The beginnings of iron in Slovenia

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Izvleček

Elementarno železo je v naravi razmeroma redko in je samorodnega in meteorskega izvora. Kovino pa se pridobiva iz kvalitetnih železovih mineralov, katerih ležišča so v svetu široko razprostranjena, večkrat tudi na površini. Zato je bilo železo že v arheoloških obdobjih dostopno večini kultur v nasprotju z barvnimi kovinami, katerih zaloge so bile pogosto oddaljene, njihova dobava v bronasti dobi pa strogo nadzorovana. Pač pa je bila pot do odkritja uporabnega železa dolgotrajnejša in tehnološko neprimerno zahtevnejša od pridobivanja bakra in izdelave zlitin.

Slovenija je spoznala železo med prvimi v Evropi zaradi ugodne geografske lege med rudonosnimi Alpami in severnim Jadranom in obilice domače površinske rude. Dokazi za stike domačega prebivalstva z rudosledci in metalurgi z vzhodnomediteranskega prostora ter za sodelovanje v trgovini z bakrom segajo v čas med 12. in 10. stoletjem pr. n. št. Na tej osnovi sklepamo, da so bili lokalni prebivalci razmeroma zgodaj seznanjeni z zahtevnim postopkom žlindranja sulfidnih vrst bakra, ki so ga tri stoletja pozneje, v 7. stoletju pr. n. št., s pridom uporabili tudi pri tehnološko zahtevnem pridobivanju železa in izdelavi uporabnih železnih izdelkov.

Ključne besede: pojav železa, prazgodovina, starejša železna doba, železen nakit, železno orožje, Slovenija

Abstract

Elementary iron is relatively rare in nature and is of native and meteoric origin. The metal is obtained from high-quality iron minerals, deposits of which are widely distributed throughout the world, very often even on the surface. Iron was therefore already available to the majority of cultures in archaeological periods, in contrast to coloured metals, deposits of which were often distant and their supply strictly controlled in the Bronze Age. However, the route to the discovery of usable iron was longer and, technologically, incomparably more demanding than obtaining copper and making alloys.

Because of its favourable geographic location between the ore-bearing Alps and the northern Adriatic and the abundance of local surface ore, Slovenia was among the first regions in Europe to be familiar with iron. There is evidence of contacts between the local population and prospectors and metallurgists from the eastern Mediterranean and participation in the copper trade dating back to between the 12th and 10th centuries BC. It can be concluded on this basis that they were acquainted relatively early with the demanding process of slagging sulphide types of copper, which was used three centuries later in the 7th century BC with advantage also in the technologically demanding production of iron and the manufacture of usable iron products.

Keywords: appearance of iron, prehistory, Early Iron Age, iron jewellery, iron weapons, Slovenia

Elementary iron is relatively rare on earth and is of native and meteoric origin. The metal is obtained from high-quality ferrous minerals, such as haematite Fe_2O_3, goethite $HFeO_2$, limonite $FeO(OH)n.H_2O$, magnetite Fe_3O_4 and siderite $FeCO_3$, deposits of which are huge, scattered throughout the world and often on the surface. Iron, therefore, in contrast to coloured metals, deposits of which were often distant and their supply strictly controlled in the Bronze Age, was already available to the majority of cultures in the archaeological periods.[1]

In Slovenia, in contrast to the modest copper deposits, there was so much iron that obtaining iron ore was the main mining activity until the end of the 19th century, when it slowly ceased because

[1] Craddock 1995, 234–235.

Fig.1: Iron ore – nuggets. **1** stone quarry Peči by Kamna gorica; **2** Rudno polje on Pokljuka (1,2 collected by A. Rečnik, 1999); **3** Mountain plateau of Dedno polje above Bohinj (collected by F. Stele, 1998). Photo T. Lauko.
Sl.1: Železova ruda – bobovci. **1** kamnolom Peči pri Kamni gorici; **2** Rudno polje na Pokljuki (1,2 nabral A. Rečnik, 1999); **3** Planina Dedno polje nad Bohinjem (nabral F. Stele, 1998). Foto T. Lauko.

of the unprofitable processing and a reduction of ore deposits. Ore of various kinds and forms (haematite, limonite, siderite) lay almost everywhere – in smaller quantities and over extensive areas. The majority of iron ore in Gorenjska and Dolenjska region was collected, which means that it was gathered on the surface; classical mining with tunnels was only needed in the Karavanke mountains, in Štajerska region and in some places in Dolenjska.

As is evident from data collected for the 18th and 19th centuries, most ore was then found in the Triglav massif (the Julian Alps), on the high plateaus of Pokljuka and Jelovica and in the Karavanke moun-

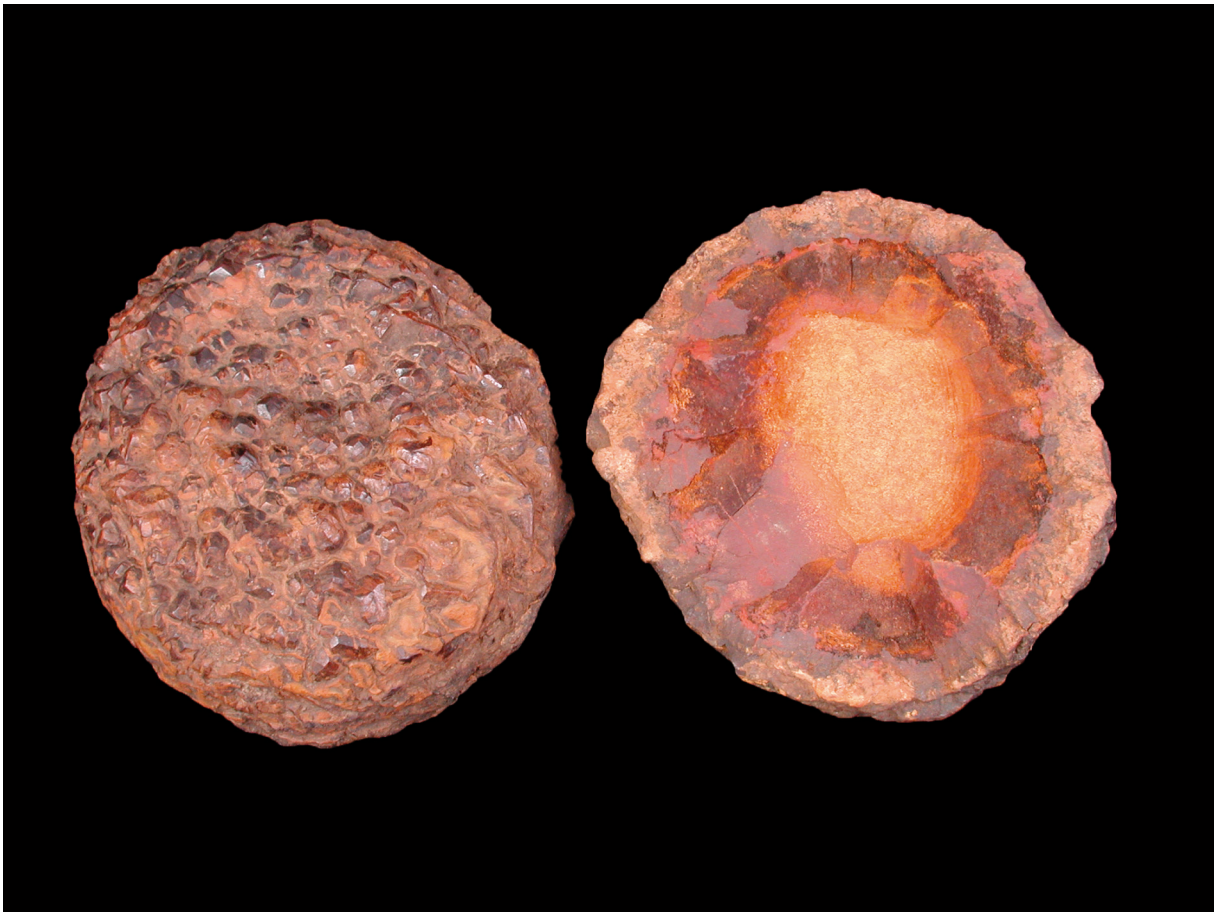

Fig. 2: Iron ore – limonite pyrite, view of the exterior and interior of the sample, vicinity of Žužemberk (collection of the Slovenian Museum of Natural History). Photo M. Jeršek.
Sl. 2: Železova ruda – limonitiziran pirit, pogled na zunanjost in notranjost vzorca, okolica Žužemberka (zbirka Prirodoslovnega muzeja Slovenije). Foto M. Jeršek.

tains.[2] Iron ore (mostly siderite with an average 25% of iron) was excavated there in tunnels – in Savske jame (above Jesenice), in Planina pod Golico, below Stol, in Zelenica and elsewhere. Pisolitic iron (pea or bean-shaped grains with iron-richer haematite and poorer limonite), which gave up to 48% iron after smelting, were collected in the Triglav massif, on Pokljuka and Jelovica (*fig. 1*). The iron foundries on the Sava and in Javornik, Bohinjska Bistrica and Stara Fužina used ore from their own mining regions, while the blast furnaces in Železniki, Kropa and Kamna gorica had to buy the ore. Bohinj ore was prospected from Rudno polje, Koprivnik and Gorjuše to Krstenica and other Bohinj mountain pastures. Iron sometimes lay right on the surface, sometimes on the floor of caves, precipices and sinkholes, hidden below a layer of gravel and soil. It was sought and collected by ironworkers, as well as farmers and cottagers. A lot of people took part in the search but there was only space for two or three men gathering ore in a single sinkhole. Work in the high mountains only took place in summer and autumn, when there was no snow; during the winter, the ore was transported by sledge to foundries in the valley.

