

Socio-economic determinants of iron production on Polish lands during antiquity

The phenomenon of metallurgical smelting centres of the Przeworsk culture

Socioekonomické determinanty výroby železa
na polských územích v době římské
Fenomén hutnických center převorské kultury

Szymon Orzechowski

Metallurgical activity of the peoples living in the area known as Germania Magna is characterized by an extensive and ad hoc nature which clearly is different from the centralized Roman production model. In the so-called Barbarian parts of Europe however, there were regions where there was a specialized and identifiably large mass production of iron. On Polish lands three such centres were active – in the Holy Cross Mountains, in West Masovia and in some regions of Silesia. The presence within a single cultural unit of several large metallurgical centres functioning on the basis of different organizational patterns is a unique phenomenon and warrants reflection upon the causes of their creation and the meaning of production for their neighbouring areas. These enormous logistical projects indicate the existence of yet unknown to us interdependent social structures of large work teams in the population, evident over a period of several generations. Their reconstruction can help us understand at least some aspects of the social and economic life on Polish lands towards the end of antiquity.

ancient metallurgy – Przeworsk culture – metallurgical centres – social structures

Hutnická činnost lidí žijících v oblasti známé jako Germania Magna se vyznačuje rozsahem a ad hoc charakterem, který se jasně odlišuje od centralizovaného římského modelu výroby. V tzv. barbarských částech Evropy však existovaly regiony, kde probíhala specializovaná masová výroba železa. Na polských územích působila tři taková centra – ve Svatokřížských horách, v západním Mazovsku a v některých oblastech Slezska. Přítomnost několika velkých metalurgických center v rámci jedné kulturní jednotky, fungujících na základě různých organizačních vzorů, je jevem výjimečným a opravňuje k úvahám o příčinách jejich vzniku a o významu výroby pro sousední oblasti. Tyto obrovské logistické projekty naznačují existenci dosud neznámé vzájemně závislé sociální struktury velkých pracovních týmů po dobu několika generací. Jejich rekonstrukce nám může pomoci pochopit alespoň některé aspekty společenského a ekonomického života na polských územích v době římské.

starověké hutnictví – převorská kultura – metalurgická centra – sociální struktury

Enormous progress that has taken place in archeo-metallurgical research in recent years, has also led to a very worrying phenomenon which is associated with the gradual dehumanization of the discipline. Fascinated with the opportunities offered by natural sciences, we gradually lose sight of man and the complex socio-economic and political processes which created the reality surrounding him, and decided about the development of the field of economy that interests us – metallurgy. The archaeological community has ceased to

understand us, which results in alienating our discipline from the mainstream of archaeology. I do not oppose analytical research and I consider it to be an indispensable element of modern science. We have to remember, however, that devoid of a broader cultural context, our findings can become merely a set of empty technical data.

In the area of the so called European Barbaricum we have encountered two organisation models of iron production. The first is represented by small workshops fulfilling the immediate needs of local communities (Pleiner 2000, 45–47). The other trend in production was realised by specialised metallurgical centres operating to satisfy the demands of external markets. In Poland among those there were the Świętokrzyskie Mountains and Masovia. Despite popular knowledge of those technologies, Silesia represents a rather extensive production model. Only the Brzeg region alludes to the aforementioned regions of specialised metallurgy (fig. 1).

It is generally believed that the skill of iron smelting was commonly known and practised among the Przeworsk culture people. It is to be confirmed by the presence of slag found on a relatively large number of sites of the culture. It should be remembered, however, that the majority of such finds has not been unequivocally defined and assigned to a smelting stage, and it cannot be ruled out that at least some of them were related to the so-called post-reduction phase of the metallurgical process, which comprised activities involving purifying iron and its further processing. An unclear chronological context of a considerable part of those finds could result in manifestations of metallurgical activity from other epochs being included in that group. It is symptomatic that discoveries of bloomery furnaces have become relatively rare, and on many systematically researched sites no traces of any metallurgical activity have been found. More evidence seems to support the idea that metallurgical production in Polish territories was distinctly regionalised. Besides the already mentioned centres of specialised metallurgy, production activity in this respect was conducted in some larger and several smaller clusters, both in the Przeworsk culture area, e.g. in Greater Poland – in the central and upper river basin of the Warta, Prosna and Odra; in Kuyavia – in the valleys of the rivers Zgłowiączka, Bachorza, Noteć and Parchań; in central Poland on the Pilica and Radomka rivers; but also of the Wielbark culture – in the Gniezno Lake District and further north on the River Drwęca, and in Pomerania and Powiśle (fig. 1). It is symptomatic that there are practically no metallurgical sites on the upper Vistula River and in the Lublin region, in the areas of intensive settlement of the Przeworsk and Wielbark cultures (Orzechowski 2013, 271–277). In the west, the clearly outlined metallurgical region in the vicinity of Żary on the Bobr River should be associated with the Luboszyce culture, as it alludes to a larger cluster of that culture in Lower Lusatia (Spazier 1996; 2007). There remain small production complexes associated with the Bogaczewo culture in Masuria and the post-Zarubinty culture on the Narew River.

Because of the character of this study, I will limit it to the general characteristics of the largest metallurgical mass-production regions, taking into account the scale and specificity of the production carried out there. I will also recall elementary data concerning the Przeworsk culture whose people were the creators of those immense production undertakings.

