

The evolution of early medieval Moravian axe-shaped currency bars through the perspective of an archaeological experiment

Vývoj raně středověkých moravských sekerovitých platidel perspektivou archeologického experimentu

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KEYWORDS

Early Middle Ages – Great Moravia – axe-shaped bars – currency – archaeological experiment – smithing – credit theory of money

ABSTRACT

The presented text attempts to assess the possibilities and limitations of processing Great Moravian currency bars (by domestic archaeologists traditionally called axe-shaped hryvniyas) into the form of an end product – a tool in the form of an axe – using an archaeological experiment. In this manner, it is also testing the possibilities of the axe-shaped bars to remain in circulation as tokens of general-purpose money. The present experiment shows that the processing of these bars is considerably loss-making, which means that in the case of their circulation as tokens, their withdrawal from circulation for the purpose of their practical utilization would be unlikely. The text also attempts to model the genesis of axe-shaped currency, seeing their roots in Moravian social currency, which probably originally had the form of real axes. During the social and political changes of the Great Moravian period, this currency acquired the form of stylised semi-finished products and were probably also integrated in anonymous market transactions at least in part of Great Moravian territory.

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1. Introduction

The range of early medieval iron artefacts from the territory of former Great Moravia includes two categories of strikingly similar finds characteristic of this period. The first of them are iron axes, the typical weapons and tools of the early Moravians. While the variability of their shapes provoked scholars from the beginning to create simpler as well as more complex, branching typologies (for summarization, see Luňák 2018, 22–39), reflections going beyond the framework of these chronological-typological categorisations were rather exceptional, almost exclusively limited to the search for their erstwhile practical function (Luňák 2018, 82–100). The study of their social or symbolic role, and especially their possible role in the establishment of social and economic relations (see Machek 1956, 251–252), was completely outside the research perspective. It is therefore not so surprising that archaeologists have persisting problems with coping with the presence of the second category of artefacts characteristic of this period, the enigmatic iron bars (Fig. 1) that occur above all during the existence of Great Moravia and shortly after its demise. In light of their evident similarity to axes, they started to be termed “sekerovité hřivny” (axe-shaped hryvniyas) (first Zelnitius 1945, 11; see also Poulík 1957, 334).

Although these axe-shaped currency bars also became the subject of typological classification, derived above all from the design of their punched eye (for summarization, see Hájník 2019, 112–113; cf. Hlavica et al. 2020, 19–20, Fig. 6), their social and economic role in early medieval society was also discussed in parallel. The main reason is that in contrast to axes it was not quite clear at first sight. Attempts at their interpretation as utilitarian objects, especially carpentry tools or possibly militaria in the manner of knives, axes or throwing weapons, have been more or less abandoned (Pleiner 1961, 405–407; Hájník 2019, 112). As the number of cross-cultural analogies grew, these opinions started to be pushed out by arguments that recognised axe-shaped bars as a specific type of a semi-finished product that was not used as a tool or weapon – and most probably not even as an intermediate product for further processing. These stylised semi-products, presumed to be used as a source of material only with difficulties, was supposed to be part of the first exchange transactions. These were identified either with primitive money characteristic of non-commercialised relations (Pleiner 1961, 436–442; see also Dalton 1965, 48; Graeber 2011, 129–130; and below), or directly with the exchange media based on the value of a commodity (i.e. “commodity money”) that already implies more advanced commercialisation of past economic life (Štefan 2014, 162–163; Hájník 2019, 141; Harvát 2019, 28; Hlavica, Procházka 2020a) and the integration of the standard of value based on the Byzantine weight system into the early medieval Moravian economy (Pošvář 1963, 140–141; Kučerovská 1989, 77;

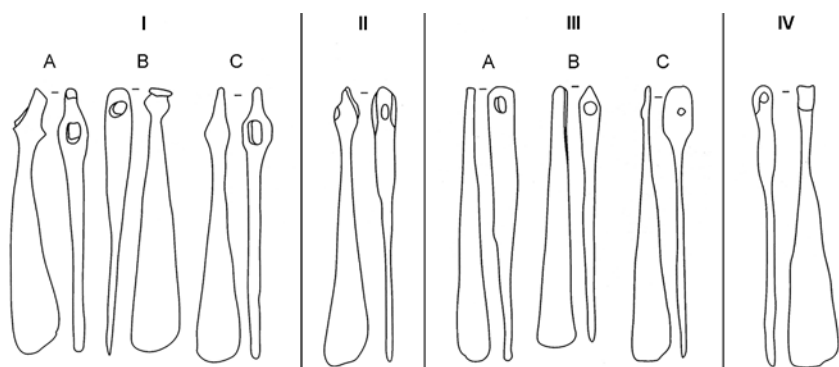


Fig. 1. Typological classification of the Moravian axed-shaped bars. After Bialeková, Turčan 2007, Fig. 9.

Obr. 1. Typologická klasifikace moravských sekerovitých hřiven. Podle Bialekové, Turčan 2007, obr. 9.

Tirpáková et al. 1989, 441; Bialeková, Tirpáková 1989, 94; contra Pleiner 1961, 426; Urbańczyk 2008, 156–157).

The question of the role of axe-shaped bars in the early medieval economy has not been unambiguously resolved yet. Likewise, it has not been satisfactorily explained why the shape of these specific iron semi-products draws precisely from the tradition of the production of early medieval axes. For a successful advance in the solution of the two, intertwined questions, future research needs above all a viable model describing the background of their production and distribution and the character of their circulation. While building such a model is not the primary objective of this text, we will nevertheless attempt to show that an archaeological experiment, even of a rather simple design, can generate data that can be used to build and test a more complex economic model in future.

