Traces of Metallurgy at the Site of Łosino 15, Compared with Other Finds Related to Ancient Metallurgy

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Abstract: The eponymous site is located in the territory of Poland—the northern part of the central section of the Słupia river, about 30 km from the coast of the Baltic sea (Fig. 1). Full elaboration of this settlement, as well as other sites in this area, is presented in the book, which is a published doctoral dissertation—“the Iron Age in the basin of the middle section of the Słupia river” [1].

In the meso-regional perspective—the areas of Pomerania, the Iron Age is a period of rapid cultural transformations, in which the Pomeranian, Oksywie and Wielbark culture communities participated. The Lusatian culture community, which also developed at the dawn of that age, was partly coeval with the aforementioned culture communities. The site of Losino 15 revealed some traces of a settlement of both the Pomeranian and the Wielbark cultures. Consequently, the beginnings of the Pomeranian culture were associated with the Hallstatt C or Hallstatt D periods [2-4], whilst its decline phase is synchronized with the end of the older Pre-Roman Iron Age and maybe with the beginning of the younger Pre-Roman Iron Age [5]. The Wielbark culture, tied with the Goths—known from the primary antique sources, occupied the areas of Pomerania in the first centuries AD, from where it further spread across the south-east.

In the case of both these cultures, the settlements still remain poorly defined compared to the well elaborated cemeteries, which places the study site as a valuable source of knowledge on the settlements and their economy, particularly the metallurgical production. The most interesting features discovered at the study site are the remains of bloomery furnaces.

It should be emphasized that exploration of potentiality of metallurgical processing of bog iron ores, which took place at the turn of the early Iron Age and the late Pre-Roman Iron Age, played a great role in the development of civilization [6]. Iron gained much significance largely due to the ease with which this raw material can be obtained. It was the time of gaining independence from the imported raw materials.
and a rudiment of the local iron smelting industry. As a result, iron became one of the basic raw materials characteristic of the material culture of those times [6, 7].

This article aims to present the views and status of the research on the ancient metallurgy, especially in Pomerania. The possibilities for interpreting the remains of bloomery furnaces will be discussed in the light of other finds of relics of the ancient metallurgy. This is all the more compelling as very few traces of that production type were noted throughout the areas of Pomerania—as opposed to the well researched metallurgical production in the Holy Cross and Mazovia regions [8-10]. Only some bottom parts of bloomery furnaces are identified nowadays at the site of Losino 15, due to the poor state of preservation of the sources.

As indicated above, the study site yielded some remains of settlement representing the Pomeranian culture community and the majority of the acquired materials are associated with it. The second settlement horizons are the sources associated with the early period of Roman influence. Currently, an explicit assessment of chronology of the discoveries in Losino cannot be formulated yet. Two alternative and temporarily equivalent hypotheses can be proposed here. According to the former one, the creators of the bloomery were representatives of the Pomeranian culture, and in the latter version, they represented the Wielbark culture.

The discussion of the issue of iron production will begin from a short presentation of views on the origins of metallurgy in Poland, with a particular emphasis put on the areas of Pomerania. It is worth a brief note here in the Bronze Age, which preceded the eponymous Iron Age, trade connected with the location of tin deposits was of great importance. Tin deposits occurred only in some parts of Europe.

It is significant in that in the Iron Age the new metal could be produced locally due to the widely available bog ores [11, 12]. Availability of the ores made a local metallurgical production possible, which resulted in the gradual replacement of bronze by iron. It must be emphasized, though, that it was a complex and lengthy process. At the turn of the seventh and eighth centuries BC, a knowledge of smelting ore into new metal become the basis for the new economic system in central Europe [11].