The people of the Przeworsk culture inhabited the area of southern and central Poland between the turn of the 3rd and 2nd century BC and the mid-5th century AD, and belonged to the largest and longest-lasting political systems in the regions. In Roman records they

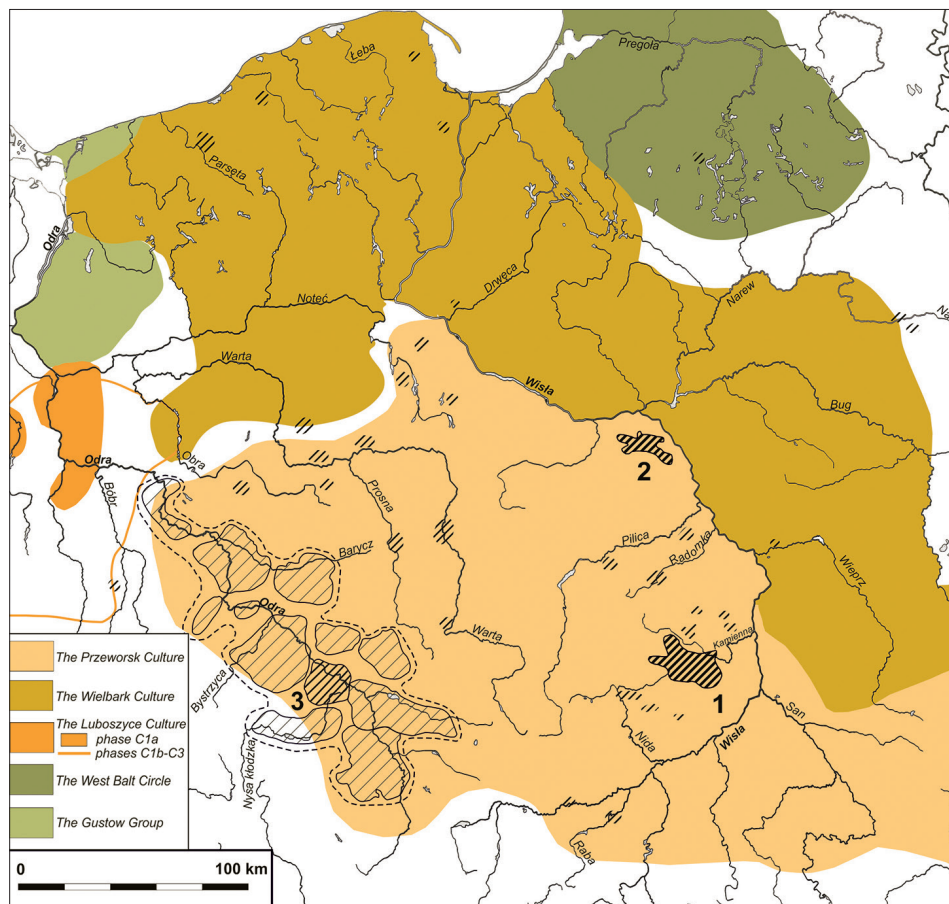


Fig. 1. Bloomery centres (1, 2, 3) and smaller smelting centres (marked with a small hatching) operating in Polish territories within the Przeworsk culture and neighbouring cultural units. 1 – Świętokrzyskie Mountains metallurgic centre and its potential enclaves; 2 – Mazovia centre; 3 – metallurgic regions in Silesia (3 Brzeg area).

Obr. 1. Hlavní (1, 2, 3) i menší hutnická centra působící na polských územích v rámci převorské kultury a sousedních kulturních jednotek. 1 – hutní centrum ve Svatokřížských horách a jeho potenciální enklávy; 2 – Mazovské centrum; 3 – hutní regiony ve Slezsku (oblast 3 Brzeg).

are known as the Lugii (*Lugiorum nomen*), and later they can be at least partially identified with Vandal tribes (see *Andrzejowski 2010*).

Among many original elements of these people's culture, particular attention needs to be paid to their achievements in black metallurgy. Apart from the economic aspect of this production, one can say they had a special preference for iron, which was used for producing not only the indispensable tools and weapon but also some elements of clothing, traditionally made from other metals. Iron fulfilled its basic function in grave furnishings, where its amount implied the symbolic significance of this metal. All the above features led to giving the Przeworsk culture the name of 'the culture of iron' (*Orzechowski 2007a*).