2. Experimental processing of axe-shaped bars into the end product

The archaeological experiment described below was based on an earlier experimental production of axe-shaped currency bars from bloomery iron (Hlavica et al. 2020). It illustrated rather convincingly that their production process was inadequately complex for these artefacts to represent a mere semi-finished product intended for further processing. The reconstruction of the production process showed that the production of most types of axe-shaped bars requires specific production steps that tested the quality of the metal and manifested the quality of the processing of the used iron. This explicit information can later be visible also in anonymous exchange transactions, in which the quality of the metal could be immediately verified also by a participant in the exchange who was neither in direct contact with the producer of the axe-shaped bars nor immediately able or willing to utilise the iron further (Hlavica et al. 2020, 26).

However, the findings from the previous research did not exhaust the potential of an archaeological experiment concerning the investigation of questions connected with the role of axe-shaped currency bars in the early medieval economy. On the contrary, this knowledge can be further extended while extending the previous activities. The implementation of the next hypothetical step in the production chain, the transformation of axe-shaped bars into the end form of the tool itself, turns out to be crucial. It can complete the production process and thus also describe the possibilities and limitations of the practical use of the axe-shaped bars as semi-finished iron products.

The experiment designed in this way seems to be promising also in another respect. Through it, also the potential of axe-shaped bars to serve as the exchange medium in the commercial economy, which is being considered by some researchers, can be tested, to a certain extent. These researchers mostly see axe-shaped bars as “commodity money”.

As argued by researchers using the perspective of the credit theory of money (see Innes 2004; Graeber 2011, 46–51), however, the concept of the evolution, as well as definition, of “commodity money” is problematic (for summarization, see Hudson 2004; Espinosa 2019). Debt theorists argue that this sort of money did not represent the next evolution stage following barter exchange, when exchange participants should have come to an agreement to use a frequently exchanged commodity as a unit of account, and then as the physical medium of exchange. The value of the “commodity money” is thus not based on an intrinsic value of the used commodity itself. The available evidence shows that they rather represent a value of an alienable credit-debt relation, which is calculated in another standard of value (e.g. the weight of silver or gold), or by already known monetary unit of account (Graeber 2011, 37–38). In this respect, the presumed “commodity money” would not be the evolutionary predecessor of monetisation, but it represents a specific variant of credit tokens, which appear as a result of insufficient tokens of already used general-purpose money (i.e. minted coins) in circulation within an already monetarised economy.

However, all tokens of general-purpose money generally have a specific feature important for the investigation of the economic role of axe-shaped bars. In order for them to remain in circulation as tokens, the intrinsic value of the usable bullion metal of which they consist must be lower than their given and generally accepted value. In the opposite case, when the price of the metal achieves or exceeds the value associated with the token, the whole system of circulation of the exchange medium starts to collapse, as the users begin to withdraw tokens from circulation for thesaurisation (storing) or utilisation as a material for further processing. An exchange system dependent on a token whose price of material for various reasons achieves or exceeds the value of the token made of this material thus cannot effectively work (Innes 2004, 17–18; Graeber 2011, 340–341; see also Heymans 2018, 87–88, 98–100). For axe-shaped bars to be able to be integrated as tokens into the commercial economy, therefore, their given price must be higher than the price of the usable iron of which they are formed.

It is precisely this crucial limitation of the circulation of tokens that opens possibilities for further research of the economic role of axe-shaped currency bars using experimental archaeology. As we attempt to illustrate in the text below, the assumption that axe-shaped bars can remain in circulation as tokens of general-purpose money is verifiable by experiment. The tested hypothesis is that the value of iron that comprises the axe-shaped bar is significantly reduced by the processing into the final product; in other words, that only a part of the material is feasibly usable when working the bar into the form of another product. Confirmation of the assumption of a considerable loss of iron material proves that axe-shaped bars could have

remained in circulation as a medium of exchange and served as tokens under the (rather probable) assumption that the given value of the bar was equal or higher than the value of the weight of iron of which it was made.

3. Material and methods

For the purposes of testing mentioned above, the axe-shaped bar could be reworked into practically any iron tool. The early medieval axe mentioned in the introduction was chosen for several reasons. A self-evident one lies above all in the similarity of its shape with axe-shaped bars. The description of the axe production process will enable comparison with the technology of the production of axe-shaped currency bars. The axe production will also make it possible to study the question of whether the stylisation of the iron semi-product into an axe form will help in any way with the subsequent processing into a real axe, or whether it rather hinders it (in other words, whether this stylisation has any practical reasons or is purely symbolic).

An axe weighing 300 g found at the Mikulčice-Valy stronghold (Fig. 2: 1)¹ was selected as the original model. Its simple shape can be easily made using basic forging techniques, not requiring any complex production process. For more complex shapes in terms of production, we can presume more sophisticated design including, among other things, a welded-on steel cutting edge or a more complex structure of the eye (Kotowicz 2018, 26; Sankiewicz, Wyrwa 2013, 345). In contrast to that, the replicas presented here were forged in the simplest possible manner, from a single piece of iron and without welding on other parts, analogically to method 1 after P. Kotowicz (Kotowicz 2018, 26, Fig. 5.1).

The experimental production was carried out in two stages. Within the first (replica No. 1), the axe was made from the remaining part of a non-carburised iron bloom that had been used for a larger part during the experimental forging of replicas of axe-shaped bars. This stage concentrated above all on the verification and specification of the details of the presumed axe production process. The time needed and the overall loss of material were followed in detail while working the iron bloom into the form of the final tool. The other axe (replica No. 2) was made by a similar process, but the material for its forging came from re-working an axe-shaped bar replica acquired earlier (see details below). The objective of this crucial part of the experiment was to examine above all the possibilities and conditions of the usability of an axe-shaped bar as a semi-finished product and to describe in more detail the limits of such use – primarily the further loss of material but also the time costs and the fuel consumption.