The second richest iron area was in Dolenjsko but iron was also exploited from Zasavje and Bela krajina region. Limonite ore of various kinds – brown and red and sandstone and clayey iron ore (*fig. 2*), in some places also pisolitic iron, was irregularly scattered in flood clay in layers of various thicknesses. In contrast with the more difficult of high mountain deposits in Gorenjska, the ore here was located in the lowlands and moderately hilly landscape. They had to uncover extensive field and meadow surfaces when prospecting. The

[2] The depiction of iron working in Slovenia in the 18th and 19th centuries, together with the data, is summarised from Ivan Mohorič (1978).

various kinds of iron ore, containing from 10% to more than 50% of iron, caused smelting difficulties because of the different qualities of ore. The extent of iron ore in Dolenjska is well illustrated by data on prospecting permits from the oldest ironworks in Dvor (1796), which at first covered both banks of the Krka river from Šmihel and as far as Žužemberk and Zalisec,[3] and later spread to nine localities: Mokronog, Novo mesto, Radeče, Kostanjevica, Metlika, Trebnje, Višnja gora, Velike Lašče and the vicinity of Ljubljana. In addition to Dvor and smaller ironworks in Gradec in Bela krajina region and in Ponikve south of Turjak, a series of smaller smelteries also operated.

The route to the discovery of usable iron, which had better properties, mainly hardness and malleability, than all comparable materials up to then (silex, copper, bronze) was longer and technologically incomparably more demanding than obtaining copper or making bronze. In order to obtain harder and more ductile metal than the copper alloy then in use, it was necessary to produce a ferrous alloy with a low carbon content, which is a characteristic of steel. The most important ferrous alloys, steel and cast iron, are in fact distinguished precisely by the share of carbon. Steel must contain a very low carbon content (0.02–2%), while cast iron can have considerably more (2–5%) but it is also therefore brittle. The production of steel is more demanding than making cast iron (pig iron) for which a smelting temperature of around 1200 °C is sufficient. A temperature of 1530 °C is needed to obtain steel, together with an absence of air (i.e. a reduction atmosphere) and then heating the iron to 750–900 °C and cooling it in carefully controlled conditions. Investigations of early steel finds show that blacksmiths then were not often successful. The invention of smelting iron thus only occurred in metallurgically developed centres, from where the process spread to other areas.

The oldest finds of smelted iron and Hittite written sources support the claim of ancient Greek sources that the first smelted iron in the Ancient World was obtained in Anatolia, on the territory of the later Hittite kingdom, at the end of the 3rd millennium BC.[4] Experts also agree that the first iron products spread from here to the lands of the eastern Mediterranean coast and Greece between the 15th and 13th century BC. Rare valuable iron objects (rings) were already owned by the Mycenaeans, who probably obtained them in trading contacts with Anatolia and also passed them on to others.[5] Among the oldest products known in Europe is the iron blade of a sickle from Gánovce in Slovakia, discovered in a ceremonial well and dated to the start of the Middle Bronze Age (15th century BC).[6] The spread of simple small iron knives during the course of the 12th century BC is also explained by trade between the eastern Mediterranean lands and Cyprus. However, iron finds are more frequent from the 12th century onwards, mainly in Greece and the Balkans and, in the 11th century also in the southern Italian peninsular and on Sicily and Sardinia. Only individual examples originate from Alpine lands and north of them.[7] They are linked to the establishment of iron in Greece, where, as also in the Near East, high quality iron for weapons and tools was already in general use from the 11th century onwards, when local metallurgy gradually developed there.[8]

Opinions on the directions by which knowledge of iron working spread in Europe are divided. On the one hand, Pleiner (2000, 23–25) advocates the traditional premise of an eastern route by which iron smelting is supposed to have spread in the 1st millennium BC, from the Aegean area, via the Balkans and central Europe and gradually northwards to Scandinavia. He cites in evidence the oldest finds of iron slag and objects, mainly from Romania. Craddock (1999, 184–185), on the other hand, argues a western route, which he bases on the mastery of slagging. The process, which is essential for obtaining usable iron but which is not necessary in smelting oxide types of copper ore, had already been developed in the 3rd millennium BC in the Middle East. It is thought to have spread from there across the Aegean region to Sicily, Sardinia and the southern Italian peninsula towards the end of the 2nd millennium BC, perhaps even because of direct Mycenaean-Cyprian contacts. It is thought also to have been taken over and adapted to local

[3] Šorn 1980, 11–12.

[4] Craddock 1995, 236–237, 256–257.

[5] de Marinis 2004, 64–65.

[6] The age of the wooden lining of the well also corresponds with the chronological determination of the sickle – the uncalibrated result of ^{14}C analysis is 1465 ± 35 BC (Furmánek 2000, 155, 158).

[7] For Romania Boroffka 1987, 55, 61: iron objects from Romanian sites Cernat (11th cent.), Deva (12th cent.). For Italy de Marinis 2004, 66–67: cemeteries Castellace (Calabria) and Molino della Badia (Catania), both 11th cent. For more northern areas of Europe Pleiner 2000, 24 (for the most part less reliably dated finds).

[8] de Marinis 2004, 65.

conditions in the Alpine regions but to have been unknown in other parts of Europe, where they smelted simpler copper minerals. The recent investigations of Austrian sites in the Eastern Alps, namely, show that smelting was used in the Late Bronze Age in places where copper was obtained from polymetallic sulphide ores (chalcopyrite, bornite). These contain a lot of iron, which is undesirable in copper, so it is removed by slagging. The process is more demanding than simple smelting of copper ore and thus closer to the complicated technology of obtaining and processing iron. It was precisely in the area of Italy and the Alps that the oldest working of iron already appeared at the start of the 1st millennium BC, which, in Craddock's opinion, was enabled by mastery of the process of slagging copper.

The inhabitants of today's Slovene territory were also among the first in Europe to be familiar with iron. The reasons can be found in the location of Slovenia between the northern Adriatic, the top of the Italian peninsular and the eastern Alps, which gave Mediterranean prospectors relatively favourable access from the sea or from the Friulian lowlands towards the interior of the pre-Alpine and Alpine world, rich in copper, iron and other ores. The bi-conical ingots from specific polymetallic copper, which appeared precisely in western Slovenia and Friuli at the end of the 11th century BC, indicate trade and traffic links at the end of the Late Bronze Age between the northern Adriatic hinterland and the eastern Alpine valleys. Systematic chemical analysis of hoard-finds have enabled the presumption that a considerable number of these semi-products originated from polymetallic copper of the *fahlore* type, which contains in addition to tetraedrite and tennantite also nickel and cobalt arsenide. There are only a limited number of such deposits in Europe; the nearest to Slovenia are in the Styrian part of the Eastern Alps (the Eisenerzer Alpen, the Rottenmanner Tauern), while they are unknown in Slovenia. It can therefore be concluded that metal from the aforementioned polymetallic ore was an item of trade between the inhabitants of the eastern Alpine valleys and the wider hinterland of the northern Adriatic.[9] And it is also precisely in this area that the first imported iron objects appeared – small blades and knives, such as have already been mentioned for the eastern Mediterranean in the 12th century BC. As with the oldest finds in Italy and in the Balkans, these can also be linked with the establishment of iron in Greece and the spread of products to neighbouring regions. The blades originate from the oldest graves in Tolmin (e.g., grave 417) and Brežec near Škocjan (graves 272, 158) to which Teržan (1995, 360) first drew attention. She has determined the inventory of these graves to the phase Ha B1–2, to a period between the middle of the 11th and end of the 10th century BC, while she explained the iron blades as forerunners of the introduction of ironworking in the hinterland of the northern Adriatic at the transition of the 2nd to the 1st millennium BC (*fig. 3*).[10]

The first examples of iron weapons in Slovenia also indicate early contacts between the western part of Slovenia and the Aegean region in the following centuries. An iron sword and spear points of characteristic Aegean shape which had been cast into the sacred abyss of Mušja jama by Škocjan were otherwise known in Greece in the 9th century BC. Teržan pointed this out and reached an argued conclusion of direct contacts between the inhabitants of the Soča valley and the Aegean at the end of the Late Bronze Age. Namely, she identified female jewellery in the 10th century graves in Tolmin that had been worn at that time in the wider hinterland of the northern Adriatic as well as in the Karst/Soča region and, at the same time, on the Greek islands of Crete, Cyprus, Rhodes, Euboea and in some places on the Greek mainland. It was characterised by bronze (and not iron) solid rings and bronze single-looped crescent shaped fibulae. Teržan concludes that the same jewellery was not just a result of trade contacts between the two regions but perhaps signified actual immigration of individuals from the Aegean at the turn of the 2nd millennium BC.[11]

The first iron jewellery – torcs, bracelets and some fibulae – appeared in Slovenia during the 9th and 8th centuries. In view of previous research, iron torcs and bracelets from Ormož (grave 7) and Ruše may be among the oldest in Slovenia, as an integral part of female attire, which consisted of similar jewellery but made from bronze and was characteristic of the area between Slovenia and the lower Danube valley in the 9th and early 8th century BC.[12] Similar iron torcs and bracelets also

[9] Trampuž Orel, Heath 2001, 161; Trampuž Orel, Orel 2010, 103–104; Trampuž Orel 2010, 52–54.