Archaeological sources from the Hallstatt period evidence the knowledge of iron-working but show no traces of its local production. This allowed to put forward a hypothesis that, at the beginning, the iron processing was based on the imported raw material. It should be noted that the literature presents a view that the domestic production of that new material took place not later than at the end of the Hallstatt period. However, there is no sufficient evidence to support this supposition [13]. Jerzy Piaskowski, a researcher who gives his assent to an assumption that early domestic metallurgy existed, accepts the possibility of iron making centred in the Holy Cross mountains during the Hallstatt and La Tene periods [14-16]. Unfortunately, though the more recent studies do not support the thesis of such early origins of the domestic metallurgy [8]. Piaskowski, defending his hypothesis, points out that the first slag-pit furnaces utilized for smelting iron represent the poorest identifiable
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sources—being in the far poorer state of preservation than slug-pits, which makes their correct interpretation difficult [14]. Additionally, there are no confirmed metallurgical sites from the Hallstatt period in the Holy Cross mountains region. Also, no unambiguous relics of ancient metallurgy were discovered at the sites of the Cloche-Pomeranian cultures. Although the surface research revealed an occurrence of slag at these sites, it was always accompanied with some materials associated with the Przeworsk culture [8]. A similar situation was observed at the site of Łosino 15, where, apart from slag and pottery associated with the Pomeranian culture, some artefacts dated to the early Roman period were noted.

Now, it is advisable to refer back to the northern regions of Poland, where the first products made from the new metal began to reach Pomerania at the end of the Bronze Age. At the beginning, iron had not immediately gained advantage over the previously known bronze. It was the time when the finished products crafted from the “new” metal appeared in Pomerania. With time, shrinking of natural resources necessary for bronze-making caused that it was gradually replaced by iron [12].

The area of Pomerania reveals no signs of local iron industry which could be clearly attributed to the population of the Pomeranian culture in the Hallstatt D period. During this period, local blacksmiths probably were still based on the imported raw material [13]. Interestingly, inventories of the Cloche-Grave culture, dated to the late Pre-Roman Iron Age, contain considerable number of features made of iron. Metallographic analyses for the artefacts of that culture from the region of Mazovia indicate a utilization of low-phosphorus iron in addition to metal derived from the local bog iron ores characterized by a high content of phosphorus, which might indicate an existence of the local metallurgy [16]. It was only an assumption requiring a further research necessary to validate it. As explained by Orzechowski S. [8], it can be presumed that the Cloche-Pomeranian population possessed the knowledge of working iron—probably imported from the region of eastern Alps.

2. Materials

Bloomery slag, the most frequent find at the archaeological sites evidencing metallurgical production, has been preserved because it is a waste product and due to its structure it is also fairly resistant to soil and weather conditions [17]. The finds of slags indicate interim or multi-season type of metallurgical activities. The site of Łosino 15 yielded slag with a total weight of about 100 kg. It occurred both in features and in the “layer”. The layers primarily yielded small and friable lumps of the “slag-like material”, which is, in fact, a sintered mixture of sand and clay. In the features, in turn, reducing slag coming from the bloomery furnaces was discovered. Also, some minor fragments of blocks, porous slag and icicle slag were recorded.

In contrast to the smelting process itself, no activity connected with an acquisition of bog iron ores was recorded. The potential traces of iron ore mining have been obliterated by the erosion processes and were not recorded in the course of excavations. Most likely, some primitive iron ore mining method relying on digging a small pit—dook was in use there [18]. In the case of bog iron ores, the mining process was even simpler, as on the wetlands, this raw material occurs at a depth of 0.3 meters below the surface or sometimes even shallower, therefore, it is enough to remove turf to reach the deck with a thickness of about 0.15 meters to 0.5 meters [19]. The picks made from antlers which were found at the site in Stroszki, Nekla commune, might support the assumptive system of ore mining [20]. Ore, after extraction, was dried and calcined with the aim to get rid of impurities. The deposits of bog iron ore in Pomerania are insignificant, just like throughout the remaining part of northern Poland. Apparently, the bog ore in the central section of the Słupia river sufficed the needs of the local metallurgists. Iron smelting probably took place on a
small scale and for their own uses. This is evidenced by some minor slag pit furnace clusters occurring in an irregular arrangement, and blocks of slag from small slag pits.

The site of Łosino 15 yielded 10 features interpreted as relics of the bloomery shaft furnace with a pit. They were characterized by a high degree of deterioration—due to the agronomic activities and slope processes, only the bottom part of the slag-pit have been preserved. These are the remains of shaft furnaces with a pit called slag-pit furnace, whose relics are slag-pits filled with slag [21, 22]. Furnaces of this type were common in the period of the Roman influence in the territory of the Barbaricum as disposable, low volume objects [23]. The furnace type which raises presented research interest consists of two parts: the shaft and the bottom—slag-pit (Fig. 2).