3.1 Production of replica No. 1 (from iron bloom)

The material for the production of the first replica was a non-carburised iron bloom weighing 1.534 kg (Fig. 3: 1). It had been made by experimental smelting of Olomučany ore in a replica of a Great Moravian furnace (see Hlavica et al. 2020, 16-17). In the first stage, it was necessary to spread out this part of the bloom into a prismatic shape. This rather laborious process, during which the iron was forged all the way into a condition in which it showed virtually no surface cracks,² took about 2 hours and 30 minutes and consumed about 9 kg of charcoal. This processing created a semi-product of a square section with a side length of 2.3 cm and an overall bar length of 28 cm (Fig. 3: 2). The oxidation during the processing, which manifested itself by scaling, reduced the weight of the semi-product by 442 g, which corresponds to a weight loss of the original iron bloom of about 29%.

The most demanding task in the production, the punching of the axe's eye, followed in the subsequent stage. Like in the production of a type I axe-shaped bar replica (Hlavica et al. 2020, 19, 21), a punch with a lenticular section (Fig. 3: 3) was used for the operation, which comes with a high risk of a rupture and damage to the semi-product. The preparation for the punching (heating and preliminary modifications) and the subsequent punching took 30 minutes. The insufficient quality of bloomery iron manifested itself in this stage, however, as the punched eye



Fig. 2. 1 – The original Great Moravian bearded axe from the Mikulčice archaeological record, Inv. No. 594-94/61; 2 – replica No. 1 after the final adjustments; 3 – replica No. 2 after the final adjustments. Photo by P. Bárta.

Obr. 2. 1 – Originál velkomoravské sekery bradatice z nálezového fondu v Mikulčicích, inv. č. 594-94/61; 2 – replika č. 1 po finálních úpravách; 3 – replika č. 2 po finálních úpravách. Foto P. Bárta.



Fig. 3. 1 – A quarter of a non-carburised iron bloom used in the production of replica No. 1; 2 – prismatic semi-product with a square section, the result of the working of the iron bloom, used further in the forging of replica No. 1; 3 – punching the axe eye using a punch with a lenticular section. Photo by K. Suchánková.

Obr. 3. 1 – Čtvrtina lupy svářkového železa využitá při produkci repliky č. 1; 2 – hranolový polotovár čtvercového průřezu obdrženy zpracováním železné lupy a dále využitý při kování repliky č. 1; 3 – probíjení oka sekery s využitím průbojníku čočkovitého průřezu. Foto K. Suchánková.

cracked during its spreading by a round punch. The spoiled part of the bar had to be cut off and the whole eye punching operation repeated. The next punching, which took about 30 minutes again, was successful. The subsequent step after the spreading of the eye (Fig. 4: 1) was the narrowing of the poll and of the part between the axe eye and the cutting edge using a semi-circular anvil stake and a corresponding hammer (Fig. 4: 2). Shaping into the required form took about 10 minutes. It was followed by cutting off the excess part of the prism and forging the cutting edge (Fig. 4: 3), which required 20 minutes.

The spreading of the side lugs turned out to be the technologically most demanding operation. It was carried out using a beak iron anvil (Fig. 4: 4) and required 20 minutes. In this stage, however, it turned out that the height of the lugs quite identical to the original could not be achieved. Due to unsuitable initial dimensions of the prismatic bar, the width of the spread edge of the axe eye did not contain enough iron material. This stage of the working thus helped specify the further production process. In order to successfully pull out the lugs, it is necessary to ensure enough material by forming the prismatic semi-product into a rectangular section and subsequent punching on the shorter side, i.e. through the longer side (this presumption was verified later when making replica No. 2).

The final step was adjusting the poll by beating it into the required shape and several more minor shape adjustments. These took about 10 minutes. The overall weight of the axe and the remaining waste (cut-off parts) in this stage amounted to 987 g; the loss thus increased by another 105 g, about 10% of the weight of the prismatic semi-product or 7% of the weight of the original part of the iron bloom. The overall charcoal consumption amounted to another 9 kg.

The simplest possible method of refining the cutting edge, which can be expected in early medieval axes, was chosen. It consisted of local carburisation (i.e. cementation) by the diffusion of carbon atoms into the metal crystal lattice comprised of iron atoms. Since the beginnings of archaeometallurgy, this method has been considered an important historical iron refining process (Pleiner 1962, 207–209), even though details of its practical realisation have not been completely explored yet. It is certain, nonetheless, that the present-day cementation process – long-term (8–12 hours) heating of the object in a closed vessel together with a cementation agent to a temperature of about 850°C – is infeasible in early medieval conditions, especially for larger objects. As diffusion in metals has another important parameter besides the concentration and time, the temperature (see Pavlík 2013, 16), its increase can considerably shorten the time of cementation, albeit at the cost of coarser grains of the matrix.

The trial cementation of the cutting edges of the replicas was carried out using a wet-applied mixture containing charcoal dust and loess loam in an about 3 : 1 ratio (Fig. 5: 1). The axe was then heated to a temperature of about 1,200°C (white colour of the flame) in the forge and then partially covered with glowing charcoal under a gradual decrease in the temperature to 900°C (orange colour of the flame). The edge remained in the forge for about 15 minutes. Nevertheless, a spark test on a rotary grindstone (Fig. 5: 2), which should have verified the successful carburisation of the edge, showed that the edge was carburised only partially and unevenly. This technique in its present form has thus turned out to be only partially successful. For greater efficiency, however, the rapid cementation process described above will need to be further examined. The fuel consumption during this stage of edge treatment was negligible (about 1–2 kg).

The closing stage of the production consisted of minor final adjustments, especially sharpening the cutting edge or filing the uneven parts with a file. The overall weight of the finished axe (Fig. 2: 2) after the final adjustments was 424 g, 124 g more compared to the original conserved artefact. Although the original model for the replica might have lost part of its weight through corrosion processes and/or conservation, a visual comparison of the two objects showed that despite the effort to imitate the proportions of the original, the replica has a somewhat more massive shape, most visibly in the narrowed part between the axe eye and the cutting edge. Another significant difference from the original was the above-mentioned less pulled out lugs, the consequence of the unsuitable type of the original prismatic bar.