[10] Teržan 2002, 87.

[11] Teržan 1990a, 60, 61, fig. 8: 3–5; Teržan 1995, 360–361; Teržan 2002, 100–101, p. 96 map 2.

[12] Teržan 1990b, 23, 63; grave 7 with iron jewellery from Ormož: see Tomanič Jevremov 1988–1989, 281–284, pl. 13: 1–2.

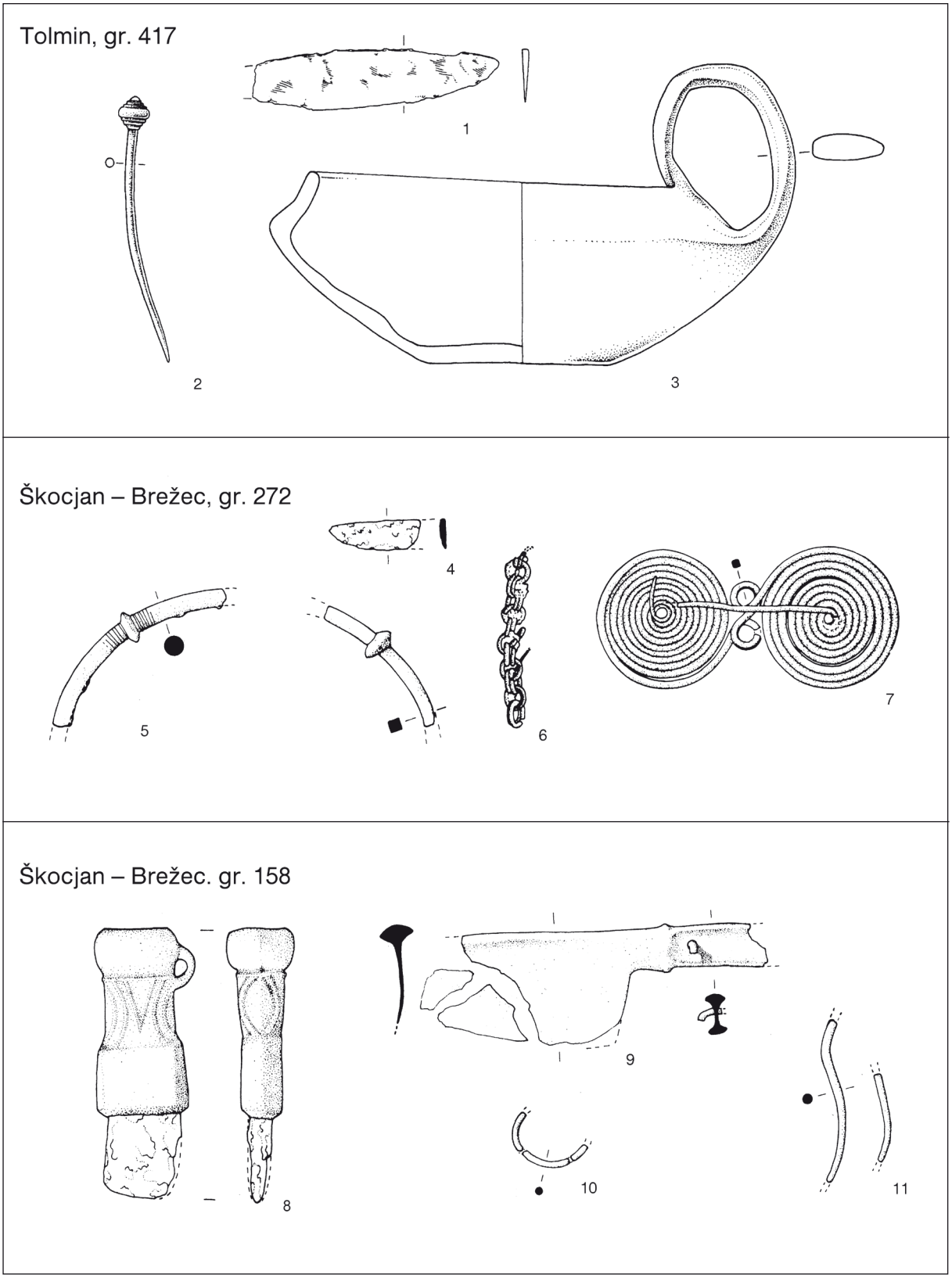

Fig. 3: Iron blades. **1** Tolmin (1–3 after Svoljšak, Pogačnik 2001, pl. 82); **4,8** Škocjan – Brežec (4–11 after Ruaro Loseri et al. 1977, pls. 16 and 23). Scale = 1:2.
Sl. 3: Železna rezila. **1** Tolmin (1–3 po Svoljšak, Pogačnik 2001, t. 82); **4,8** Škocjan – Brežec (4–11 po Ruaro Loseri et al. 1977, t. 16 in 23). M. = 1:2.

appear in graves in western Slovenia (Brežec by Škocjan, grave 209; Tolmin, grave 342; some graves from Šmihel and Križna gora). Since they often appear with early bronze single-looped bow fibulae, Teržan dated the iron jewellery to the same period – the 1st half of the 8th century.[13] The same iron inventory has also been found in central Slovenia (e.g., a bronze torc and a spiral iron bracelet in grave 64 in Ljubljana) in the phase Ljubljana II b, which Gabrovec (1973) defined as the start of the »iron horizon« in the 2nd half of the 8th century. Teržan,[14] on the other hand, proposed an earlier start of iron in Ljubljana, i.e., the 1st half of the 8th century because otherwise the time difference between the iron inventories of Ormož grave 7 and Ljubljana grave 64, which are in other ways similar, seems too great.

Fibulae that enrich iron jewellery in the 8th century are double-looped crescent-shaped fibulae and bow fibulae. The first are primarily characteristic of the western parts of Slovenia. Among these, a Basarabi-type fibula, with a high-shouldered foot, even indicates links between Tolmin and some other sites in the west, with cultural centres in the east in the lower Danube Basin during the 8th and start of the 7th century.[15] Among iron bow fibulae, however, those with a double loop appear in western and central Slovenia in the 2nd half of the 8th century,[16] while Teržan draws attention to two iron double-looped fibulae in Poštela (eastern Slovenia). She compares their shape to similar fibulae distributed in the Balkans and the lower Danube Basin already in the 8th century. She thus suggests that iron may have appeared in eastern Slovenia prior to the central Slovene area.[17]

Within the phase Podzemelj 1–2, in the 2nd half of the 8th century, iron also appears in Slovenia in its true role – as the best material for weapons and tools because of its exceptional hardness and, at the same time, malleability. It is possible to follow the appearance of weapons in graves of a militarily organised society in the Dolenjska Hallstatt group, in which a numerically superior class of warriors over unarmed men can clearly be seen[18] and, therefore, also a large number of weapons. The end of the use bronze offensive weapons and introduction of iron for weapons (spears, axes) in Dolenjska is presumed to have taken place from the start of the 7th century onwards.

A similar conclusion cannot be made about the transition to the use of iron tools, because tools were not commonly (with rare exceptions) laid in graves in the Hallstatt period (i.e. the Early Iron Age). We also lack data because the interiors of Hallstatt settlements have not been investigated. In any case, iron tools occur in the graves of the Idrija group with the arrival of the Celts and with the prevailing La Tène culture.

As far as the oldest local production of iron products is concerned, for the moment we do not have reliable data such as iron-working workshops and tools because the interiors of Hallstatt settlements have not yet been investigated, or publication is incomplete of the very few excavations of settlements (Zgornja krona above Vače, Most na Soči). We therefore have indirect evidence of the local extraction of iron – iron tailings and the hearths of smelting furnaces, mainly from the Early Iron Age. An extensive and thorough study of settlement, economic and social structures in the period in question in the region of Dolenjska, Bela krajina and Posavje (Dular, Tecco Hvala 2007) has contributed greatly to this. Within the framework of planned research, trial excavations have been caried out on the edge of settlements, which among other things have uncovered slag in the majority of Dolenjska Hallstatt settlements, and most settlements from the Early Hallstatt period were established in the immediate vicinity of iron ore deposits.[19] Trial excavations of a hillfort at Kostjavec above Tihaboj in the Mirna valley uncovered iron slag in the cultural layers, which were also possible to define chronologically on the basis of pottery (the phase Podzemelj 2) to the 1st of the 7th century BC.[20]

There is incomparably less direct evidence of iron production. The most important is still the contemporary discovery of iron smelting furnaces at the locality Branževec above the village of Sela by Dolenjske Toplice in 1986, which occurred at the start of trial excavations of a Late Bronze Age and Early Iron Age fortified settlement at Cvinger by Dolenjske Toplice. The largest iron smelting site in Slovenia to date with well documented smelting

[13] Teržan 2002, 93–94.

[14] Teržan 1990b, 63.

[15] Teržan 1990a, 57, fig. 4: 1, fig. 5; Teržan 2002, 98, map 4 with cited literature.

[16] Gabrovec 1973, 343.

[17] Teržan 1990b, 23.

[18] Cf. Teržan 2008, 238–245, 258 in a recently published comprehensive analysis of the burial structure in the tumulus 48 in Stična.

[19] Dular,Tecco Hvala 2007, 214–216.

[20] Dular, Pavlin, Tecco Hvala 2003, 188.