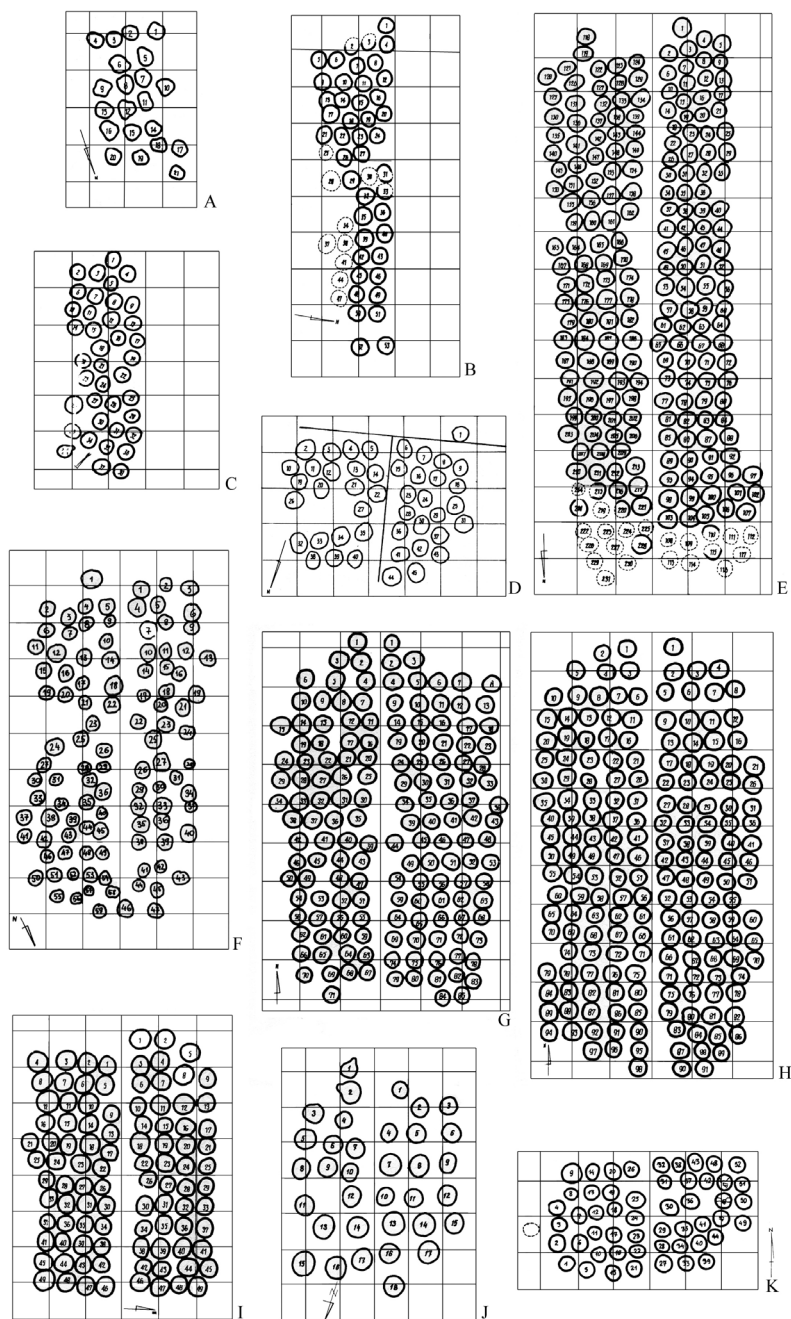


Fig. 2. Plans of various types of organised slag-pit clusters from the Świętokrzyskie Mountains (acc. to Bielenin 1992).

Obr. 2. Plány různých typů organizovaných seskupení zahloubených nístěj ve Svatokřížských horách (podle Bielenin 1992).

It has already been mentioned that besides a few traces of iron smelting in the settlements which satisfied local needs, the Przeworsk culture people organized some huge production centres geared towards producing huge amounts of the material to be exported. The huge smelting centres operating in the Świętokrzyskie Mountains area, in Western Masovia and in Silesia might have fulfilled this function.

The Świętokrzyskie Mountains metallurgical centre undoubtedly holds a special position. Approximately 8,000 metallurgical workshops with over 550,000 furnaces worked in the area of almost 1,000 km². Jointly they could have produced about 11,000 tonnes of iron, and the heyday of its activity was in the mid-2nd century AD (*Bielenin 1992*, 190–197; *Orzechowski 2013*, 245–250). The other large metallurgical region of the Przeworsk culture located in the western Masovia comprised the area of about 300 km². It is estimated that from the 1st to the mid-2nd century AD there worked here between 120 and 150 thousand furnaces which jointly produced about 1400–1800 tonnes of iron (*Woyda 2002*, 123–125).

Each of the above mentioned production regions worked out its own methods of organising labour and production technologies. For the Świętokrzyskie Mountains area, a typical form was so called ‘organised’ bloomery ironwork containing two furnace clusters of almost identical layout, usually located outside the area of permanent settlement (*fig. 2*). In Masovia, on the other hand, there were created enormous production settlements which grouped from a few to several thousand of bloomery furnaces, located on the outskirts of the dwelling area. Frequently, the furnaces here were inexplicably set in ideally straight lines, 200 to 300 metres long (*fig. 3*). In the biggest settlement recognised so far, in Milanówek-Fałęcin, there could have operated up to 15,000 bloomery furnaces.

In turn, in the Brzeg region in Silesia metallurgical workshops created ‘nest’ complexes consisting of several sites, remote from the settlement zone. Most frequently, they included a metallurgical workshop, a forge and less often a settlement serving as a traditional dwelling place. According to *S. Pazda (1994, 168)*, in the 4th and 5th centuries about 130 tonnes of iron were produced here.

It is worth noticing that centres of specialised metallurgy, operating in various regions occupied by the Przeworsk culture people, were present throughout practically the whole period of its existence, for almost six hundred years. At the earliest that trend in production shaped in Masovia where, already towards the end of the younger pre-Roman period (1st century BC), huge settlement-production complexes began to emerge. The apogee of that activity occurred mainly during the Early-Roman period and distinctly slowed down only towards its end. It is surmised that the phenomenon was directly related to the appearance of the Wielbark culture settlements, identified with the Goth migration in eastern Masovia in the mid-2nd century. However, it did not mean a complete abandonment of that activity. It was indeed “moved” outside the settlements and was considerably fragmented, yet on some sites it might have developed even until the beginning of the 4th century (phase C2; *Woyda 2002*, 122, 123, 140).