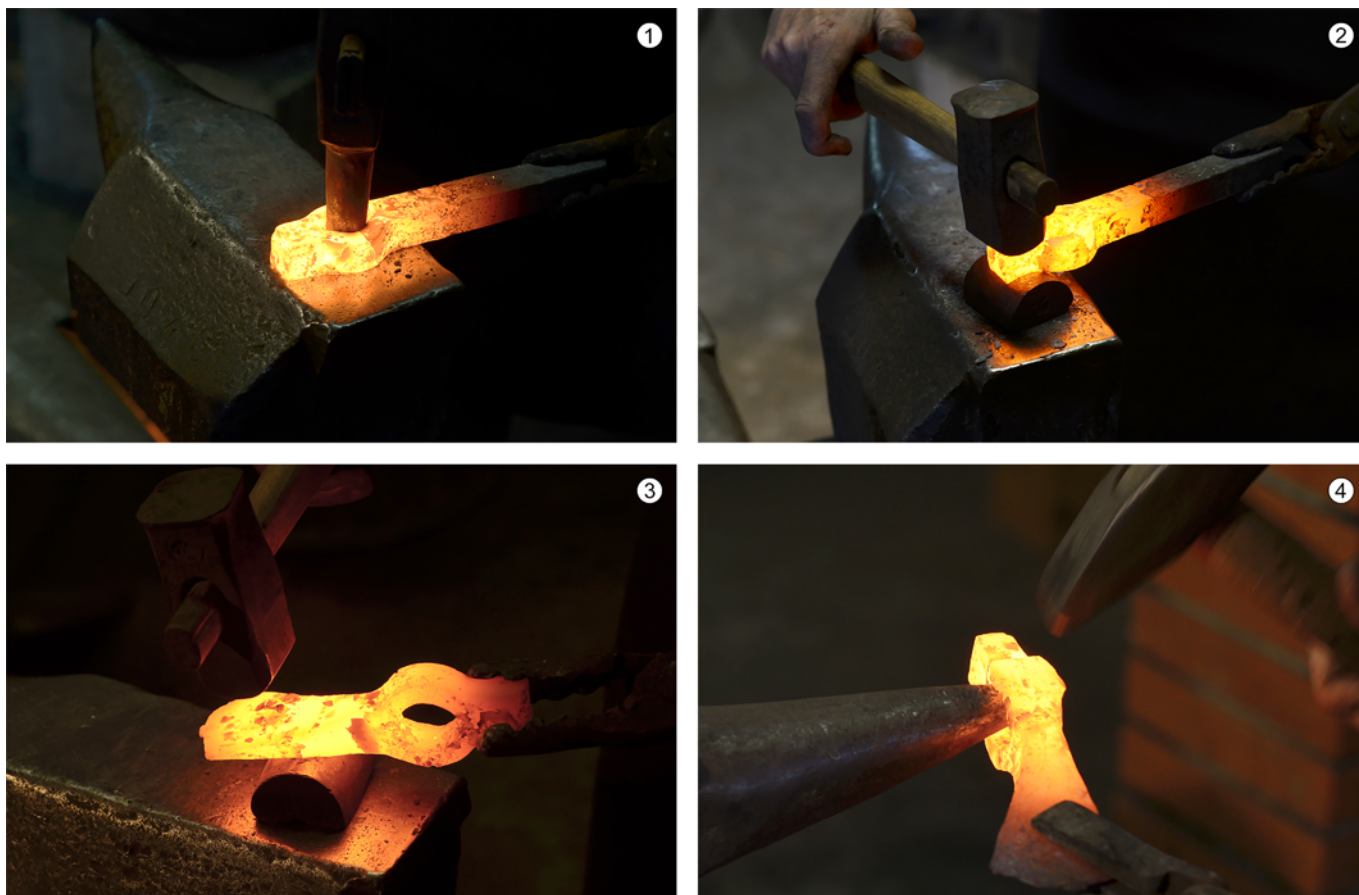


Fig. 4. 1 – Axe eye spreading using a round punch; 2 – narrowing the poll section of the axe using a semi-circular anvil stake and a corresponding hammer; 3 – forging the axe’s cutting edge; 4 – spreading out the lugs along the sides of the punched eye. Photo by K. Suchánková.

Obr. 4. 1 – Roztahování oka sekery prostřednictvím kulatého průbojníku; 2 – prosazování týlové části sekery s využitím půlkruhové babky a odpovídajícího kladiva; 3 – kování břitu sekery; 4 – rozkovávání křidélek po stranách probitého oka. Foto K. Suchánková.



The overall time costs of the production of replica No. 1 (excluding the unsuccessful punching) thus amounted to 3 hours and 40 minutes. Including the attempt at cementing the edge and the final adjustments, we can round the time needed to make an axe from an already cut-off part of the bloom to about four hours. The overall consumption of fuel in the form of charcoal was a little below 20 kg, and the overall loss of material from the bloom during the forging was just below 36% (547 g out of the original weight of the bloom, which was 1.534 kg). Together with the final surface finish of the axe, we can estimate the overall loss of iron to about 36.5% of the weight of the used part of the iron bloom.³

Fig. 5. 1 – The cutting edge covered with the cementing mixture; 2 – spark test on a rotary grindstone indicating how successful the carburisation of the edge was. Photo by M. Hlavica.

Obr. 5. 1 – Ostří pokryté cementační směsí; 2 – jiskrová zkouška na rotačním brusku ukazující na úspěšnost nahlíčení ostří. Foto M. Hlavica.