Fig. 4: Products of iron smelting – loaf-shaped iron blooms and pieces of iron slag. **1** the hillfort Grad by Šmihel, **2** Dunaj by Jereka (both from the collection of the National Museum of Slovenia). Photo T. Lauko.
Sl. 4: Produkti taljenja železa – železne pogače in kosi žlindre. **1** Grad pri Šmihelu, **2** Dunaj pri Jereki (zbirka Narodnega muzeja Slovenije). Foto T. Lauko.

pits, which in the opinion of researchers belong to the hearths of 12 (unpreserved) furnaces, is located outside the hillfort. The remains of fired clay, charcoal and iron slag were found in the pits. In view of radiocarbon analysis of the charcoal and magnetometric investigations of the smelting area, the entire smeltery, with an area of approximately 5000 m^2 and, it is suspected, approximately 100 furnaces, belongs to the Early Iron Age.[21] Thorough metallographic and spectral analysis of the composition of the slag and clay linings of the pits from this exceptional site would be of fundamental importance for understanding the local technology of smelting iron in the Early Iron Age in Dolenjska. A circular pit with a hearth on the floor, with fragments of slag and La Tène pottery, discovered in 1979 after protective excavations lasting several years of late Roman buildings within an Iron Age settlement at Kučar by Podzemelj, is a later example. Because of the smaller dimensions of the pit and the destruction of the upper part of the suspected furnace, this is thought to have been not for the smelting of iron ore but the further processing of the iron into usable iron. It is dated to the end of the Late Iron Age.[22]

Individual finds of intermediate products of smelting, such as loaf shaped iron blooms or lumps and iron slag in other areas of Slovenia also indicate the local processing of iron (*fig. 4*). Iron semi-products also include ingots, of course, which are rare among finds in Slovenia. They belong to various periods, and they may be the result of local iron processing or part of the standard form of iron trade. During archaeological excavations in the second half of the 20th century, two presumed Iron Age ingots were discovered. A small iron block ingot originates from an Iron Age settlement in Kučar.[23] The second iron ingot, of irregular shape, is a surface find from a settlement on Špičasti hrib above Dole pri Litiji, which existed in the Hallstatt and then in the late

[21] Dular, Križ 2004, 228–229; Mušič, Orengo 1998, 157–186; Dular, Tecco Hvala 2007, 184, 217.

[22] Dular, Ciglenečki, Dular 1995, 54–55; Dular, Tecco Hvala 2007, 216–217.

[23] Dular, Ciglenečki, Dular 1995, 62–63, 69–70, pl. 76: 18; J. Dular sees an excellent analogy in ingots from Manching.

Fig. 5: Iron semi-products. **1** Ledine by Lesce, **2** Ivškov hrib above Bukovca by Laško, **3** Gradec by Mihovo, **4** Glinjek above Polšnik (collection of the National Museum of Slovenia). Photo T. Lauko.
Sl. 5: Železni polizdelki. **1** Ledine pri Lescah, **2** Ivškov hrib nad Bukovco pri Laškem, **3** Gradec pri Mihovem, **4** Glinjek nad Polšnikom (zbirka Narodnega muzeja Slovenije). Foto T. Lauko.

Roman period.[24] Other examples are more or less occasional finds (*fig. 5*). A large iron double pointed bipyramidal ingot with forged points from Ledine near Lesce (*fig. 5:* 1), 67 cm long and weighing 7 kg, is undoubtedly one of the more outstanding. It was discovered as the last of three ingots of the same type, in 2007 during geological investigations for the Gorenjska motorway section Vrba-Peračica. The ingot has a good analogy in similar large and heavy Celtic bipyramidal ingots from the second La Tène hoard from Sauggart in Würtemberg.[25] Ingots of this type were widespread throughout Europe between the start of the 5th and middle of the 1st century BC in areas in which the Celts lived or that were under Celtic influence. The typical forged points are explained as visual evidence of the excellent malleability and ductility of iron in such ingots. Their particular shape is similar to earlier ingots, which often have a drilled hole and were widespread in the central parts of Europe. They are dated to the late Hallstatt period (between the 6th and 5th centuries BC) and it seems that they copy bipyramidal ingots from the New Assyrian period. These generally have a hole drilled for easier transport and were first discovered in a palace in Khorsabad (Iraq) in the treasure find of Sargon II, dated to the late 8th century BC.[26] The smaller ingot of a similar type but with shorter points found above Bukovca near Laško (*fig. 5:* 2) has an analogy in the La Tène Sauggart hoard find.[27] The block ingot found at Gradec by Mihovo in Dolenjsko (*fig. 5:* 3), and the ingot in the shape of a cube at Glinjek above Polšnik (*fig. 5:* 4), seem more similar to Roman ingots in terms of weight, size and shape – massive blocks – from Carinthian Magdalensberg (Austria) or from Sisak and Hrvatska Dubica (both Croatia).[28]

The continuation of ironworking in the following periods, which have similarly not yet been followed in systematic archaeometallurgical investigations, could be explained by the rich stockpiles of iron ore in Slovenia, which must have been very ample

[24] Dular, Pavlin, Tecco Hvala 2003, 175–176, fig. 24.
[25] Pleiner 2006, 28–29, fig. 7: 1–6.
[26] Pleiner 2006, 23–32, figs. 5: 1–10, 6: 4–5, 7: 6.
[27] Pleiner 2006, 28–29, fig. 7: 2.
[28] Pleiner 2006, 39–43, fig. 17: 6,7.

in prehistory in view of their long persistance far into the New Age. According to precious objects from Italic workshops, found mainly in the 7th century graves of leading members of the Hallstatt community in Dolenjsko, it can be concluded that the iron deposits attracted the economic interest of neighbours, primarily the nearby communities of northern Italy and, indirectly, perhaps also Etruria. We can only speculate about the possible advantages of Slovene iron ore in terms of its quality in comparison with ore in the nearby regions of Austrian Carinthia and Styria and elsewhere, because there has not so far been systematic mineralogical and metallographic research of ore and slag in Slovenia. The same applies to the demanding processes of obtaining malleable iron, which we suspect local blacksmiths mastered but have not yet verified this. As we already attempted to show at the beginning, our presumptions are connected with the arrival of foreign prospectors and metallurgists from the Aegean. They passed on their valuable technological knowledge first to the southern parts of the Italic peninsula, where iron metallurgy was introduced with the aid of the Etruscans during the 9th and 8th centuries and then gradually spread towards the north to the Po plain and from there to Alpine regions.[29]

In addition to the Dolenjska Hallstatt community, which occupied one of the two large iron working regions – Dolenjska with Bela Krajina and Zasavje, the Sveta Lucija Hallstatt community in the Soča valley also had an outstanding social and economic position. As the successor to the preceding Tolmin community, it controlled in addition to the Soča valley also Bohinj with the Triglav massif, which was the second large iron region. Archaeological finds show that the Bohinj basin was settled at the end of the 7th century BC, so when iron was already in use in Slovenia. The settlers certainly arrived from the Tolmin area – by the most difficult routes across the high passes of the Lower Bohinj mountains, probably those between Rodica (1966 m) and Lanževica (2003), access to which is closest. The same burial rituals and women's attire with Sv. Lucija fibulae from graves in Bitnje, Lepence and Jereka indicate their affiliation to the Soča valley community and the economic centre of Most na Soči. They deliberately settled in Bohinj as miners and ironworkers, as is shown by the remains of ironworking smelting pits and considerable quantities of slag in two prehistoric posts in the valley – in Ajdovski gradec near Bohinjska Bistrica and Dunaj by Jereka.[30] Because of the rich ironworking tradition in Bohinj, in addition to prehistoric slag, slag from later periods (up to the end of the 19th century) can also be found, when smelting was only done in the valley because of the invention of blowing air into the smelting furnace by water drive. Finds of slag and smelting pits or furnaces in the high mountains would thus be particularly important for proving prehistoric iron working. When Iron Age miners collected iron on the high Bohinj mountain pastures, just like Zois' miners 2400 years later ,[31] they had to transport the iron from the Triglav massif to Most na Soči. Because the most important connection from the Tolmin side in the 19th century still ran over the 1900 m high Škrbina pass,[32] it could be possible that this and neighbouring passes had an equally important role in the Early Iron Age. One of these passes may have been Globoko pass, from which there is even a view of Tolmin from the Bohinj side.[33]

[29] de Marinis 2004, 66–68.

[30] Gabrovec 1974, 299; Gabrovec 1987, 30–35; contemporary geophysical research of Ajdovski gradec with magnetometry further has confirmed the existence and extent of metallurgical activity – see Mušič 1999, 401–402.

[31] Sigmund Zois Freiherr von Edelstein (1747–1819), a rich aristocrat, natural scientist, patron of the arts and owner of large estates with iron deposits and iron foundries in Carniola (part of today's Slovenia at the time of the Austrian Empire).

[32] As Rutar (1882, 272) reports, at that time they most frequently walked across Škrbina and also exported Bohinj livestock to the Tolmin area. With today's knowledge of conditions, though, it must be noted that this pass is difficult of access for animals from the Bohinj side.

