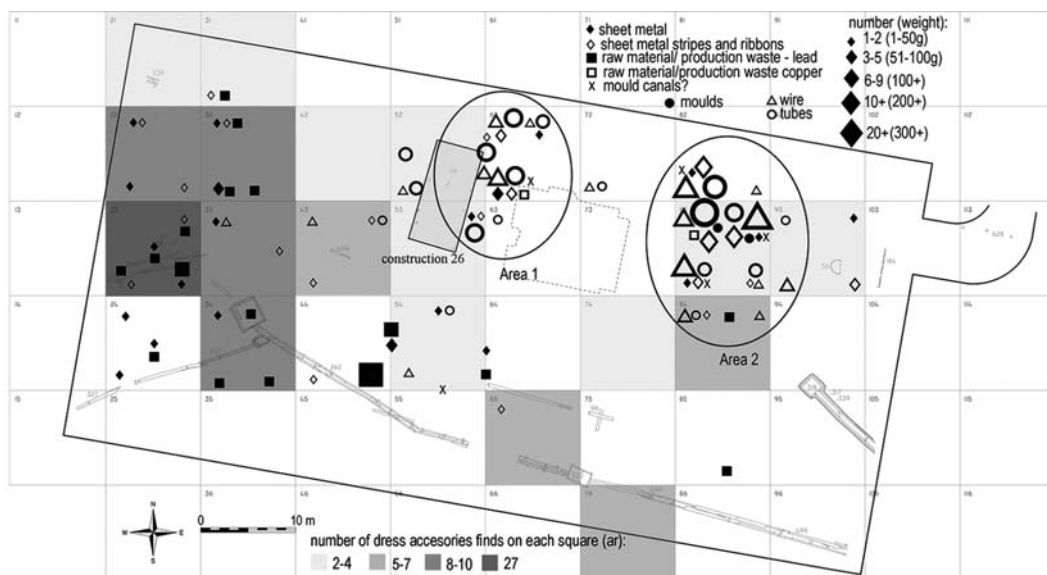


Fig. 18. Wrocław, New Market Square. Map of distribution of production waste from phase 6. Background colour of each square indicates number of finished dress accessories found.

Obr. 18. Vratislav, Nowy Targ. Plánek distribuce výrobního odpadu v rámci 6. sídelní fáze. Barevná škála jednotlivých čtverců vyjadřuje rozdílné množství nálezů finálních výrobků oděvních aplikací.

finds is surrounding structure 26 from the east – but in this area there are only few finished products – a hole reinforcement, a strap end and a cast mount from lead/tin alloy (fig. 19). In fact, the most important find that might prove production activities in this area is an unfinished product of a strap end. Nevertheless, a further possible production zone can be observed in phase 6 – ‘area 2’.

‘Area 2’ is located in the eastern part of the market square, mostly on square 83 and on adjacent squares 82, 84 and 93 (fig. 18) with 226 specimens found, mostly wires (92) and tubes (69), a large quantity of sheet metal scraps (54) as well as raw material lumps (11). Although the two areas seem different at first sight, when it comes to percentual distribution of finds they show a lot of similarities (fig. 20), especially when we consider tubes and wires as a part of the same manufacturing process and some of the tubes as semi-products of wire. In ‘area 2’ some pre-products were also found – most importantly, an unfinished buckle plate, cut from a strip of sheet copper-alloy metal (fig. 10). Whole dress accessories found in ‘area 2’ also indicate that some sort of production from sheet metal might have taken place there, since most finds are stamped into shape belt mounts (fig. 21). Furthermore, 2 moulds were found in ‘area 2’, both not well preserved. First was used probably for casting small rings of ca. 1 cm diameter (*Lisowska in print*, fig. 7g), while the second was probably used for rings, although it’s not sure due to its state (*Lisowska in print*, fig. 7f). From ‘area 2’ we have almost no lead alloy lumps, and only a few copper alloy ones – the last alloy was used for casting in this moulds. Those 2 moulds indicate that not only cold stamping and hammering took place in this area, but also some basic casting could



Fig. 19. Wrocław, New Market Square. Dress accessories finds from 'area 1', phase 6: a – hole reinforcement mount, b, c – belt mount, d – strap end; a, c, d – copper alloy, b – lead alloy.