3.2 Production of replica No. 2 (from an axe-shaped bar)

The experience from the forging of replica No. 1 was used in the second part of the experiment whose objective was to verify the conditions under which an axe-shaped bar can be used as a semi-finished product for the forging of iron artefacts. The largest of the axe-shaped bar (weight of 794 g, length of 44 cm) made within a previous archaeological experiment (see Hlavica et al. 2020, 21, Fig. 12: I) was used as material in the production of the second axe. Although the weight of the model axe rather approached replicas of an axe-shaped bar of medium length (about 30 cm and a weight of 321–392 g, see Hlavica et al. 2020, Tab. 1), the largest bar was chosen above all due to the presumed loss of iron material especially during the reverse working into a prismatic semi-product. The experience with the production of replica No. 1 clearly showed that even the simple axe cannot be produced from an axe-shaped bar in any other way than by its re-forming into the original prismatic semi-product. The selection of the largest axe-shaped bar ensured a sufficient reserve of iron material and thus the successful completion of the whole production process. This subsequently made it possible to assess the loss of iron material during the transformation of the axe-shaped bar into a tool in the form of an axe.

The first steps in the faggoting of the axe-shaped bar replica included the removal of the bar's eye, forging the stylised "cutting-edge" down (Fig. 6: 1) and its subsequent spreading



Fig. 6. 1 – Forging down the axe-shaped bar stylized "cutting edge"; 2 – the axe-shaped bar reformed into the shape of a rod of an uneven thickness. Photo by K. Suchánková.

Obř. 6. 1 – Skovávání listu sekerovité hřivny; 2 – sekerovitá hřivna překovaná do podoby prutu nerovnoměrné tloušťky. Foto K. Suchánková.

out into a rod shape. This process took about 20 minutes and increased the length of the semi-product to 53 cm. Due to the original shape of the axe-shaped bar, the rod had uneven thickness in different parts (Fig. 6: 2). The semi-product processed in this way was subsequently divided into six equally long segments that were faggoted by bending the individual parts, gradually putting them together and welding them in the forge (Fig. 7: 1). Four segments were faggoted at the first attempt during this manually exacting process. The remaining two fell off the main iron mass due to the presence of transverse cracks in the rod. The pieces that had fallen off had to be welded together and, in the next step, welded onto the rest of the faggoted iron mass (Fig. 7: 2). The whole faggoting process took 1 hour and 20 minutes. After successful welding, the faggot was reformed into a prismatic semi-product. In view of the knowledge gained while making replica No. 1, the prism was not shaped into a square but rather into a rectangular section with sides of 21 and 25 mm (Fig. 7: 3). The use of a rectangular rod was supposed to secure more iron material along the sides of the punched eye of the axe and thus facilitate the process of pulling out the characteristic lugs. The production of this final semi-product took about 15 minutes.

The subsequent punching of the axe eye took place on the shorter side (i.e. through the faggoted segments). The eye was then, once again, spread using a round punch. This was the moment when one of the few advantages of the demanding re-forging of the axe-shaped bar into a prismatic semi-product manifested itself. Due to intensive forging and, therefore, higher quality of the worked iron, the material proved to be less prone to cracking. The axe eye was punched through in a single attempt and the spreading of the eye was also free of major complications or cracks. This stage of the production took about 20 minutes altogether.

The rest of the production process was identical with the forging of replica No. 1. The parts in front of and behind the axe eye were narrowed using a semi-circular anvil stake and hammer, an operation that took about 10 minutes. The spreading out of the lugs took somewhat longer, preceded by the welding of smaller cracks in the axe body (c. 35 minutes altogether). The more suitable shape of the original prismatic semi-product made the pulling of the side lugs much easier, and the resulting height was much closer to the original model than in replica No. 1.

The excess part of the prism was then cut off (5 minutes), the remaining cracks welded, and the cutting edge forged (25 minutes). The additional adjustments of the poll and the eye took about 15 minutes. Like in the previous case and with identical time costs, the cutting edge was cemented using the mixture described above. A spark test on a rotary grindstone showed a similar result to the previous case – uneven carburisation of the cutting edge.

Like in the case of the axe production from an iron bloom, the overall time costs of the production of replica No. 2 (Fig. 2: 3) from an axe-shaped bar including the carburisation of the edge reached about 4 hours. The overall charcoal consumption was considerably lower, only about 9 kg. The weight of the forged axe and the remaining scrap iron was 522 g, which means that over 34% of the weight of the bar (272 g out of the original weight of 794 g) was lost purely during the forging alone. After the final surface finish (cutting edge sharpening and smoothing of other edges), the final weight of replica No. 2 settled on 394 g (these finishing adjustments took away another about 12 g, i.e. 3% of the weight of the forged axe and 1.5% of the weight of the bar). Including this step, the overall loss of iron during the production thus reached 35.5% of the weight of the used bar.



Fig. 7. 1 – Faggoting the rod using forge welding; 2 – welding on the fallen-off parts of the faggot using disodium tetraborate octahydrate (borax); 3 – final prismatic semi-product of a rectangular section with visible traces of faggoting in the form of surface lines. Photo by K. Suchánková.

Obr. 7. 1 – Paketování prutu s využitím kovářského svařování; 2 – přivařování odpadlých částí paketu s využitím oktahydrátu tetraboritanu sodného (boraxu); 3 – finální hranolový polotovár obdélníkového průřezu s patrnými stopami po paketování v podobě povrchových rýh. Foto K. Suchánková.