[33] Memory of earlier links with the Soča side has also been preserved until today in a humorous tale from Bohinj and in an oral tradition from Volče near Tolmin. Both sources are connected with the former burial of people from Bohinj on the Primorska side, in Volče. The story (Cvetek 1993, 216) narrates a mistake in transporting a deceased from Bohinj across the Bača pass to Primorska – instead of the chest containing his corpse, they brought a chest of dried pears to the Volče cemetery. The oral tradition from Volče by Tolmin also claims that the first Christians even carried their dead from Bohinj to bury them at Sveti Danijel (St. Daniel) in Volče (Rutar 1882, 34; Duša 1995, un-numbered pages). Sv. Danijel is the oldest church in the upper Soča valley and Volče its oldest parish in the late 10th century (Höfler 2001, 21, 82). At the same time, the Bohinj parish, in contrast, was part of the Rodine-Radovljica oldest parish (Höfler 1988, 207–209). Both oral traditions, therefore, report a certain discordance of Bohinj burial rituals with the church arrangement, specifically that Bohinj inhabitants were formerly buried in Volče instead of in Rodine or Radovljica. That they even had to traverse mountain passes shows the deep spiritual link of the Bohinj people

It is therefore tempting to assume that it would have then been more sensible to smelt the ore where it was collected, than to carry it down to the valley and then transport it again across the high mountain chain on the Tolmin side. This idea was conceived by A. Rjazancev, a physician who, with a professional team of geologists, minerologists and chemists, first investigated the high mountain traces of mining, ironworking and deposits of remaining iron grains on the mountain pastures of the Triglav massif for the Technical Museum Jesenice in the 1960s.[34] At that time, in fact, the only slag discovered to date in the high mountains was found on Komna and it was also analysed. The find, which should be identified today, is a good argument for further investigation of the Bohinj mountains in order to discover evidence of possible prehistoric high mountain ironworking, as well as prehistoric links with Tolmin. Mija Ogrin (Museum of Gorenjska) started archaeological topographic surveys and trial excavations soundings of the mountain pastures on Pokljuka, Zadnji Vogel, Lepa Komna, Jelovica and elsewhere a few years ago and discovered traces of occasional human residence from the Bronze Age and, above all, the Roman period.[35]

Rjazancev with his team also performed the first experimental smelting of iron in a wind furnace, which was very advanced for that time. They showed that certain pisolitic iron with a large share of iron (more than 80%) and a suitable share of silex, which they collected on Dedno polje, resulted in iron similar to steel. Ten years ago, a metallurgist from Bohinj, I. Cundrič, made fresh attempts at smelting and also published the results (2002). He did not succeed in smelting ore with a wind furnace, perhaps also because he used limonite ore, collected at Mrzli studenec on Pokljuka, which is rather iron-poor. He was successful in another attempt at smelting in which he used air blown with a ventilating fan. The smelting lasted seven hours and the result was a 5 kg bloom, without slag, which was hammered out. It contained steel with a ferrite structure and cementite.[36]

Unfortunately, research studies into the beginnings of ironworking in Slovenia are incomparably more modest compared with the influence that iron had on the development of Iron Age communities in Slovenia. The same holds true for the later importance of local ironworking, which remained one of the essential economic branches until the start of the 20th century. The first archaeologist to start researching ironworking was A. Müllner at the end of the 19th century. He contributed the basic work on the history of ironworking, in which he dealt with the question of ore deposits and ironworks from archaeological periods to the 19th century. We also owe to him an inventory of prehistoric ironworking sites (including Vače, Magdalenska gora by Zgornja Slivnica, Cvinger by Stična, Cvinger by Dolenjske Toplice, Vinji vrh, Kučar by Podzemelj, Breznik by Dragatuš etc.).[37] Work on Müllner's theme was continued by W. Schmid in the 1930s, with research into some settlements with smelteries and forges (Kučar in Bela krajina, Ajdovski gradec and Dunaj by Jereka in Bohinj, Vače). Unfortunately, his excavations were usually poorly documented but he published research of buildings and analysis of slag in Spodnja and Zgornja krona by Vače.[38] Interest in systematic research of iron then died out, except for individual initiatives, which were not continued in more extensive research.

We do not have archaeological evidence of equal worth about ironwork in the Late Iron Age, or in the Roman and following medieval periods. The gap could be filled by systematic metallographic research into iron ore, slag, semi-products and products but this has not yet started. Such investigations are not very popular within the Slovene archaeological profession because, for the moment, taking samples for domestic metallurgical investigation is significantly damaging. Despite the abundance of characteristic La Tène iron weapons and tools that appeared in Slovenia from the 4th century BC onwards, we do not yet know the technological properties of these products, nor the possible quality of the iron, for which Celtic smiths were famed. An archaeometallurgical study of five pieces of Roman iron weapons from a Roman Republican period hoard (3rd to 2nd century BC) discovered in Grad by Šmihel, is an exception. Among other

with those of the Soča valley, which could be explained by a pre-Christian prehistoric tradition.

[34] Rjazancev 1963; numerous professional papers and reports on this project, also by his associates, were published in other volumes of *Tehnična priloga Železarja* 4/2 (1962), 5/2 (1963), 6/1 (1964) and 8/1 (1966), in which Pibernik and Ravnik (p. 80) mention the find of slag on Komna.

[35] Ogrin 2006, 96–106.

[36] Cundrič 2002.

[37] Müllner 1909.

[38] Schmid 1939. Only from his excavations are known iron semi-products – remains of rejected cast ("pig") iron and loaf shaped blooms.

things, the study explains the different technological quality of Roman products is explained.[39] The relation to the famous iron from Noricum, actually already steel, which is thought only to have been obtained in Kärnten and Burgenland in Austria, therefore, is still not clear. Perhaps the metallurgical research of fragments of iron from the excavations in the Early Iron Age settlement Most na Soči[40] will finally reveal prehistoric steel also in Slovenia ?

[39] Kmetič, Horvat, Vodopivec 2004.

[40] Mlinar, Klasinc, Knavs 2008 (M. Mlinar, pers. comm.: iron fragments from the Iron Age layer SU 10 at Maregova guna, unpublished).

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BOROFFKA, N. 1987, Folosirea fierului în România de la începuturí pînă în secolul al VIII-LEA î.e.n. – *Apulum* 24, 55–77.

CRADDOCK, P. T. 1995, *Early Mining and Production.* – Edinburgh.

CRADDOCK, P. T. 1999, Paradigms of metallurgical innovation in prehistoric Europe. – In: A. Hauptmann, E. Pernicka, T. Rehren, U. Yalcin (eds.), *The Beginnings of Metallurgy*, Der Anschnitt, Beiheft 9, 175–192, Bochum.

CUNDRIČ, J. 2002, *Pozabljeno bohinjsko zlato*. – Slovenj Gradec.

CVETEK, M. 1993, *Naš voča so včas zapodval - bohinjske pravljojce*. – Ljubljana.

DULAR, J. and B. KRIŽ 2004, Železnodobno naselje na Cvingerju pri Dolenjskih Toplicah (Eisenzeitliche Siedlung auf dem Cvinger bei Dolenjske Toplice). – *Arheološki vestnik* 55, 207–250.

DULAR, J. and S. TECCO HVALA 2007, *Jugovzhodna Slovenija v starejši železni dobi. Poselitev - gospodarstvo - družba / South-Eastern Slovenia in the Early Iron Age. Settlement - economy - society.* – Opera Instituti Archaeologici Sloveniae 12, Ljubljana.

DULAR, J, S. CIGLENEČKI and A. DULAR 1995, *Kučar. Železnodobno naselje in zgodnjekrščanski stavbni kompleks na Kučarju pri Podzemlju / Eisenzeitliche Siedlung und frühchristlicher Gebäudekomplex auf dem Kučar bei Podzemelj*. – Opera Instituti Archaeologici Sloveniae 1, Ljubljana.

DULAR, J., P. PAVLIN and S. TECCO HVALA 2003, Prazgodovinska višinska naselja v okolici Dol pri Litiji (Vorgeschichtliche Höhensiedlungen in der Umgebung von Dole pri Litiji). – *Arheološki vestnik* 54, 159–224.

DUŠA, Z. 1995, *Podobe volčanske župnije skozi 1100 let.* – Volče.

FURMÁNEK, V. 2000, Eine Eisensichel aus Gánovce. Zur Interpretation des ältesten Eisengegenstandes in Mitteleuropa. – *Praehistorische Zeitschrift* 75, 153–160.

GABROVEC, S. 1973, Začetek halštatskega obdobja v Sloveniji (Der Beginn der Hallstattzeit in Slowenien). – *Arheološki vestnik* 24, 338–385.

GABROVEC, S. 1974, Halštatske nekropole v Bohinju (Die Hallstattnekropolen in Bohinj). – *Arheološki vestnik* 25, 287–318.

GABROVEC, S. 1987, Prazgodovina Bohinja. – In: J. Dežman (ed.), *Bohinjski zbornik,* 30–35, Radovljica.

HÖFLER, J. 1988, Gradivo za historično topografijo predjožefinskih župnij na Slovenskem. Pražupniji Radovljica in Kranj. – *Acta Ecclesiastica Sloveniae* 10, 201–251.

HÖFLER, J. 2001, *Gradivo za historično topografijo predjožefinskih župnij na Slovenskem. Primorska: Oglejski patriarhat / Goriška nadškofija / Tržaška škofija*. – Nova Gorica.

KMETIČ, D., J. HORVAT and F. VODOPIVEC 2004, Metallographic examinations of the Roman Republican weapons from the hoard from Grad near Šmihel / Metalografske preiskave rimskega republikanskega orožja iz zaklada z Gradu pri Šmihelu. – *Arheološki vestnik* 55, 291–312.

de MARINIS, R. C. 2004, Iron Metallurgy in Protohistoric Italy. – In: W. Nicodemi (ed.), *The Civilisation of Iron,* 63–81, Milano.