In the Świętokrzyskie Mountains, the beginnings of organised metallurgy date back to as late as the end of the early-Roman period, though the majority of organised slag-pit clusters functioned mainly in the 2nd and possibly at the beginning of the 3rd century (phases B2 to C1b) Also in this case, after that period the activity did not disappear completely, but might have survived in the form of fragmented manufacture further into the late-Roman period (*Bielenin 1992*, 167–179; *Orzechowski 2007b*, 72–91).

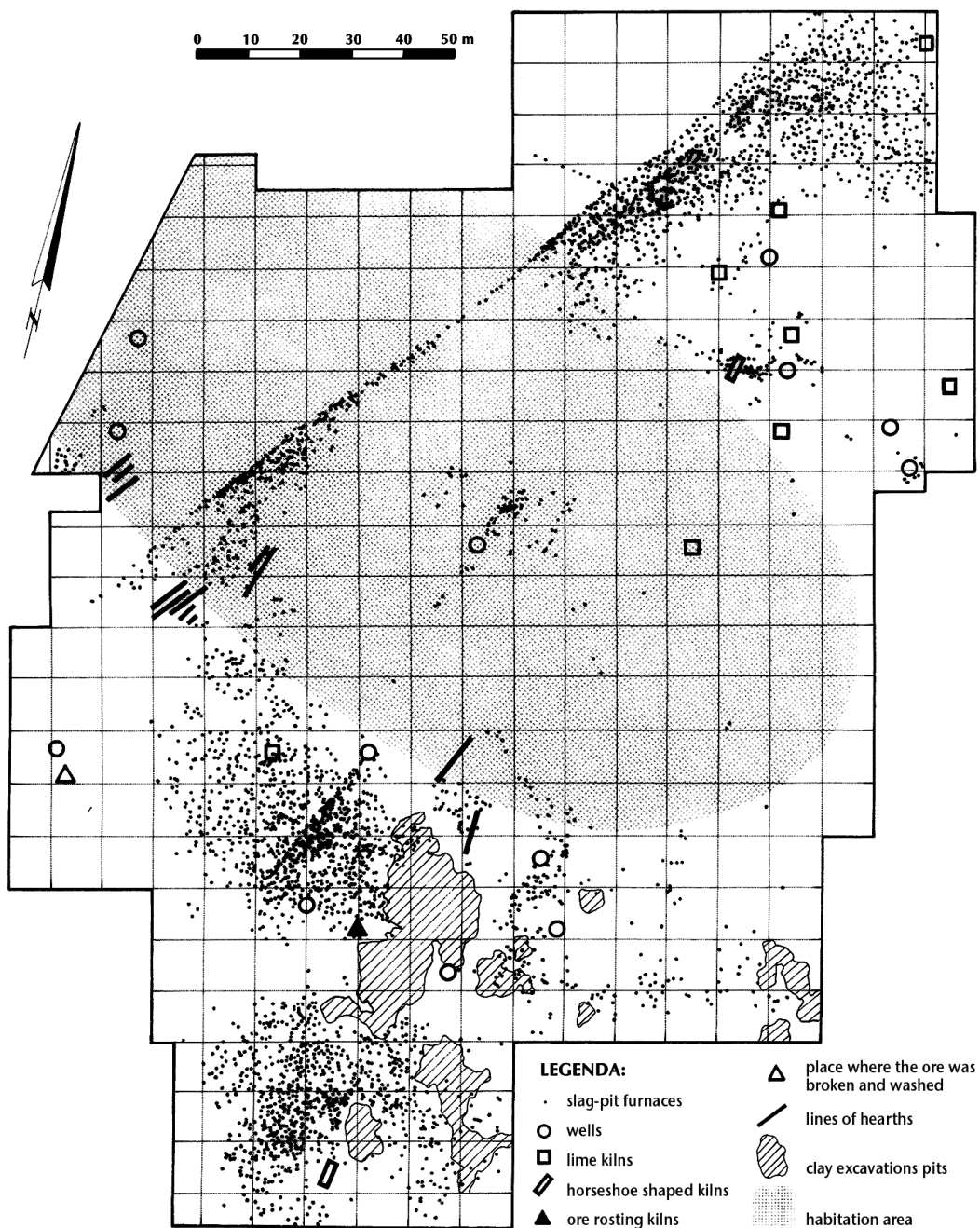


Fig. 3. Plan of the examined section of the settlement in Biskupice with a characteristic borderline along which the furnaces were concentrated (acc. to Woyda 2002).

Obr. 3. Plán zkoumané části sídliště v Biskupicích s charakteristickou hranicí, podél které byly pece koncentrovány (podle Woyda 2002).

Slightly later than the beginnings of mass production in the Świętokrzyskie Mountains region, some metallurgical regions in Silesia also started to operate whose heyday occurred mostly during the younger and Late-Roman period. More than 50 % of all smelting sites in this region are associated with the phase C of the Roman period (mid-2nd – beginning of the 4th c.). The end note of organised production was the so-called Brzeg metallurgic region dating to the phase D (second half of the 4th – mid-5th century; *Madera 2002*, 66, 67).

We do not know, however, whether they were created as a result of single decisions of strategic character, or by evolution – as a result of increased demands for iron needed by developing settlements. In the former case, one would have to assume the existence of a thriving headquarters that would be responsible for it and find a motivation for making such decisions. In the latter, one would have to explain how such specialized forms of team-work organization could have spontaneously emerged in agricultural environments and, what is more, in the domain so remote from pre-industrial economy?