4. Results

A comparison of both production processes showed that the use of an axe-shaped bar as a semi-finished product brings considerable additional costs especially in terms of material. The loss of the iron material in the production of replica No. 1 (weighing 437 g) from an iron bloom was (excluding the final surface finish) 36% (547 g out of the original weight of 1.534 kg). A similar procedure of working an axe-shaped bar into replica No. 2 (weighing 406 g) also suffered from a considerable loss;

it amounted to c. 34% excluding the additional surface finish (272 g out of the original weight of 794 g). To this loss, however, we need to add the loss of iron during the production of the axe-shaped bar. Based on a reverse calculation,⁴ it might have amounted to as much as 624 g out of the original weight of the used part of the bloom with an original weight of c. 1.417 kg. This means that the total loss throughout the production, from working the iron bloom into the form of an axe-shaped bar to faggoting the bar and forging the axe, might have reached as much as 896 g (272 g + 624 g; the 116 g of remaining scrap iron is not included in the loss), which amounts to approximately 63% in relation to the assumed original weight of the source part of the bloom. The difference in iron loss between the direct production of an axe from an iron bloom and the production from an axe-shaped bar is thus about 27% against the bar. The situation is similar as regards time costs. The time costs of the production replica No. 1 are approximately 4 hours, similar to the processing of replica No. 2. If we take into account the time for the production of the axe-shaped bar (see Hlavica et al. 2020, Tab. 1), however, the resulting time is about 7 hours and 30 minutes. Charcoal consumption reached 20 kg in the production of replica No. 1 and c. 9 kg in the production of replica No. 2. Including the consumption in the production of the axe-shaped bar, we reach the value of 19 kg of charcoal.

5. Discussion

It turns out, therefore, that the insertion of another intermediate product in the form of an axe-shaped bar into the production chain lacks any greater practical justification, not even for a smith who can externalise the costs of its production (i.e. if the costs of working the axe-shaped bar into the final product is the only part counted). Only two benefits have been discovered in this hypothetical case: lower fuel consumption, as the bar itself need not be heated so intensively thanks to its narrower profile, and a somewhat higher quality of the iron due to intensive forging during the faggoting of the bar. However, one of the few ways, if not the only one, of externalising the costs of the bar production is receiving it free of expenses (as a gift).

The assumption of the circulation of axe-shaped bar as subjects of social (non-market) exchange or mutual gifts is not completely unfeasible. This type of transaction is characteristic of primitive money or, using a more recent term, social currencies. These circulate above all in pre-monetary economies and are designed for specific socially conditioned payments, especially payments enabling the establishment, consolidation, or correction of social relations between individuals, kins, or communities (Graeber 2011, 130; Herbert 1993, 112–114; Grierson 1977, 19–29). In a certain phase of the Early Middle Ages, the use of social currency can be most likely imagined also in Moravia, where representatives of the individual kins might have realized social payments using the axe-shaped currency. However, a necessary precondition for this is that at least some of these kins would have been able already at that time to organise iron mining and processing, the production of axe-shaped bar and, subsequently, to at least partially control their circulation (see also Guyer 1986, 580). By this symbolic exchange of axe-shaped bars, the individual kins might have formed alliances (e.g. through marriages), consolidate them or resolve mutual disputes. Quite hypothetically, the received stocks of iron currency might have been then delegated to specialised smiths in the centres, who would have worked within attached production (see Costin 2005, 1070–1071) and might have been withdrawing the currency from circulation for their patrons for the purposes of practical use.

This notion is faced with a fundamental problem, however. Even in this “ideal” context of the “human economy” (see Graeber 2011, 207–208) these currencies are seldom utilised as semi-finished products. The reasons include not only the difficult transformation described above, which brings little benefits compared to the production from an original semi-product (iron bloom), but also the loss of their symbolic value. These social currencies were, therefore, perceived as a potential source of material only under exceptional circumstances (such as a critical lack of material). Ethnology even knows cases when they were simply thrown away instead of utilising after their symbolic function had vanished (Guyer 1986, 589; cf. Pleiner 1961, 436).

The issues related to the social currency lead to a consideration of the axe-shaped bars’ conspicuous shape similarity to contemporary axes. A way to finding an answer to the question of the shape specifics of the axe-shaped bars lies in a reconstruction of the development of this currency in time. A characteristic feature of metal social currencies is that they often have the form of real utilitarian tools. It seems that in some contexts, due to increased demand for them and the necessity of their production in larger quantities, they degrade into the form of stylised semi-products (e.g. Herbert 1993, 113; Einzig 1966, 110; Dalton 1965, 50; Peng 1994, xxiii–xxiv; Wang 1951, 90–100, 144–156). As illustrated by a comparison of the costs of the experimental production of the axe-shaped bars (see Hlavica et al. 2020, Tab. 1) and real axes (see above), the replacement of the originally circulating tools by stylised semi-products brings about significant savings in both time and material. These increase further with the gradual reduction of the size of these stylised shapes (e.g. Scheidel 2009, 139), which might have been the result of the lack of or increasing value of the used material due to increased demand for products from it.

We can transfer this general presumption of the development of social currencies also to Moravian axe-shaped currency bars and ponder their genesis and the transformation of their role in early medieval society. If we look at the issues related to their emergence from this diachronic perspective, it turns out that real axes might have been the primeval Moravian social currency (primitive money). The former role of axes in socially determined payments can be also implied by the relatively recently living habit of symbolically recording debts by making notches with an axe. After all, its relict in the form of the phrase “*máš u mě sekyru*” (you have an axe with me), which is an equivalent to the phrase “you owe me”, has persisted even in the modern contemporary Czech language (Machek 1956, 251–252).