Obr. 19. Vratislav, Nowy Targ. Nálezy oděvních aplikací z „areálu 1“, 6. sídelní fáze: a – kovový chránič otvoru; b, c – opaskové aplikace; d – řemíkové nákončí; a, c, d – slitina mědi, b – slitina olova.

have been done; however, the lack of larger number of lumps doesn't allow the conclusion that there was a true casting manufacture located there.

If we consider structure 26 from square 52, a stall used for trading, finished items finds from 'area 1' might be remains of activities focused on finishing pre-products, while 'area 2' was 'strictly' production zone. It should be noted though, that in phase 6 most finished products were found in western area of the market (*fig. 18*).

There are 207 metal scraps from phase 7, mostly sheet metal fragments (77), wire (67) and tubes (50). Only 14 lumps of raw material were found. Most of the finds – over 50 %

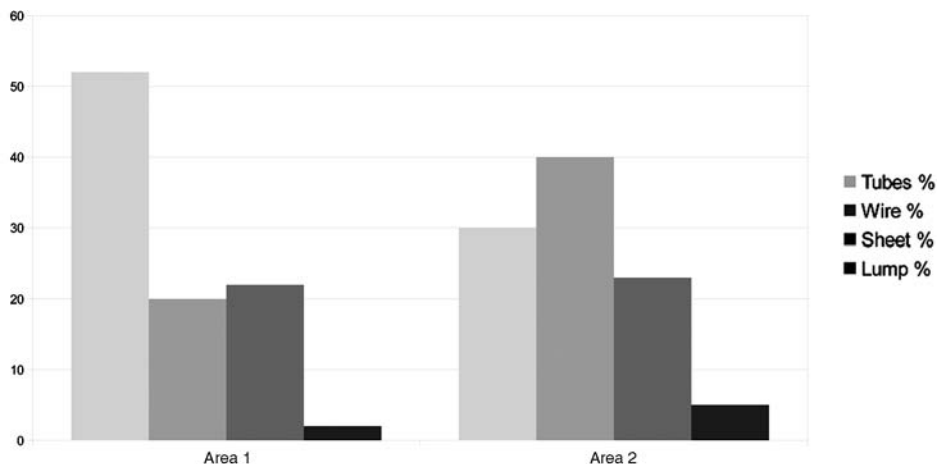


Fig. 20. Wrocław, New Market Square. Comparison of production waste finds in area 1 and area 2.

Obr. 20. Vratislav, Nowy Targ. Porovnání nálezů výrobního odpadu v „areálech 1 a 2“.

(104) – come from ‘area 1’ (fig. 22). The majority of them are sheet metal scraps (36), wire parts (35) and tubes (30). Only 3 lumps of raw material were found. In this phase the structure 26 was stopped being used, and almost exactly at the same place, a similar structure 27 was raised. It was also a pole building and was probably fulfilling the same role of a market stall. In its proximity 11 finished items were found (fig. 23).

It should be noted that there are no finds from ‘area 2’ in phase 7. There are only 22 scrap metal finds of different types from square 73, but all of them come from a feature interpreted as a bomb crater which was ‘formed’ during WW 2. Craftsmen (?) probably stopped producing things in ‘area 2’, but due to insufficient data it is impossible to determine what domestic or ‘global’ changes forced them to stop the production.

5. Some observations about organization of the trade and production on the market

As already mentioned, both in ‘areas 1 and 2’ during all phases of their existence, the minority of finds were lumps of raw material, compared to sheet metal products, tubes and wires (fig. 24). It seems that the main production outcome of those workshops were metal tubes and drawn-wire.

When it comes to dress accessories production, tubes could have been easily manufactured to *aiglets* (lace chaps; *nestelhulsen*) and sheet metal fragments to buckle plates (fig. 10). Since the 14th century the composite folding clasps and even normal buckles (see Sawicki 2017, catalogue no. 22 and 30) were becoming fashionable, though it seems that this fashion had lasted only till the end of that century. A large number of tubes in Phase 6 and 7, in both production areas, might indicate that *aiglets* (lace chaps) were not as rare as the state of research indicates (no finds of such items from the Lower Silesia region had been published yet).