The key to explaining the origin, the principles and the time when mass production functioned is the issue of potential markets for the iron produced here. Indicating consumers for the metallurgical regions in Silesia poses the least problems. One can see here a clear correlation between the settlement development and the increase in metallurgical production. The Brzeg region must have had the largest range of influence, though it worked mainly to satisfy the needs of the Brzeg–Oława settlement region, but might also have supplied lands on the Widawa River, and between the Oława and the Nysa Kłodzka rivers (*Pazda 1994*, 171, 172). Upper Silesia was rather self-sufficient in this respect.

The centre in Masovia, operating mainly during the Early-Roman period, was at the time the only region producing large surplus of the material within the Przeworsk culture area. Among its direct consumers there must have been the neighbouring settlement region on the Bzura River and through it probably also the central-Poland settlement cluster in the vicinity of Łódź (*Skowron 2006*, 26, 162). The presence of early-Przeworsk sites in the Vistula River valley might also indicate close ties between that region and the Sandomierz Upland. One might assume that iron from Masovia stimulated the economic development of the Przeworsk culture in its older stages of development.

Naturally, the intended purpose of the immense production of the Świętokrzyski region excites most controversy. If we assume that the time of functioning of the so-called organised slag-pit clusters where mass production was carried out was relatively short, i.e. was enclosed between the end of the 1st and the beginning of the 3rd century AD, then the issue acquires a completely new dimension.

The idea of the iron export to Roman provinces should naturally be ruled out, but its occurrence within the limes zone (Roman borderland) is more likely. The thesis that increased production in the Świętokrzyskie Mountains might have been related to the Marcomanni wars seems very attractive (*Woyda 1982*, 112–116; *Urbańczyk 1996*, 7; *Bielenin 2002*, 19; *Oleđzki 2008*, 165; *Orzechowski 2013*, 255–256). It seems to be indicated by numerous premises, such as the inflow of Roman imports into metallurgical areas, the chronology of the organized furnace clusters, and the political situation in the Roman borderland zone. Cassius Dio (*Historia Romana LXXI*, 12) mentions an alliance from the year 171 between the Romans and the Cotini who previously traditionally supplied that market with iron. In the year 173 the *foedus* was already broken, and the rebellious Cotini were relocated probably to the south bank of the Danube. It cannot be ruled out that after the end of the

war and the fall of the Cotini in Slovakia, a new ready market opened in this area. It is also possible that even earlier, at the height of the Marcomanni power, some amounts of iron from the Świętokrzyskie Mountains might have arrived there as trade goods or a tribute for that tribal union (compare *Modzelewski 2004*, 438–439).

However, if we assume that the whole of the enormous production was left on the site, then we also have to accept that it must have triggered certain economic processes within the Przeworsk culture itself. After all, ‘pumping’ such large amounts of strategic material into the economy must have affected its development. Perceived at the turn of the early and younger Roman period, acceleration of settlement processes within many regions of the Przeworsk culture, as well as its expansion southwards might have been related to the mass production of iron (compare *Godłowski 1985*, 81–87, 129–131).

Analysing the phenomenon of mass production of iron in the Przeworsk culture, one has to ask the question how economic enterprises, the running of which exceeded the possibilities of individual manufacturers, or even of organisational structures such as family or neighbourly community, might have functioned in the social conditions existing at the time? The political system of the barbarian world towards the end of the antiquity created a multi-stage social structure, defined as segmentary lineage (*Modzelewski 2004*, 349). Besides a family and a territorial-neighbourly community identified with districts known as *pagus* mentioned by Tacitus (*Germania* 6, 12, 39) and Caesar (*Commentarii de bello Gallico* IV, 1; VI, 23), there also existed superior units, namely a tribe *civitas*.

The majority of questions related to everyday functioning of those small communities, such as undertaking economic activities, observing traditions, as well as social order, must have been resolved at the level of those units. A community of a higher order, consisting of many such organisations, namely a tribe *civitas*, operated mostly in the face of a threat of warfare, or when undertaking migration. Social integration within that highest segment was based on a variety of relationships: family ties, neighbourly, ethnic but also on a common tradition and cult. The permanence of such ties must also have been influenced by a form of administrative constraint. Tacitus (*Germania* 7) mentioned limited royal power which can serve as evidence that the binder and executor of obligations were not only privileged individuals.

It is assumed, that at least during the older periods they were egalitarian societies, and the superior authority was limited to the issues of cult and warfare (*Wolfram 1996*, 72; *Kolendo 2008*, 124–125; *Heather 2012*, 70). Who, therefore, made social and political decisions and who enforced obeying certain decisions important for the society? According to some researchers, the assembly served that purpose at the level of neighbourly, but also tribal relations. How could huge metallurgical centres of the Przeworsk culture function in such realities, and how can one explain the stability of economic activities they conducted?

Commodity production of iron in the Przeworsk culture reflects social interrelations, unknown to us nowadays, connected to team work of large groups of people subordinate to the superior idea, and realized for a period of at least a few generations. It is curious, that metallurgic centres were generally located in areas previously undeveloped, with poor settlement traditions, or on the proverbial *cruda radice*. One has to assume, that already at the moment they were established, particular components of the created settlement network were adjusted to realising specific production tasks on the above-regional scale. At the same time, they were in direct vicinity of large settlement clusters.