Slag was discharged from the reduction zone down to a special cavity called slag-pit. In this way, slag was separated from metallic iron shale [21, 24]. To remove the shell from the furnace, the upper-shaft part of it was tipped over. Fragments of the walls that might come from its bottom part occurred at the study site in the feature F194 located in the vicinity of the features which are relics of the slag-pits. Six of them (F15, F16, F17, F18, F19 and F20) interpreted as the remains of slag-pit furnaces clustered in the eastern part of section F, the others (F3, F5, F8 and G146) occurred in the vicinity or were adjacent to the feature F194. The study features were found in a non-ordered arrangement similarly to the remains of the furnaces at the site in Goślinów, Gniezno district [23]. The preserved bottom parts of the furnaces indicate that the study site reveals a small or medium-sized slag-pit [21]. The size and number of bloomery furnaces was dependent upon local demand for iron and the skills of the ancient metallurgists [8].

The slag-pits recorded at the analysed site do not contain slag blocks but only icicle slag, which accumulates on the bottom of a bloomery furnace (Fig 3). Similar features, without the preserved blocks of slag, were recorded at the site in Stroszki [20] and at the site of Leśno 3.

Slag blocks with dimensions corresponding to the slag-pit, discovered at the eponymous site, were obtained from the feature F194, vicinal to the slag pit furnace cluster. The total weight of the slag obtained from the feature is about 60 kg. Predominantly, it was slag from bloomery furnaces characterized by its perforated and partially molten structure and also, some lumps of expanded “slag-like material”, which were results of the direct contact with the surface of the molten slag with the ground or the outer body of the shaft furnace. Some fragments of slag blocks had charcoal impressions. Also, numerous small, perforated amorphous slags, probably connected with the reduction phase were noted. Occurrences of icicle slag belonged to rarer finds. Most of the slags derived from the study feature represent a perforated type with a spongy structure, while the well liquefied fractions
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Fig. 4  Fragments of walls of the shaft type furnaces and slag blocks derived from the feature F194, the site of Łosino 15, Brudzew commune.

occurred sporadically. Two small lumps of slag, which seem particularly noteworthy, presumably come from the upper layer of the slag blocks and possess a characteristic widening in the upper part with the well-preserved surface of free solidification.

Thankfully, it was possible to measure the approximate diameter of the lumps. It amounted to about 30 cm and therefore, it can be concluded that these lumps come from small bloomery furnaces (Fig. 4). Among the slag pieces obtained from the feature F194, there were also fragments of walls of an unspecified metallurgical feature, possessing a layer of slag on its inner side and on the outer side—sintered clay was noted. Probably, they are parts of walls of the shaft type furnaces or an unspecified hearth. One of the wall fragments contained a layer of vitrification-glazing, which suggests proximity of the tuyeres. Additionally, daub with some traces of vitrification occurred in slag-pit furnaces at the site of Leśno 3. Thickness of the preserved fragments of walls was measured and it amounted to between 3 cm and 4.5 cm. With high probability, it can be stated that, originally, the wall of the furnace shaft was about 3 cm to 6 cm thick. Daub obtained from the aboveground parts of the bloomery furnaces at the site in Rumia represented similar thickness [25]. Small pits with slag recorded in the vicinity of this feature, in the Łosino settlement, were interpreted as bottom parts of bloomery furnaces.

Their sizes roughly corresponded to the sizes obtained for the slag blocks.

The function of feature F194, because of its location, formal characteristics and content of the fill, is a problematic issue. This feature is characterized by a significant size, which indicates that, originally, it could serve as a semi-recessed residential building or a waste pit. Pottery obtained from this fills are fragments of numerous vessels associated with the Pomeranian culture.