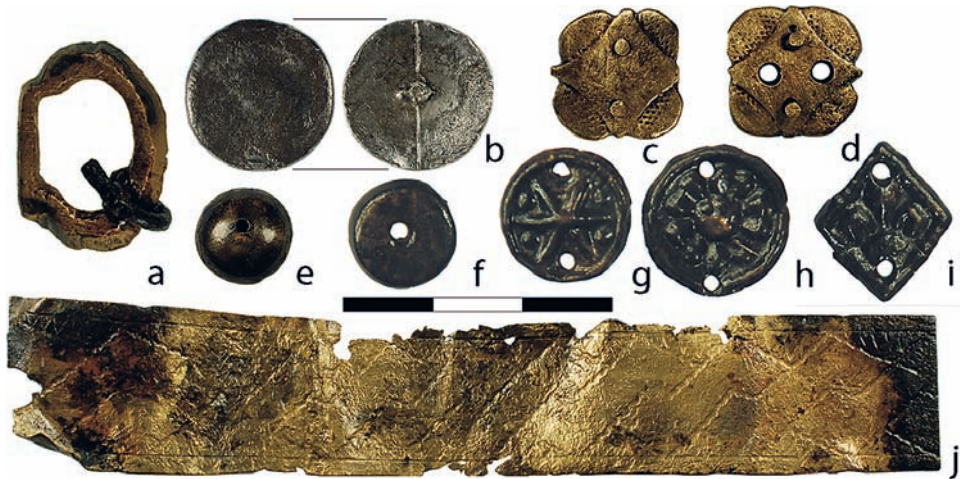


Fig. 21. Wrocław, New Market Square. Dress accessories finds from 'area 2', phase 6: a – buckle; b-i – belt mounts; j – composite strap end plate or buckle plate; a, c-j – copper alloy, b – lead alloy.

Obr. 21. Vratislav, Nowy Targ. Nálezy oděvních aplikací z „areálu 2“, 6. sídelní fáze: a – přezka; b-i – opaskové nášivky; j – plechová součást kompozitního nákončí řemínku; a, c-j – slitina mědi, b – slitina olova.

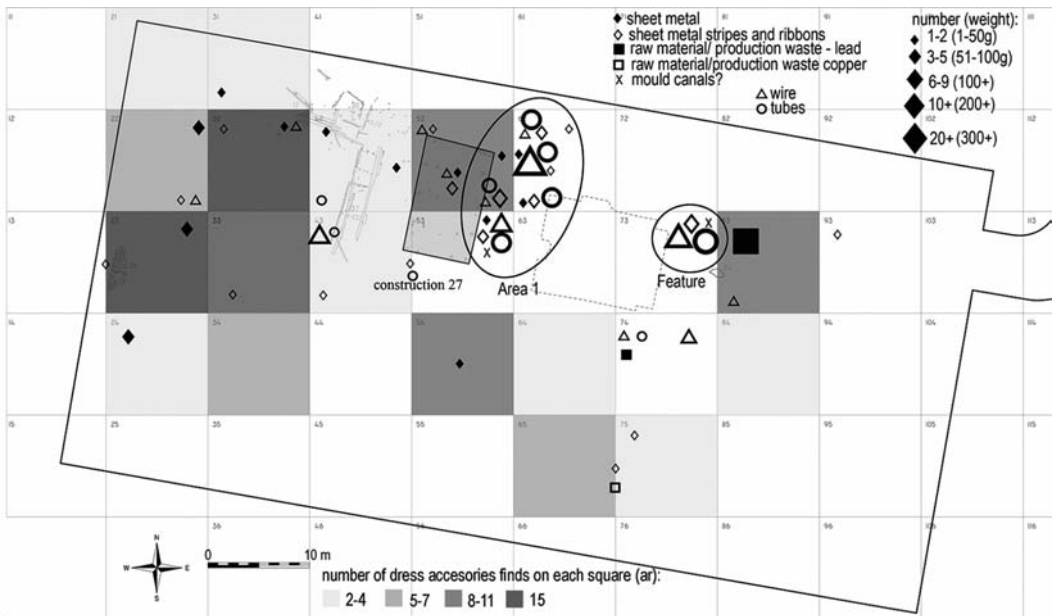


Fig. 22. Wrocław, New Market Square. Map of distribution of production waste from phase 7-8. Background colour of each square indicates number of finished dress accessories found.

Obr. 22. Vratislav, Nowy Targ. Plánek distribuce výrobního odpadu v rámci 7-8. sídelní fáze. Barevná škála jednotlivých čtverců vyjadřuje rozdílné množství nálezů finálních výrobků oděvních aplikací.