Activities relating to iron-smelting production were carried out on the considerable area covering – as was the case of the Świętokrzyskie Mountains centre – almost 1,000 km². The metallurgical zones in western Masovia and between the Odra, Oława and Nysa Kłodzka rivers – Brzeg region – were much smaller, yet even they occupied the area of 300 km² each. Though not the whole area had to be excluded from agricultural use, a part of it suffered natural degradation which made it useless for food production. The belief that large areas of ‘no-man’s land’ existed within the already settled areas at the time is more and more frequently challenged. All farmland, including pastures and woods, as well as land lying fallow temporarily belonged to neighbourly communities and access to them must have been restricted (*Modzelewski 2004, 257–259; Rodzińska-Nowak 2012, 117–123*). It seems that locating metallurgical activity in wasteland or zones of dispersed settlement was largely related to the restricted access to ‘free’ plots of land within the already developed zones. Thus the threat already signalled by ancient authors, of conflict between miners, smelters and farmers, caused by pollution of water, soil and air was postponed.

Let us look at the team work phenomenon in metallurgy, which had inevitable consequences for the order and social relations existing at the time. In primitive communities that were generally characterised by an egalitarian structure, aims requiring joint efforts of large groups of people were fairly rare. Apart from defending the shared territory or seizing new lands, it is difficult to find activities – especially of economic character – triggering the need of cooperation on a larger scale. In the region of our interest one can point out only two undertakings that required integrated activities of larger groups of people. The first was associated with ‘servicing’ the Amber Road, the other with production of iron in large metallurgical centres (*Urbańczyk 1996, 4–8*). In a certain way, though on a much smaller scale, sites producing the so-called manufactured ceramics within the Krakow region allude to that model. It was also there that production settlements specialising in mass manufacturing of pottery for sale were established.

In the case of such large logistic enterprises as those encountered while mass-producing iron, there appears the question concerning the principles of its supervision and division of profit. After all, it is generally known that those regions were not exceptionally affluent. In settlements and burial grounds found in the specialised iron-smelting zone one cannot see the wealth of the material produced here. If we observe a certain accumulation of luxurious commodities, they are usually outside the production zone and bear evidence of profits concentrated in the hands of a narrow privileged group. An excellent example here is the valley of the Kamienna River, where large monetary deposits and numerous imported objects were found (*Orzechowski 2000*). In this context it is difficult to agree with the belief stating there was no fully hierarchical society during the first two centuries after Christ, when the largest Przeworsk culture metallurgical centres operated. Another model seems more likely, which assumes that already at the turn of the eras at least some tribal organisations possessed clearly distinguished power structures in the form of the elders, as well as ‘kings’ who did not limit themselves merely to representing and serving a cult (*Heather 2012, 56, 58, 61*). It is confirmed by information documented in the sources, that the Suebian people who arrived in Gaul, but also the Marcomanni, Quadi, or Cherusci were led by rulers with a strong position. If we assume that the model of making decisions important for particular communities was based only on the system of the assembly acclamation, then how can one explain the stability of the discussed economic enterprises realised

throughout the period of several generations and their perfect organisation? Only strong executive authority could guarantee running such large economic undertakings.

Considering those conditions, it is also worth looking closer at the distribution of regions of centralised metallurgy on maps of the Przeworsk settlement. We can see that they were generally located outside the large stabilised settlement clusters (see *Godłowski 1985*, maps 1–6, 9). However, it does not mean that they operated in complete isolation from main settlement regions. The Świętokrzyskie slag-pit clusters from the Łysogóry range area obviously leaned towards the great settlement macro-region in the Sandomierz Upland, while western Masovia must have had various connections with the settlements on the lower and middle Bzura River, and possibly also with the area of eastern Masovia. Similarly the Brzeg region was established between two largest clusters of the Lower and Upper Silesia and, as has been mentioned before, might have served an ancillary part in relation to the Bystrzyca-Oława region regarded as the largest tribal territory in this area.

A close relationship between metallurgical centres and strong territorial organisations was fully justifiable, or even necessary. Considering the then level of agriculture and its low effectiveness, even temporary releasing a part of the population from the duty of acquiring food and transferring them to production tasks in metallurgy, required primarily large demographic reserves and appropriate economic stimuli, but also certain coercive measures. If we accept, after *K. Czarniecka (1990, 115)*, that about 30 % of the population at the time were small children and elderly people who did not participate in the production process, the problem of workforce for that very demanding branch of economy becomes even more acute.

Respecting certain organisation principles by direct producers in such a vast territory during a period of probably a few generations, indicates the existence of stable social and political relations in the mass production regions. Only strong territorial organisations might have legitimised and supervised such activity. Even if we assume, that iron produced by the discussed metallurgical centres was distributed only in the Polish lands, iron trading must have been approved of and protected by above-regional political structures. In the context of the existence of stable roads for trading amber which had to travel even further from its source to its purchaser, such an assumption appears highly likely. In the Przeworsk culture area the freedom of such trade might have been guaranteed by the Marcomanni rulers. The time of its decline partially overlaps abandoning the mass production and its fragmentation, and consequently popularisation of the technologies in the whole area of the Przeworsk culture.