MLINAR, M., R. KLASINC and M. KNAVS 2008, Zaščitne arheološke raziskave na Mostu na Soči leta 2001. Najdišča Maregova guna, Štulčev kuk in Plac / Rescue archaeological excavations at Most na Soči in the year 2001. The sites of Maregova guna, Štulčev kuk and Plac. – *Arheološki vestnik* 59, 189–208.

MOHORIČ, I. 1978, *Problemi in dosežki rudarjenja na Slovenskem* 1–2. – Maribor.

MUŠIČ, B. 1999, Geophysical prospecting in Slovenia: an overview with some observations related to the natural environment / Geofizikalna prospekcija v Sloveniji: pregled raziskav z nekaterimi ugotovitvami glede naravnega okolja. – *Arheološki vestnik* 50, 349–405.

MUŠIČ, B. and L. ORENGO 1998, Magnetometrične raziskave železnodobnega talilnega kompleksa na Cvingerju pri Meniški vasi (Magnetic Investigation of the Iron Age Iron-Smelting Complex at Cvinger near Meniška vas). – *Arheološki vestnik* 49, 157–186.

MÜLLNER, A. 1909, *Geschichte des Eisens in Krain, Görz und Istrien von Urzeit bis zum Anfange des XIX. Jahrhunderts*. – Wien, Leipzig.

OGRIN, M. 2006, Arheološke raziskave v Julijskih Alpah. Bohinj in Blejski kot (Archäologische Erforschungen der Julischen Alpen. Bohinj und Bleder Winkel). – In: T. Cevc (ed.), *Človek v Alpah. Desetletje (1996–2006) raziskav o navzočnosti človeka v slovenskih Alpah / Der Mensch in den Alpen. Zehn Jahre (1996-2006) Forschungen über die Anwesenheit des Menschen in den slowenischen Alpen,* 96–110, Ljubljana.

PIBERNIK, B. and F. RAVNIK 1966, Zgodovinski pregled, povzet iz arhivskih podatkov o rudarjenju in oglarjenju v Julijskih Alpah, 67–80 / Historische Übersicht der bestehenden Archivunterlagen über das Bergwesen in den Julischen Alpen, 40–55. – V: *Železar, Tehnična priloga* 8/1, 67–80, 40–55, Kranj.

PLEINER, R. 2000, *Iron in Archaeology: The European Bloomery Smelters*. – Praha.

PLEINER, R. 2006, *Iron in Archaeology: Early European Blacksmiths*. – Praha.

RJAZANCEV, A. 1963, Po poti železarskega Bohinja. – In: *Železar, Tehnična priloga* 5/2, 43–99, Kranj.

RUARO LOSERI, L., G. STEFFÈ DE PIERO, S. VITRI, and G. RIGHI 1977, *La necropoli di Brežec presso S. Canziano del Carso. Scavi Marchesetti 1896-1900.* – Monografie di Preistoria "Atti dei Civici Musei di Storia ed Arte" 1, Trieste.

RUTAR, S. 1882, *Zgodovina Tolminskega.* – Gorica.

SCHMID, W. 1939, Vače. Predzgodovinska naselbina. – *Glasnik muzejskega društva za Slovenijo* 20, 96–114.

SVOLJŠAK, D. and A. POGAČNIK 2001, *Tolmin, prazgodovinsko grobišče* I. *Katalog / Tolmin, the prehistoric Cemetery* I. *Catalogue.* – Katalogi in monografije 34, Ljubljana.

SVOLJŠAK, D. and A. POGAČNIK, 2002, *Tolmin, prazgodovinsko grobišče* II. *Razprave / Tolmin, the prehistoric Cemetery* II. *Treatises*. – Katalogi in monografije 35, Ljubljana.

ŠORN, J. 1980, Železarna na Dvoru pri Žužemberku. – In: J. Šorn, M. Matijevič, M. Žargi (eds.), *Železarna na Dvoru pri Žužemberku: zgodovina, tehnologija, izdelki,* 7–36, Novo mesto.

TERŽAN, B. 1990a, Polmesečaste fibule. O kulturnih povezavah med Egejo in *Caput Adriae* (Die Halbmondfibeln. Über die Kulturverbindungen zwischen der Ägäis und dem *Caput Adriae*). – *Arheološki vestnik* 41, 49–88.

TERŽAN, B. 1990b, *Starejša železna doba na Slovenskem Štajerskem / The Early Iron Age in Slovenian Styria.* – Katalogi in monografije 25, Ljubljana.

TERŽAN, B. 1995, Stand und Aufgaben der Forschungen zur Urnenfelderzeit in Jugoslawien. – In: *Beiträge zur Urnenfelderzeit nördlich und südlich der Alpen,* Römisch-Germanisches Zentralmuseum Mainz, Monographien 35, 323–372, Bonn.

TERŽAN, B. 1996, Sklepna beseda / Conclusion. – In: B. Teržan (ed.), *Depojske in posamezne kovinske najdbe bakrene in bronaste dobe na Slovenskem* II / *Hoards and Individual Metal Finds from the Eneolithic and Bronze Ages in Slovenia* II. – Katalogi in monografije 30, 243–258, Ljubljana.

TERŽAN, B. 2002, Kronološki oris / Chronological Outline. – In: D. Svoljšak, A. Pogačnik, *Tolmin, prazgodovinsko grobišče* II. *Razprave / Tolmin, the prehistoric Cemetery* II. *Treatises*. – Katalogi in monografije 35, 85–102, Ljubljana.

TERŽAN, B. 2008, Stiške skice / Stična – Skizzen. – In: S. Gabrovec, B. Teržan, *Stična* II/2. *Gomile starejše železne dobe. Razprave / Stična* II/2, *Grabhügel aus der älteren Eisenzeit. Studien.* – Katalogi in monografije 38, 189–325, Ljubljana.

TOMANIČ JEVREMOV, M. 1988–1989, Žarno grobišče v Ormožu (Das Urnengräberfeld von Ormož). – *Arheološki vestnik* 39–40, 277–294.

TRAMPUŽ OREL, N. 2010, Spektralne raziskave prazgodovinskih barvnih kovin v Narodnem muzeju Slovenije v obdobju 1998–2008. – *Argo* 53/1, 50–55.

TRAMPUŽ OREL, N. and D. J. HEATH 2001, Depo Kanalski Vrh - študija o metalurškem znanju in kovinah na začetku 1. tisočletja pr. n. š. / The Kanalski Vrh hoard - case study of the metallurgical knowledge and metals at the beginning of the 1st millennium BC. – *Arheološki vestnik* 52, 143–171.

TRAMPUŽ OREL, N. and B. OREL 2010, Caput Adriae and the Eastern Alps: possible metallurgical connections during the transition from the final Late Bronze Age to the Early Iron Age. – In: P. Anreiter (ed.), *Mining in European History and its Impact on Environment and Human Societies. Proceedings for the 1st Mining in European History-Conference of the SFB-HIMAT 12.–15. November 2009, Innsbruck*, (Conference Series), 99–105, Innsbruck.

Začetki železa na Slovenskem

Elementarno železo je v naravi razmeroma redko in je samorodnega in meteorskega izvora. Kovina pa se pridobiva iz kvalitetnih železovih mineralov, kot so hematit Fe_2O_3, goethit $HFeO_2$, limonit $FeO(OH)n.H_2O$, magnetit Fe_3O_4 ter siderit $FeCO_3$, katerih ležišča so ogromna, široko posejana po svetu, večkrat tudi na površini. Zato je bilo železo v nasprotju z barvnimi kovinami, katerih zaloge so bile pogosto oddaljene, njihova dobava pa strogo nadzorovana, kar je bila značilnost bronaste dobe, že v arheoloških obdobjih dostopno večini kultur.[1]

V Sloveniji je bilo v nasprotju s skromnimi bakrovimi rudišči železa toliko, da je pridobivanje železove rude predstavljalo glavno rudarsko dejavnost do konca 19. stoletja, ko je zaradi nerentabilnosti predelave in zmanjševanja rudnih zalog počasi prenehalo. Ruda več vrst in oblik (hematit, limonit, siderit) je ležala takorekoč povsod – v manjših količinah in na razsežnih območjih.Večina železove rude na Gorenjskem in Dolenjskem se je zbirala, kar pomeni, da so jo nabirali na površini; klasično rudarjenje z rovi je bilo potrebno le v Karavankah, na Štajerskem in ponekod na Dolenjskem.

Kot je razvidno iz zbranih podatkov za 18. in 19. stoletje, so tedaj največ rude našli v Triglavskem pogorju, na visokih planotah Pokljuke in Jelovice ter v Karavankah.[2] Železovo rudo (večinoma siderit s povprečno 25 % železa) so kopali v rovih v Savskih jamah, v Planini pod Golico, pod Stolom, na Zelenici in drugod. Bobovce (fižolasta zrna z železom najbogatejšega hematita in revnejšega limonita), ki so po taljenju dali do 48 % železa, so zbirali v Triglavskem pogorju, na Pokljuki in Jelovici (*sl. 1*). Fužine na Savi in v Javorniku, v Bohinjski Bistrici in Stari Fužini so delovale z rudo z lastnih rudarskih območij, plavži v Železnikih, Kropi in Kamni gorici pa so rudo morali odkupovati. Bohinjsko rudo so iskali od Rudnega polja, Koprivnika in Gorjuš do Krstenice in drugih bohinjskih planin. Bobovci so deloma ležali kar na površju, deloma pa na dnu jam, brezen in vrtač, skriti pod plastmi grušča in prsti. Iskali in zbirali so jih fužinarski rudarji pa tudi kmetje in kajžarji. Pri iskanju je sodelovalo veliko ljudi, pri zbiranju v posameznem breznu ali vrtači pa je bilo prostora le za dva ali tri rudarje. Delo v visokogorju je potekalo le poleti in jeseni, ko ni bilo snega; pozimi pa so bobovce s sanmi dostavljali v dolino k fužinam.