With the commencement of the Great Moravian period, these initially non-commercial, socially determined transactions might have considerably intensified due to the rapid socio-political transformation. It created an increased demand for the social currency, which had to be produced in greater quantities. This could result in the replacement of originally used axes by the production of less costly stylised semi-products that might have gradually divert further and further from the original model and technology of production. This assumption corresponds rather well with the current generally accepted typology of the bars (Fig. 1), in which this diversion from the original model would have been reflected in the design of the punched eye. From the most complex type I characterised by the presence of side lugs pulled out in a complicated way, the technology gradually simplified to type II with a mere symbolic hint of the lugs and type III, which is simply punched without any additional adjustments. The end of the last type IV was not even designed by punching but by the technically least complicated method – bending

(also see Hlavica et al. 2020, 19–20, Fig. 6). This typological sequence may, therefore, hypothetically also illustrate the chronological sequence, the gradual simplification of the production of the bars in time (from the most complex to the simplest in terms of the production). The fact that these individual types of bars probably circulated in parallel (Hájník 2019, 139) would indicate that the bars remained in circulation relatively long without being withdrawn on a mass scale to be processed as material. Even in this context, therefore, the recycling of the bars would not have been a systemic matter but rather a phenomenon determined by special circumstances.

Current knowledge shows, however, that the role of the social currency may change as the “human economy” meets a commercial one. These currencies can then be integrated into ordinary market transactions, becoming a medium of market exchange in their context (Graeber 2011, 150, 220). While the characterisation of the precise background and extent of the transition of Great Moravian society from a “human economy” to a commercial economy is beyond the scope of this work, it turns out that axe-shaped bars might have gone through this transformation of their function. A code of law called *Zakon sudnyj ljudem* (Court Law for the People), inspired by the Byzantine Ecloga, was most probably in effect in at least a part of Great Moravia’s territory. This code enumerates penalties for various transgressions by payments in a unit called *stljaz* (Vašica 1971, 182, 185, 191). *Stljaz* is a term that does not occur in the Greek original; evidently, it replaces the Byzantine solidus, which was not available in the early medieval Moravia. The code even records the exchange equivalence of the *stljaz* to a pound of gold, and thus indirectly also to the Byzantine solidus (Kučerovská 1989, 77). This indicates that a monetary unit of account was already known in Great Moravia. Due to the absence of Byzantine solidi in circulation, however, it was replaced by a local equivalent whose name is etymologically related to axe strokes or notches (see Hájník 2019, 123). This equivalent might have originally had the form of making classical notches or scores that are characteristic of tallies, for instance (Burian 1959; Machek 1956, 251–252; Henkelman, Folmer 2016, 143–150). A problem of this type of classical credit systems is, of course, that they usually work only in non-anonymised transactions, i.e. between people who know each other relatively well and have mutual confidence in the repayment of the debt recorded in such a manner. In more anonymised transactions that already lack guaranty in the form of stronger social bonds among their actors, the time comes for credit tokens. Their issue, circulation and the value of credit inserted in them (i.e. their exchange value expressed in a monetary unit of account or in a weight of precious metal) and the lacking “community” guaranty are replaced by a guaranty from the local or central economic and political authority (Graeber 2011, 219–220, 225; see also Henry 2004, 93–94; Hart 1986, 638, 650). The experimental processing described above proved that axe-shaped bars might have played the role of credit tokens, because even in the case of commercialisation of the economy, in view of the relatively high loss of iron during the forging operations, it would not have been advantageous to withdraw the bars from circulation as a commodity and recycle them into utilitarian tools or militaria. And if so, then only under very specific conditions within which the real value of the iron from which axe-shaped bar consisted would considerably exceed the value associated with this token.

The presumed transformation of the function of axe-shaped bars as social currency to the function of tokens of general-purpose money would correspond rather well to their characteristic

manifestation in the archaeological record from the early medieval Moravia, above all the evidence of their circulation within some of the most important Great Moravian centres, namely Pohansko near Břeclav and Mikulčice (Vidlák 2018, 70–74; Poláček 2007, Fig. 12). This would indicate that at least the core of the Great Moravian territory was already confronted with more anonymised market interactions, a fact that resulted in the need to support the traditional credit system with the integration of credit tokens issued by the local authority, most probably by the Moymirid ruler. He would likewise have guaranteed the particular exchange value of the axe-shaped bars by establishing an exchange equivalence to another crucial commodity or monetary unit that was codified in the period legal code (*Zakon sudnyj ljudem*). This codification was crucial for the adoption of general-purpose money in everyday transactions because it clearly set the value of the iron token representing *stijaz* in the weight of gold. Through it, this token could be then compared to the value of the Byzantine solidus and thus probably also to other goods, especially imported ones (see also Graeber 2011, 60–62). The central power authority also defined the above-mentioned penalties, most probably along with other fees, in this token, which maintained the demand for them and ensured their convertibility.

However rural communities, where the axe-shaped bars occur in relatively small numbers (Hlavica, Procházka 2020a, Fig. 35, 36), most probably functioned differently from the world of the Moymirid centres. Due to the lower level of individual anonymization, there would have still prevailed a non-commercialised system of neighbourly gift-giving and mutual aid, or of exchange based on mutual obligations (Graeber 2011, 104–105, 327–329). There, like in the less commercialised or non-commercialised periphery areas of the presumed Great Moravian market system (see Hlavica, Procházka 2020b), axe-shaped bars might still have persisted in the role of a social currency. The two economic worlds – the world of “human economy” and the commercial one – thus might have coexisted and pervaded one another in the Great Moravian period, while axe-shaped bars would have played a specific role in either of them.

Conclusion

The presented text aims to use an archaeological experiment to investigate issues related to the social and economic role of axe-shaped bars and its transformations in time. By forging two axe replicas modelled on an axe of a simpler shape found within the Great Moravian centre in Mikulčice, we have described the process of production of an axe from two types of semi-finished products: a non-carburised iron bloom and an axe-shaped bar that had been made of the same bloomery iron within a previously published archaeological experiment.

The quantification of the costs of production in the form of the loss of iron material, time and fuel has made it possible to compare the efficiency of forging the axe from both semi-products and thus ponder the question of the conditions and manner within which an axe-shaped bar can be used as a semi-finished product for further processing. The recorded results have proved that the use of the axed-shaped bars as semi-products was much more loss-making as compared to the production from iron blooms, especially in terms of material. The only benefits are fuel saving and a somewhat higher quality of the metal, which was due to intensive forging during the reverse faggoting of the bar into a prismatic semi-product.