With such a large-scale production, requiring collective efforts of specialists from various fields – such as mining, preparing raw materials, smelting and iron processing – there must have been diverse problems connected to storage, distribution and transport of large amounts of that strategic material. Family institutions, and even neighbourly communities, were too weak to ensure continuity of production with insufficient workforce, or the safety for producers. Considerable food surplus must also have occurred, which allowed teams of smelters and ore miners taking care of production to be, at least temporarily, excluded from farming the land or animal husbandry.

There is much evidence of the long-distance iron trade, and not only in the organised and centralised Roman world (*Straube 1996; Bielenin 1999, 209–212; Serneels 2004, 206–213*). Despite internal political division in pre-Roman Gaul, metallurgical regions of

the Senones, Bituriges-Cubi or the Cenomani supplied iron to even very remote areas where no traces of native metallurgy were found. It was possible thanks to the supervision of the powerful Aedui tribe, who controlled more important trade routes between central and eastern Gaul at the time (*Orzechowski 2007c*, 256, 257). In the Przeworsk culture lands the freedom of such trade might have been guaranteed by the Marcomanni state. The time of its decline partially coincides with abandoning the mass trend in production and its fragmentation and, consequently, popularisation of those technologies on the entire area influenced by the Przeworsk culture.

Finally, it is worth drawing attention to yet another social aspect of conducting production activities on a scale exceeding everyday needs of local communities. It is believed, that iron metallurgy was one of the first crafts to emerge from the trends of natural economy. Specialist and arcane knowledge and technical skills, as well as expensive tools caused it to be an occupation for a specialised professional group. A complicated and multi-stage process of iron production made it necessary to split competence. The size of production carried out within large metallurgical centres finally must have influenced establishing specialised groups of manufacturers providing production workshops with sufficient amounts of raw material, or realizing subsequent stages of the metallurgic process. If we assume that only one large organised slag-pit cluster in the Świętokrzyskie Mountains needed almost 20 tonnes of iron ore, and at least as much of charcoal, and its production capacity might have equalled even 2 tonnes of iron, then we must also assume that the appropriately numerous and prepared staff of ore miners, charcoal burners, smelters and blacksmiths must have been delegated to man it (*Bielenin 1992*, 190–197; 1999, 201–203). Only such organisation of work, based on advanced job specialisation, might have managed such a challenge and ensure continuity of production.

Iron production in the Przeworsk culture is a phenomenon of particular significance for the history of Polish territories towards the end of the antiquity. An analysis of the creation and functioning mechanisms of the mass trend of this activity is indispensable for understanding the complicated social-economic and political processes occurring at the time, not only within the Przeworsk culture but also in the whole central and eastern Europe. Without a thorough analysis of mutual relations and references between that extremely important sphere of productive activity and the cultural development of the peoples inhabiting the Polish lands at the time, we will not create a credible image of that reality. In view of the lack of written records and limited significance of classic archaeological sources from that period, determining economic indicators and organisation requirements needed for the functioning of those enormous production enterprises would allow for answering several questions concerning the character of the then existing social structures and their mutual relations. The image of independent, but at the same time lazy, pleasure-seeking and belligerent Germani, evoked in written sources, does not match their achievements in the field of metallurgy which required enormous workload and abiding by the rules of teamwork. Broadening the range of research on the prehistoric iron metallurgy by examining the previously neglected social-economic and political aspects of such activity, can contribute new data to the image of a broadly understood cultural model of barbarian communities of the so-called Barbarian Europe, we are trying to recreate.