Drugo najbogatejše železarsko območje je bilo na Dolenjskem, izkoriščali pa so tudi rudo iz Zasavja in Bele krajine. Limonitna kosovna ruda različnih vrst – rjavi in rdeči ter peščeni in ilovnati železovec (*sl. 2*), ponekod tudi bobovec – je bila nepravilno raztrosena v naplavinah ilovice v različno debelih plasteh. V nasprotju s težje dostopnimi visokogorskimi rudišči na Gorenjskem je tukaj ruda ležala v nižinskem in zmerno gričevnatem svetu. Pri iskanju so morali razkrivati obširne njivske in travniške površine. Različne vrste železovcev, ki so vsebovali od 10 pa do več kot 50 % železa, so pri taljenju povzročale težave zaradi različne kakovosti rude. Razprostranjenost železove rude na Dolenjskem lepo ilustrirajo podatki iz dovoljenja za iskanje rude najstarejše železarne na Dvoru (1796), ki je sprva obsegalo oba bregova Krke od višine Šmihela do vključno Žužemberka in Zalisca,[3] pozneje pa se je raztegnilo na devet okrajev, Mokronog, Novo mesto, Radeče, Kostanjevica, Metlika, Trebnje, Višnja Gora, Velike Lašče, Ljubljana-okolica. Poleg Dvora in manjših železarn v Gradcu v Beli krajini in v Ponikvah južno od Turjaka je delovala tudi vrsta manjših talilnic.

Pot do odkritja uporabnega železa, ki je imelo boljše lastnosti, predvsem trdoto in žilavost, kot vsi dotedanji primerljivi materiali (kremen, baker, bron), pa je bila dolgotrajnejša in tehnološko neprimerno zahtevnejša od pridobivanja bakra in izdelave brona. Da bi dobili tršo in bolj žilavo kovino od tedaj uporabljanih bakrovih zlitin, je bilo treba izdelati železovo zlitino z nizko vsebnostjo ogljika, ki je značilna za jekla. Najpomembnejši železovi zlitini, jeklo in lito železo, se namreč razlikujeta prav v deležu ogljika. Jeklo ga mora vsebovati zelo malo (0,02–2 %), lito železo pa ga lahko ima precej več (2–5 %), vendar je zato krhko. Izdelava jekla je zahtevnejša od izdelave litega železa (grodelj), pri kateri zadostuje talilna temperatura okrog 1200 ^{0}C. Za pridobivanje jekla pa je potrebna temperatura 1530 ^{0}C in odsotnost zraka (t. i.

[1] Craddock 1995, 234–235.

[2] Podoba železarjenja na Slovenskem v 18. in 19. stoletju je skupaj s podatki povzeta po Ivanu Mohoriču (1978).

[3] Šorn 1980, 11–12.

redukcijska atmosfera), nato segrevanje železa na 750–900 ^{0}C in ohlajanje v skrbno nadzorovanih razmerah. Preiskave zgodnjih najdb jekla kažejo, da so bili tedanji kovači redko uspešni. Zato je do odkritja taljenja železa prišlo le v metalurško razvitih središčih, od koder se je postopek širil v nova območja.

Najstarejše najdbe iz taljenega železa in hetitski pisni viri podpirajo trditev starogrških virov, da so prvo taljeno železo v Starem svetu pridobivali v Anatoliji na ozemlju poznejšega hetitskega kraljestva konec 3. tisočletja pr. n. št.[4] Strokovnjaki se tudi strinjajo, da so se prvi železni izdelki razširili od tu naprej v dežele vzdolž vzhodnosredozemskih obal in v Grčijo med 15. in 13. stoletjem pr. n. št. Redke dragocene železne predmete (prstani), so že tedaj posedovali Mikenci, ki so jih verjetno pridobili s trgovskimi stiki z Anatolijo in jih tudi sami posredovali drugim.[5] Tako je med najstarejšimi izdelki v Evropi znano železno rezilo srpa iz Gánovcev na Slovaškem, odkrito v obrednem vodnjaku in datirano na začetek srednje bronaste dobe (15. st. pr. n. št.).[6] Tudi širjenje preprostih manjših železnih nožev v 12. st. pr. n. št. se pojasnjuje s trgovskim posredovanjem vzhodno sredozemskih dežel in Cipra. Sicer pa so železne najdbe pogostejše od 12. st. pr. n. št. dalje predvsem v Grčiji in na Balkanu, v 11. stoletju pa tudi na jugu italskega polotoka ter na Siciliji in Sardiniji. Le posamični primerki izvirajo iz alpskih predelov in severneje od njih.[7] Povezujejo jih z uveljavitvijo železa v Grčiji, kjer je bilo tako kot tudi na Bližnjem vzhodu kvalitetno železo za orožje in orodje v splošni rabi že od 11. stoletja dalje, ko se je tam postopoma razvila lokalna metalurgija.[8]

Mnenja o smereh, po katerih se je širilo znanje o predelavi železa v Evropo, so deljena. Na eni strani Pleiner (2000, 23–25) zagovarja tradicionalno predpostavko o vzhodni poti, po kateri naj bi se taljenje železa širilo v 1. tisočletju pr. n. št. iz egejskega območja, čez Balkan v srednjo Evropo in postopoma proti severu do Skandinavije. Pri tem navaja kot dokaz najstarejše najdbe železove žlindre in predmetov, predvsem iz Romunije. Na drugi strani pa Craddock (1999, 184–185) zagovarja zahodno pot, ki jo utemeljuje z obvladovanjem žlindranja. Postopek, ki je neizogiben za pridobivanje uporabnega železa, ni pa potreben pri taljenju oksidnih vrst bakrove rude, so razvili že v 3. tisočletju pr. n. št. na Srednjem vzhodu. Od tam naj bi se razširil preko egejskega območja na Sicilijo, Sardinijo in jug Italskega polotoka proti koncu 2. tisočletja, morda celo zaradi neposrednih mikensko-ciprskih stikov. Prevzeli in priredili krajevnim pogojem naj bi ga tudi v alpskih območjih, niso pa ga poznali v ostalih delih Evrope, kjer so talili preprostejše bakrove minerale. Novejše raziskave avstrijskih najdišč v vzhodnih Alpah namreč kažejo, da so uporabljali žlindranje v pozni bronasti dobi tam, kjer so baker pridobivali iz polimetalnih sulfidnih rud (halkopirit, bornit). Te vsebujejo veliko železa, ki je v bakru neželjeno, zato so ga odstranjevali z žlindranjem. Postopek je bil zahtevnejši od preprostega taljenja bakrove rude in zato bližji kompliciranim tehnologiji pridobivanja in obdelave železa. Tako se je prav na območju Italije in Alp pojavila najstarejša predelava železa že v začetku 1. tisočletja pr. n. št., ki jo je po Craddockovem mnenju omogočilo obvladovanje postopka žlindranja pri bakru.

Tudi prebivalci današnjega slovenskega ozemlja so bili med prvimi v Evropi, ki so spoznali železo. Razloge vidimo v legi našega ozemlja med severnim Jadranom, vrhom Italskega polotoka in Vzhodnimi Alpami, ki je omogočala sredozemskim rudosledcem razmeroma ugoden dostop od morja ali s Furlanske nižine proti notranjosti predalpskega in alpskega sveta, bogatega z bakrom, železom in drugimi rudami. Na trgovske in prometne povezave ob koncu pozne bronaste dobe med severnojadranskim zaledjem in vzhodnoalpskimi dolinami kažejo že bikonični ingoti iz specifičnega polimetalnega bakra, ki so se pojavili prav v zahodni Sloveniji in Furlaniji konec 11. st. pr. n. št. Načrtne kemijske analize depojskih najdb so omogočile, da za precejšnje število teh polizdelkov predpostavljamo izvor iz polimetalne sulfidne bakrove rude vrste *medlica* (nem. *Fahlerz*, angl. *fahlore*), ki poleg tetraedrita in tenantita vsebuje tudi nikljeve in kobaltove arzenide. V Evropi je le omejeno število takih rudišč, nam najbližja so v štajerskem delu Vzhodnih Alp (Nizke Ture), medtem ko jih v Sloveniji ne poznamo. Zato sklepamo, da je bila kovina iz omenjene rude predmet trgovanja med

[4] Craddock 1995, 236–237, 256–257.

[5] de Marinis 2004, 64–65.

[6] S kronološko opredelitvijo srpa se ujema tudi starost lesene obloge vodnjaka – nekalibrirani rezultat analize ^{14}C je 1465 ± 35 let pr. n. št. (Furmánek 2000, 155, 158).

[7] Za Romunijo Boroffka 1987, 55, 61: železni predmeti z romunskih najdišč Cernat (11. st.), Deva (12. st.); za Italijo de Marinis 2004, 66–67: grobišči Castellace (Calabria) in Molino della Badia (Catania), oboje 11. st.; za severnejša območja Evrope Pleiner 2000, 24–25 (večinoma manj zanesljive datacije najdb).