Fig. 23. Wrocław, New Market Square. Dress accessories finds from 'area 2', phase 7–8: a – composite strap end (?); b – strap end; c – belt buckle; d – folding clasp; e, f – belt mounts; g–j – brooches.

Obr. 23. Vratislav, Nowy Targ. Nálezy oděvních aplikací z „areálu 2“, 7.–8. sídelní fáze: a – kompozitní řemínkové nákončič; b – řemínkové nákončič; c – opasková přezka; d – klapková spona; e, f – opaskové nášivky; g–j – spony; a–e, g–j – slitina mědi, f – slitina olova.

The whole market square in phases 5–8 can be divided into two zones. The first one has already been mentioned: the production zone of 'area' 1 and 2. In the second zone, located in the western part of the market square, most of the 'final' products from copper and lead alloys were found (Sawicki 2017). It is highly possible that those objects might have been sold in this area by specialised traders, who could easily travel with their business. As indicated in written sources, travelling tradesmen were allowed to sell their products on the New Market Square (Goliński *in print*). Such simple stalls (?) are represented (probably in a little romantic way) on iconography from the period – where Dietmar von Aist, dressed as a simple tradesman, offers a brooch or a buckle to a noble lady (fig. 25).

These 2 zones are located in different places on the Market Square, especially 'area 2' and the trade zone (compare fig. 16 and 18). The only exception located in 'area 1' refers to the stall 26, which might have functioned as repair or re-work facility for tradesmen working at the stall. As it can be observed on modern open markets, community of craftsmen and traders compete against and at the same time support each other, for instance by sending clients to each other (etc.), which seems to lead to a greater specialization between craftsmen and manufacturing more unique products. L. Boerner (2005) also suggest that the concentration of sellers with similar products reduced search costs of potential buyers. As we can read further: 'this also increased price competition, the sufficient heterogeneity of the products and the uncertainty of sellers having customers, makes such a grouping optimal. In most cases this grouping is not only socially efficient, but also profitable for the sellers' (Boerner 2005, 3).

Despite definite locations and type of finds, it is impossible to state whether 'areas 1 and 2' were used by specific craftsmen, i.e. beltmakers (*gurtlers*) or just general craftsmen, nor if there was a region used by one person and his workshop workers or many single producers, doing similar work in same area. It's important to note though, that in the list of Wrocław's tax-paying craftsmen from 1403 (see Goliński 1997), there are no separate entry

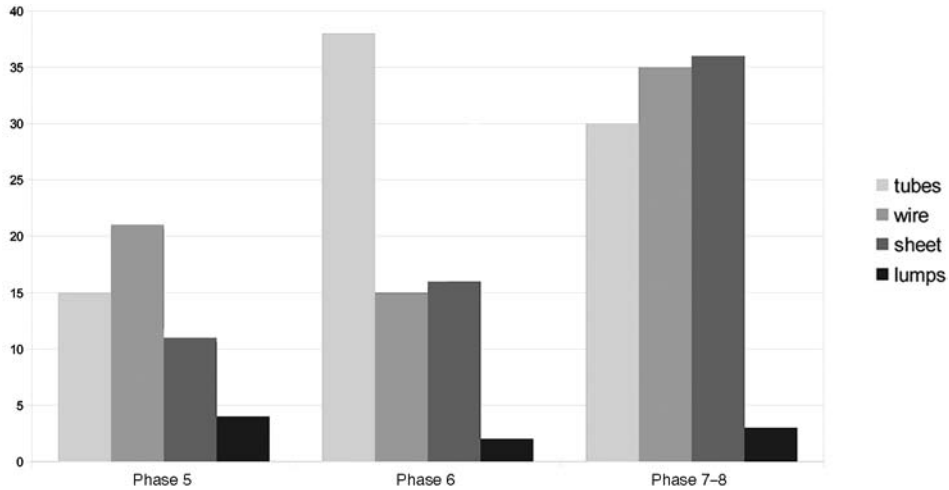


Fig. 24. Wrocław, New Market Square. 'Area 1' production waste finds across phases.