References

- Andrzejowski, J. 2010: The Przeworsk Culture. A Brief Story (for the Foreigners). In: U. Lund Hansen – A. Bitner-Wróblewska eds., *Worlds Apart? Contacts across the Baltic Sea in the Iron Age*. Nordiske Fortidsminder C/7, København – Warszawa: Det Kongelige Nordiske Oldskriftselskab, 59–110.
- Bielenin, K. 1992: Starożytne górnictwo i hutnictwo żelaza w Górach Świętokrzyskich. Kielce: Kieleckie Towarzystwo Naukowe.
- Bielenin, K. 1999: Starożytne hutnictwo żelaza w Górach Świętokrzyskich – kilka uwag bardziej ogólnych. In: S. Kukawka ed., *Szkice prahistoryczne. Źródła – Metody – Interpretacje*, Toruń: Wydawnictwo Naukowe Uniwersytetu Mikołaja Kopernika, 197–216.
- Bielenin, K. 2002: Kilka dalszych uwag dotyczących starożytnego hutnictwa świętokrzyskiego. In: S. Orzechowski ed., *Hutnictwo świętokrzyskie oraz inne centra i ośrodki starożytnej metalurgii żelaza na ziemiach polskich*, Kielce: Świętokrzyskie Stowarzyszenie Dziedzictwa Przemysłowego w Kielcach, 11–25.
- Commentarii de bello Gallico*: Gajusz Juliusz Cezar, Wojna galijska. Przekład i opracowanie E. Konik. Wrocław – Warszawa: Biblioteka Narodowa 1978.
- Czarnańska, K. 1990: Struktura społeczna ludności kultury przeworskiej. Próba rekonstrukcji na podstawie źródeł archeologicznych i analizy danych antropologicznych z cmentarzyska. Warszawa: Państwowe Wydawnictwo Rolnicze i Leśne.
- Germania*: P. Cornelius Tacitus *Germania*, Przekład T. Płóciennik, wstęp i komentarz J. Kolendo. *Fontes Historiae Antiquae*. Zeszyty Źródłowe Zakładu Historii Społeczeństw Antycznych 10. Poznań: Wydawnictwo Naukowe Uniwersytetu im. Adama Mickiewicza 2008.
- Godłowski, K. 1985: Przemiany kulturowe i osadnicze w południowej i środkowej Polsce w młodszym okresie przedrzymskim i okresie rzymskim. *Prace Komisji Archeologicznej (Polska Akademia Nauk. Oddział w Krakowie. Komisja Archeologiczna) 23*, Wrocław – Warszawa – Kraków: Zakład Narodowy im. Ossolińskich.
- Heather, P. 2012: *Imperia i barbarzyńcy. Migracje i narodziny Europy*. Poznań: Rebis.
- Historia Romana*: Dionis Cassii Cocceiani, *Historiarum Romanarum que supersunt*. Berlin: P. Boissevain 1895–1931.
- Kolendo, J. 2008: Komentarze. In: P. Cornelius Tacitus *Germania*, przekł. T. Płóciennik, *Fontes Historiae Antiquae* 10, Poznań: Wydawnictwo Naukowe UAM, 105–203.
- Madera, P. 2002: Ślady starożytnego hutnictwa żelaza na Śląsku w ujęciu chronologiczno-przestrzennym. In: S. Orzechowski ed., *Hutnictwo świętokrzyskie oraz inne centra i ośrodki starożytnej metalurgii żelaza na ziemiach polskich*, Kielce: Świętokrzyskie Stowarzyszenie Dziedzictwa Przemysłowego w Kielcach, 61–70.
- Modzelewski, K. 2004: *Barbarzyńska Europa*. Warszawa: Iskry.
- Olędzki, M. 2008: Czas przemian. Barbaricum między Bałtykiem a środkowym Dunajem w dobie wojen markomańskich. Łódź: Wydawnictwo Uniwersytetu Łódzkiego.
- Orzechowski, S. 2000: Zespół cmentarzysk i bogatych depozytów monetarnych z doliny rzeki Kamiennej a zagadnienie chronologii starożytnego hutnictwa świętokrzyskiego. *Między Wisłą a Pilicą. Studia i materiały historyczne* 1, 35–61.
- Orzechowski, S. 2007a: The region of iron: the Przeworsk culture iron producing centre in Barbaricum. In: P. and S. Crew eds., *Early ironworking in Europe II. Archaeology, technology and experiment*. Second International Conference, Plas Tan y Bwlch, 26–28.
- Orzechowski, S. 2007b: Zaplecze osadnicze i podstawy surowcowe starożytnego hutnictwa świętokrzyskiego. Kielce: Kieleckie Towarzystwo Naukowe.
- Orzechowski, S. 2007c: „Czarna metalurgia” w Galii przed podbojem rzymskim. *Zarys problematyki*. *Kwartalnik Historii Kultury Materialnej* 55, 235–259.
- Orzechowski, S. 2013: Region żelaza. Centra hutnicze kultury przeworskiej. Kielce: Wydawnictwo Uniwersytetu Jana Kochanowskiego w Kielcach.
- Pazda, S. 1994: Brzeski rejon starożytnej metalurgii żelaza (IV–V w. n.e.). *Acta Universitatis Wratislaviensis. Studia Archeologiczne* 25/1595. Wrocław: Wydawnictwo Uniwersytetu Wrocławskiego.
- Pleiner, R. 2000: *Iron in archaeology. The European bloomery smelters*. Praha: Archeologický ústav AV ČR.
- Rodzińska-Nowak, J. 2012: *Gospodarka żywnościowa ludności kultury przeworskiej*. Kraków: Historia Iagelonica.

- Serneels, V. 2004:* Réflexions sur la consommation du fer dans l'antiquité, et spécialement à l'époque romaine. In: M. Mangin et al. eds., *Le fer*, Paris: Errance, 206–213.
- Skowron, J. 2006:* Kultura przeworska w dorzeczu środkowej i dolnej Bzury. Monografia osadnictwa. Poznań: Wydawnictwo Poznańskie.
- Spazier, I. 2007:* Das Eisenverhüttungszentrum Wolkenberg, Niederlausitz. Veröffentlichungen zur brandenburgischen Landesarchäologie 39/40 (2005/2006), 89–229.
- Straube, H. 1996:* Ferrum Noricum und die Stadt auf dem Magdalensberg, mit Beiträgen von H. Dolenz und G. Piccotini. Wien – New York: Springer.
- Urbańczyk, P. 1996:* Struktury władzy na ziemiach polskich w I tysiącleciu n.e. *Kwartalnik Historyczny* 103/4, 3–22.
- Wolfram, H. 1996:* Germanie. Kraków: Universitas.
- Woyda, S. 1982:* Głos w dyskusji. In: J. Wielowiejski ed., *Znaczenie wojen markomańskich dla państwa rzymskiego i północnego Barbaricum*. Scripta Archaeologica 2, Warszawa: Polskie Towarzystwo Archeologiczne i Numizmatyczne. Komisja Archeologiczna, 112–117.
- Woyda, S. 2002:* Mazowieckie centrum metalurgiczne z młodszego okresu przedrzymskiego i okresu wpływów rzymskich. In: S. Orzechowski ed., *Hutnictwo świętokrzyskie oraz inne centra i ośrodki starożytnej metalurgii żelaza na ziemiach polskich*, Kielce: Świętokrzyskie Stowarzyszenie Dziedzictwa Przemysłowego w Kielcach, 121–154.