3. Results and Discussion

If it can be assumed that the traces of black metallurgy are associated with the activity of the Pomeranian culture community, the feature F194 should be treated as a waste pit. This might seem even more likely because of the late chronology of pottery derived from the discussed feature. A fragment representing the features of the Jastorf culture allows to assume conservatively its association with the decline phase of that culture. Consequently, it might seem advisable to search for a relationship between the process of gaining knowledge of iron smelting and the influences reaching from the west. Considering the context of cultural background of the study relics of the ancient metallurgy, the issue of metallurgy in the Jastorf culture seems particularly compelling. Iron artefacts, associated with the earliest phase of that culture—the Marianowo phase, prevailed among the ones acquired from the sites in Troszyn, Marianowo and Lubieszewo [26]. Their occurrence is connected with the spread of iron throughout the area of western Pomerania in the late Pre-Roman Iron Age. Previously, iron artefacts were rather sporadic occurrences. Their presence is connected with an origin of the local production of this raw material and, therefore, a potential Jastorf impact on their knowledge of the black metallurgy cannot be ruled out, as it seems to be evidenced by the finds of its elements in pottery. Moreover, the small amount of pottery with elements of Jastorf culture was discovered in Łosino 15.
Yet another interesting fact—the first products made from bimetal and iron occur in the early Iron Age in Central Pomerania, in the district of Ślupsk [27]. During the period of HaC, iron in Pomerania was rather infrequent. In the case of eastern Pomerania, far more iron artefacts dating back to the HaC period were fund in the graves of the Pomeranian culture. The clusters of graves which contained iron artefacts were found in two zones in Pomerania—in the Gdańsk area and near Ślupsk. Probably, the local production was based on the imported raw material [27].

In this point, it is advisable to mention the sites associated with the Pomeranian culture, from where the materials connected with the process of iron smelting were derived. The settlement in Koników reveals this type finds where, apart from a large number of pits and hearths, also furnaces for smelting iron were recorded [28]. Iron smelting in the study area, just like in the other part of Pomerania, was based on the exploitation of bog iron ores. It is possible that mining of the raw material needed in metallurgical production was already initiated by the representatives of the Pomeranian culture [19, 29]. Unfortunately, the context of the discovery of some occurrences of slag recorded on the riverside of the Stupia precludes the possibility to determine their cultural background [29].

On the other hand, in the light of the rather numerous analogies with the “Roman” sites, the relics of the ancient metallurgy point to the Wielbark culture. In this situation, the occurrence of pottery associated with the Pomeranian culture, along with the finds of slag in the feature F194, need explaining. It seems that, here, it can be a partially sunken residential building connected with the Pomeranian culture community, which was then re-used during the Roman times as a pit for the waste from smelting processes. Quite likely, the object representing the Wielbark culture could disturb the pit of the Pomeranian culture but it is not clearly distinguishable in stratigraphy.

As already mentioned, there are numerous references in the literature to the artefacts associated with iron smelting found in the deposits from the Roman period. They occurred at the sites in Głuszyna and Wygoda [30, 31]. Some artefacts interpreted as bottom parts of slag-pits similar to the artefacts obtained from the study site, were also recorded at the site in Rumia [25] and in Leśno.

The most convincing evidence of the black metallurgy in the study area comes from the site of Widzino 8. Five features, connected with the period of Roman impact, are associated with this settlement, including two probable but strongly damaged slag-pit furnaces. Unfortunately, a very poor state of preservation of the features preclude any unambiguous functional interpretation of the find. Only the bottom part of features measuring about 1 m in diameter and having a depth of about 0.12 m were preserved [32]. As in the case of Łosino 15, also here—the slag pits, initially, were probably smaller. Their fills contained small pieces of slag, charcoal and daub, which became sufficient grounds to treat the study features as remains of the bottom parts of the furnaces used for smelting iron. The fragments of daub are considered remains of the capping dome. At the site of Widzino 8, the process of smelting iron is also associated with the stone paving, within which pottery and slag were discovered. It seems likely that the feature in question was related to the process of iron pre-treatment [32]. Similar pavings, triangular in shape, were noted in Kleszczewko, Pszczółki commune [33].

Some features which contained fragments of slag were recorded at the site of Płaszewko 5 as well. These sources are tied with the period of Roman influence [34].