Obr. 24. Vratislav, Nowy Targ. „Areal 1“, výrobní odpad v rámci jednotlivých sídelních fází.

for craftsmen specializing in drawing-wire (*drahtzieher*) and sheet-making (*messing-schlagler*), though bottle makers (*flasheners*) who might have been producing basic metal sheets are mentioned. However, it is remarkable that there is only one specialist called a *nestler* (Goliński 1997, 482), who could be identified as lace chaps maker. It is possible that the main (?) production of wire, sheet and *aiglets* (lace chaps) was happening on the New Market, though other craftsmen could have easily produced wire and tubes for their own purpose when necessary.

At the New Market Square other 'workshops' existed as well, such as leatherworkers (see *Konczewska in print*). However, the lack of any constructions (except stall no. 26) makes it difficult to say how this space looked like. As I stated before, this sort of metal production doesn't need a large furnace or kiln that would have been dug in the ground or required a construction; in fact, a small fireplace, even a mobile one, might have been used to soften the metal.

We also need to take into account the dynamics of changes that happens on this sort of public space (see also *Sawicki 2017*). Traders could have changed their places, but it's highly possible that some kind of unwritten tradition existed as to who was allowed to work and where. Furthermore, the quantity of finds (1003 specimens) may seem remarkable at first glance, but when compared to the long time of using the marketplace and to more than 350 finds of dress accessories from non-ferrous metals doesn't seem so substantial anymore (see *Sawicki 2017*). We need to take into account that producers were able to re-melt almost all scraps, so they cleaned their work-space very exactly. What quite undoubtedly indicates production zones is the fact that production waste on the market was located in clearly clustered areas (which is completely different to pre-market phases). We can only imagine that people were selling their things directly from the ground which is visible on photographs from the beginning of the 20th century taken at the so called 'Tippenmarkt' – a pottery market – located on the same place (New Market Square; *fig. 26*).

Fig. 25. Große Heidelberger Liederhandschrift (Codex Manesse), Zürich, ca. 1300–1340, Picture of Minnesanger Dietmar von Aist dressed as a tradesman. Source: University of Heidelberg Library, Heidelberg: <http://digi.ub.uni-heidelberg.de/diglit/cpg848/0123>
 Obr. 25. Rukopis Codex Manesse, Curych, ca. 1300–1340, vyobrazení minesengra Dietmara von Aist oděného jakožto kupec. Zdroj: University of Heidelberg Library, Heidelberg: <http://digi.ub.uni-heidelberg.de/diglit/cpg848/0123>



6. Conclusion

Production of ‘small finds’ and a spatial analysis based mostly on production waste finds in late medieval period is a topic not much discussed yet. In this paper I prepared a basic typology of production waste in relation to what purposes it could have served (i.e. sheet metal as a basic for dress accessories and other items found on market) and I tried to determine what *chaînes d’opérateurs* it might have involved (i.e. sheet metal worked into tubes and then to wire). Spatial analysis of finds gives us some valuable information about organization of production, although in pre-market phase the finds are dispersed, and most of them are lead alloy lumps. It indicates the existence of places of domestic manufacture, possible small professional work-places (such as construction 288 with two moulds found



Fig. 26. Wrocław, New Market Square. Pottery market – ‘Tippenmarket’, between 1930–1940. Source: Wratislaviae Amici: <https://dolny-slask.org.pl/986220,foto.html?idEntity=586821>.

Obr. 26. Wrocław, Nowy Targ. Hrnčířský trh (Tippenmarket), 1930–1940. Zdroj: Wratislaviae Amici: <https://dolny-slask.org.pl/986220,foto.html?idEntity=586821>.

inside). In market-phases we clearly see two areas (*fig. 18*) with finds related to sheet-metal work, and we observe that they are located quite far away from the concentration of final products, which were mostly found in western part of the excavated area (see *fig. 16* and *18*).

It should not be forgotten, that metal production doesn’t always need kilns or more complicated furnaces, as some small, simple work can just be done ‘cold’ or with only minor heating involved. Moreover, such craftsmen could easily travel with their materials and tools. When it comes to organization of work it is very possible that craftsmen in both ‘areas’ were producing, among others, half-products which were traded later to other craftsmen who finalized them.

This study is based on observations of a large assemblage, which allowed us to gain a general picture of distribution of finds etc. However, further investigations should focus on a more specialist studies involving XRF scans and microscopic analysis of chosen specimens – it should provide us with more information about the manufacturing process, the exact specializations of craftsmen and possibly alter some opinions about work organization in the given ‘areas’.

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