Making use of the discovered findings, the following discussion has attempted to consider the social and economic role of axe-shaped bars in Great Moravian society. It showed that the

bars might have long circulated as credit tokens representing a monetary unit, whose original tokens were not available in Great Moravia, although this specific form of axe-shaped iron token had probably originally served as a pre-monetary social currency (or primitive money). The experimental processing has also shown that the shape affinity between the axe-shaped bars and the axes has no practical substantiation in the production process. Most likely, it refers to an earlier stage of social exchange in which real iron axes might have played a specific part. So far, however, only data from the most important central places of Great Moravia indicate this presumed shift from the role of a pre-commercial currency to tokens of general-purpose money. A commercial economy might have started to gradually develop there. However, this shift of the economic role of axe-shaped bars might not have been perceptible yet in rural and peripheral areas of Great Moravia. This means that two parallel, mutually permeating social and economic worlds, the world of the “human economy” and of the commercial economy, might have existed in the context of Great Moravia, with axe-shaped bars possibly playing their specific role in each of them.

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Notes

- 1 The original artefact is deposited in the depository of the Institute of Archaeology of the Czech Academy of Sciences, Brno, under ID No. 594-94/61.
- 2 The cracks were continuously welded with the use of borax (disodium tetraborate octahydrate) as the flux and subsequently removed by forging. While smelting agents were undoubtedly used in early medieval forging, it is not quite clear yet what fluxes the contemporary smiths actually used.
- 3 The information about the original weight of the replica before the final surface finish are missing in the records of the experiment (the axe was only weighed together with the scrap metal; it was not weighed separately until after the surface finish). In view of the more detailed records of the forging of replica No. 2, however, we can estimate that the loss after the final surface adjustments was about 3% of the weight of the raw forged piece; this means that replica No. 1 without surface finish weighed about 437 g (i.e. 13 g more). The overall loss of iron including the loss from the surface finish would thus amount to about 560 g from the weight of the original bloom, or about 36.5% (the weight of the raw forged piece and the remaining waste would amount to 974 g).
- 4 The total loss of iron during the experimental forging of the iron ingot replicas (with a total weight of 2.213 kg; more precisely, 1.953 kg of the weight of the products and 260 g of scrap iron) amounted to 44% for all the replicas, i.e. 1.731 kg out of the original parts of the iron bloom with an overall weight of 3.944 kg (Hlavica et al. 2020, 25). If we divide this loss proportionally among the individual bars based on their weight, we can estimate the loss of iron incurred during the production of the used type I bar weighing 794 g (with a weight ratio of 36% of the overall weight of all the products and the waste) at c. 623 g. The overall weight of the used part of the iron bloom would thus have amounted to 1.417 kg.

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Resumé

Cílem předloženého textu bylo prezentovat možnosti využití archeologického experimentu k řešení otázek spjatých se společenskou a ekonomickou rolí sekerovitých hřiven a její proměnou v čas. Prostřednictvím kování dvou replik seker (obr. 2: 2, 3), jejichž předlohou byla sekera jednoduššího tvaru nalezená v kontextu velkomoravského centra v Mikulčicích (obr. 2: 1), byl popsán proces výroby sekery ze dvou typů polotovarů – ze železné lupy svářkového železa (obr. 3, 4) a z jedné ze sekerovitých hřiven (obr. 6, 7), která byla ze svářkového železa vyrobena v rámci dříve publikovaného archeologického experimentu (Hlavica et al. 2020).

Kvantifikace nákladů na výrobu v podobě úbytku železné suroviny, času a paliva umožnila porovnat efektivitu kování sekery z obou polotovarů a následně se zamyslet i nad otázkou, za jakých podmínek a jakým způsobem je možno sekerovitou hřivnu využít jako polotovar pro další zpracování. Zaznamenané výsledky prokázaly, že využívání hřiven jako polotovarů bylo oproti výrobě z lup mnohem nákladnější, především co se týče ztracené suroviny. Mezi benefity můžeme řadit jen úsporu paliva a o něco lepší kvalitu kovu, jež byla důsledkem prokovávání v rámci zpětného paketování hřivny do formy hranolového polotovaru.

Využití zjištěných poznatků v následné diskuzi vedlo k zamýšlení nad společenskou a ekonomickou rolí sekerovitých hřiven ve velkomoravské společnosti. Ukazuje se, že hřivny mohly dlouhodobě cirkulovat jako tokeny reprezentující monetární účetní jednotku, jejíž médium nebylo na Velké Moravě fyzicky dostupné. Tato specifická podoba moravských peněz se pak pravděpodobně vyvinula z tzv. společenských platidel, resp.

primitivních peněz (viz také Graeber 2011, 130). Tvarová správnost hřiven se sekerami, jak ukázalo experimentální zpracování, nemá v produkčním procesu žádné praktické opodstatnění, nejspíše tak odkazuje na starší fázi společenské směny, v níž mohly specifickou roli hrát skutečné železné sekery. Na předpokládaný posun od role předkomerčních platidel ke komerčnímu směnnému prostředku však zatím ukazují jen data z jádrových centrálních míst někdejší Velké Moravy (Poláček 2007, Fig. 12; Vidlák 2018, 70–74). Zde se již mohla postupně začít rozvíjet komercializovaná ekonomika. Avšak ve venkovských stejně jako v periferních oblastech Velké Moravy ještě tento posun ekonomické role sekerovitých hřiven nemusel být patrný. V kontextu Velké Moravy tak mohly existovat dva paralelní a vzájemně se prolínající společensko-ekonomické světy, a to komunitní a komercializované ekonomiky. V každém z nich pak mohly mít sekerovité hřivny svoji specifickou roli.

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