It seems advisable to approach the sources connected with iron smelting present at the aforementioned site of Leśno 3, which—with high probability—are associated with the Wielbark culture. Ten relics of bloomery furnaces belong to some of more interesting discoveries at this site. The slag pit
furnace cluster excavated there, alike the one discovered in Łosino 15, was characterized by an “irregular” bloomery furnace clusters. Similarly to the site of Łosino 15, these features had an oval shape in plan view and their thickness ranged from 40 cm to 60 cm. Their infills contained relatively small icicle slag. The materials from these features, analysed by J. Piaskowski [35], were characterized by a low iron content. In addition to the slag in features and their vicinity, also some fragments of daub were recorded—probably derived from the above ground parts of the furnaces. Some fractions of daub possess traces of vitrification on the inside-glazing, as well as remains of shafts from Losino 15. This proves a high temperature causing glazing on the inner side of the shaft, due to proximity of the air supply holes [21].

Unfortunately, neither the site Łosino 15 nor Leśno 3 yielded any materials related to the “spirit” of the furnace, which means the above-ground part of the furnace with traces of a round hole. In addition to the slag and daub, also some strongly fragmented pottery, whose chronology is difficult to establish, as well as some fragments of vessels dated to the Roman period were recorded in slug-pits. This allows to connect these features with the Wielbark culture settlement.

The research on slag from Leśno 3 indicated their association with the bloomery furnace with a pit. Icicle slag prevailed in the derived material [36]. The results of the analyses were compared with the tests performed for the samples obtained from the site of Łosino 15. A substantial degree of morphological similarity was noted in slag obtained from both the sites. The chemical composition of the samples was also alike [36]. Additionally, some fragments of daub with a visible layer of vitrification, analogous to those of the Łosino settlement, were recorded in Leśno 3. It can therefore be presumed that the remains of metallurgical production from the site of Łosino 15 date back to the Roman period. This is evidenced by numerous similarities between the sources obtained from both these settlements.

Unfortunately, the sites located in the Shupia river basin, as well as in Leśno 3, revealed no presence of “slag-like” material or scale. The “slag-like” material is relatively frequently recorded in the form of iron spatter generated during removing it from the furnace or splinters produced in its further processing—reforging [37]. The scale, which is an oxidation layer that forms on the surface of the hot metal, constitutes the other evidence of an existence of the forging processes. It has a form of thin flakes with a diameter of a few millimetres, which are produced under the blows of the hammer [38] and they can be collected using a magnet [21].

The traces of the black metallurgy discovered at the sites dated to the times of influence of the Roman period, located within the central basin of the Shupia, may indicate that the slag-pit furnaces from Łosino 15 probably should be treated as associated with the Wielbark culture settlement rather than with the Pomeranian culture—maybe influences from Jastorf culture.

4. Conclusions

Finally, it is advisable to briefly reiterate the location of the analysed slag pits. The study furnace cluster was located on the outskirts of the “Pomeranian” settlement, in the near vicinity of the other features from this settlement horizon. Interestingly, the sources from the early Roman period, discovered in Łosino 15, cluster predominantly just around the relics of the ancient metallurgy. The question can be posed: was it an iron smelting zone located at a large distance from the settlement? Unfortunately, at the present stage of the research, the issue of cultural background of the remains of bloomeries remains open. Hopefully, the new research in Pomerania can help solve this problem in the future.

In the vicinity of the cluster of slug-pits, there occurred a charcoal kiln, which could supply charcoal used as fuel for the metallurgical process.
Nevertheless, this is only a supposition based on the presence of the hearths interpreted as charcoal kilns situated near slag-pits discovered at the site in Stroszki, Nekla commune [20].

In the light of the available data, it can be concluded that the production of iron in the study area did not develop on a larger scale compared to the Mazovian and the Holy cross metallurgical centres. Probably, in Pomerania, the production of iron was supposed to just meet the local needs of the inhabitants. According to Bielenin K. [39]—an outstanding expert at black metallurgy, slag-pits and workshops in a non-ordered arrangement were a reflection of the production type focused on the needs of the craftsman, the settlement community or the gens.

References

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