[8] de Marinis 2004, 65.

prebivalci vzhodnoalpskih dolin in širšim zaledjem severnega Jadrana.[9] Tako so se prav na tem območju pojavili tudi prvi uvoženi železni predmeti pri nas – majhna rezila in noži, kakršni so bili že omenjeni za vzhodno Sredozemlje v 12. st. pr. n. št. Podobno kot najstarejše najdbe v Italiji in na Balkanu tudi te lahko povežemo z uveljavitvijo železa v Grčiji in s širjenjem izdelkov na sosednja območja. Rezila izvirajo iz najstarejših grobov v Tolminu (grob 417) in Brežcu pri Škocjanu (grob 272, 158), na kar je prva opozorila Teržanova (1995, 360). Inventar teh grobov je opredelila v stopnjo Ha B1–2 v časovno obdobje med sredino 11. in koncem 10. stoletja, železna rezilca pa pojasnila kot predhodnike uvajanja železarjenja v zaledju severnega Jadrana na prehodu 2. v 1. tisočletje pr. n. št. (*sl. 3*).[10]

Na zgodnje stike zahodnega dela Slovenije z egejskim prostorom v sledečih stoletjih kažejo tudi prvi primerki železnega orožja pri nas – železni meč in sulični osti značilnih egejskih oblik, ki so bili odvrženi v svetiščno brezno Mušja jama pri Škocjanu. To, da so bili poznani v Grčiji v 9. st. pr. n. št., je prav tako izpostavila Teržanova, ki je argumentirano sklepala tudi na neposredne povezave med prebivalci Posočja in Egeje na koncu pozne bronaste dobe. V grobovih 10. stoletja v Tolminu je namreč definirala žensko nošo, ki se je tedaj nosila tako v širšem zaledju severnega Jadrana kot tudi na kraško-posoškem območju, obenem pa na grških otokih Kreti, Cipru, Rodosu, Evboji in ponekod na grški celini. Označeval jo je bronast (in ne železen) nakit in sicer masivni prstani in bronaste enozankaste polmesečaste fibule. Teržanova sklepa, da enak nakit ni bil le posledica trgovskih stikov med obema območjema temveč morda pomeni dejansko priselitev posameznikov iz Egeje na prelomu 2. tisočletja.[11]

V 9. in 8. stoletja pr. n. št. se je pri nas pojavil prvi železni nakit – ovratnice, zapestnice in nekatere fibule. Glede na dosedanje raziskave utegnejo biti med najstarejšimi v Sloveniji železne ovratnice in zapestnice iz Ormoža (grob 7) in Ruš kot sestavni del ženske noše, ki je sicer imela enak nakit, vendar iz brona, in je bila značilna za prostor med Slovenijo in spodnjim Podonavjem v času 9. in zgodnjega 8. stoletja.[12] Podobne železne ovratnice in zapestnice se pojavijo tudi na grobiščih v zahodni Sloveniji (Brežec pri Škocjanu – grob 209, Tolmin – grob 342, Šmihel, Križna gora). Tam se pogosto nahajajo skupaj z (zgodnjimi) bronastimi enozankastimi ločnimi fibulami, zaradi katerih jih je Teržanova datirala v 1. pol. 8. stoletja.[13] Enak železni inventar pa se nahaja tudi v osrednji Sloveniji (npr. bronasta ovratnica in železna spiralna zapestnica v grobu 64 v Ljubljani) v horizontu Ljubljana II b, ki ga je Gabrovec (1973) opredelil kot začetek "železnega horizonta" v 2. polovico 8. st. Teržanova je v tem primeru predlagala prestavitev pojava železa v Ljubljani v zgodnejši čas, tj. v 1. polovico 8. stoletja, ker se ji v nasprotnem primeru zdi časovna razlika med podobnima železnima inventarjema ormoškega groba 7 in ljubljanskega groba 64 prevelika.[14]

Fibule, ki obogatijo železni nakit v 8. stoletju, so dvozankaste polmesečaste fibule in ločne fibule. Prve so značilne predvsem za zahodne predele Slovenije, tip Basarabi z visoko ramenasto nogo celo kaže povezave Tolmina in nekaterih drugih zahodnih najdišč s spodnjim Podonavjem v 8. in v začetku 7. st.[15] Med ločnimi fibulami pa so železne dvozankaste fibule vodilne v zahodni in osrednji Sloveniji v 2. polovici 8. st.,[16] med tem ko Teržanova opozarja tudi na železni dvozankasti fibuli s Poštele, katerih analogije vidi na balkanskem oziroma karpatskem prostoru že v 8. stoletju. Ob tem nakazuje, da ima pri prvem pojavu železa Podravje morda celo prednost pred osrednjim slovenskim prostorom.[17]

V okviru stopnje Podzemelj 1–2, v 2. polovici 8. st. pa se železo tudi pri nas pojavi v svoji pravi vlogi – kot najboljši material za orožje in orodje zaradi svoje izjemne trdote in obenem žilavosti. Pojavu orožja je mogoče slediti v grobovih bojevniško urejene družbe v dolenjski halštatski skupini, v kateri je lepo razvidna številčna prevlada sloja oboroženih moških nad neoboroženimi[18] in zato tudi veliko število orožja. Prenehanje uporabe

[9] Trampuž Orel, Heath 2001, 161; Trampuž Orel, Orel 2010, 103–104; Trampuž Orel 2010, 52–54.

[10] Teržan 2002, 87, 91.

[11] Teržan 1990a, 60, 61, sl. 8: 3–5; Teržan 1995, 360–361; Teržan 2002, 100–101, str. 96 karta 2.

[12] Teržan 1990b, 23; za grob 7 z železnim nakitom iz Ormoža gl. Tomanič Jevremov 1988–1989, 281–284, t. 13: 1–2.

[13] Teržan 2002, 93–94.

[14] Teržan 1990b, 63.

[15] Teržan 1990a, 57, sl. 4: 1, sl. 5; Teržan 2002, 98, karta 4 s citirano literaturo.

[16] Gabrovec 1973, 343.

[17] Teržan 1990b, 23.

[18] O tem Teržan 2008, 238–245, 258 v nedavno objavljeni vsestranski analizi strukture pokopov v gomili 48 v Stični.

bronastega napadalnega orožja in širjenje železnega orožja (sulice, sekire) na Dolenjskem predvidevamo od začetka 7. st. dalje. O prehodu na uporabo železnega orodja ne moremo sklepati podobno, ker v halštatskem obdobju ni bilo običajno prilaganje orodja v grobove (razen redkih izjem), podatkov pa nimamo tudi zaradi neraziskane notranjosti halštatskih naselbin. Vsekakor se pojavi železno orodje v grobovih idrijske skupine s prihodom Keltov in s prevlado latenske kulture.

Kar zadeva najstarejšo domačo proizvodnjo železnih izdelkov, zaenkrat nimamo zanesljivih dokazov, kot so kovaške delavnice in orodja. Razlog je še neraziskana notranjost halštatskih naselbin ali pa nepopolna objava zelo redkih izkopavanj naselbin (Zgornja krona nad Vačami, Most na Soči). Zato pa imamo posredne dokaze za lokalno pridobivanje železa – železove žlindre in kurišča talilnih peči, predvsem iz starejše železne dobe. K temu je veliko prispevala obsežna in temeljita študija poselitvenih, gospodarskih in družbenih struktur v omenjenem obdobju na območju Dolenjske, Bele krajine in Posavja (Dular, Tecco Hvala 2007). V okviru načrtnih raziskav so se izvajala sondiranja robov naselbin, ki so med drugim odkrila žlindro v večini dolenjskih halštatskih središč, večina naselbin iz starejšega halštata pa je bila tudi postavljena v neposredni bližini železovih rudišč.[19] Sondiranje gradišča Kostjavec nad Tihabojem v Mirenski dolini je odkrilo železovo žlindro v kulturnih plasteh, ki jih je bilo mogoče na podlagi gradiva tudi kronološko opredeliti (stopnja Podzemelj 2) v prvo polovico 7. st. pr. n. št.[20]

Neposrednih dokazov o pridobivanju železa, kot so talilne peči, je neprimerno manj. Najpomembnejše je še vedno sodobno odkritje železarskih talilnih peči na ledini Branževec nad vasjo Sela pri Dolenjskih Toplicah leta 1986, do katerega je prišlo ob začetku sondažnih raziskav poznobronastodobnega in starohalštatskega utrjenega naselja na Cvingerju pri Dolenjskih Toplicah. Do sedaj največji železarski talilniški prostor pri nas z dobro dokumentiranimi talilnimi jamami, ki po mnenju raziskovalcev pripadajo kuriščem dvanajstih (neohranjenih) peči, se nahaja izven gradišča. V jamah so bili odkriti ostanki prežgane ilovice, oglje in železova žlindra. Glede na rezultate radiokarbonske analize oglja in magnetometričnih raziskav talilniškega območja pripada celotni talilniški obrat z domnevno okrog sto pečmi in s površino približno 5000 m^2 in starejši železni dobi.[21] Temeljite metalografske in spektralne analize sestave žlindre in jamskih ilovnatih oblog s tega izjemnega najdišča bi bile temeljnega pomena za poznavanje domače tehnologije taljenja železa v starejši železni dobi na Dolenjskem. Poznejšega izvora je okrogla jama s kuriščem na dnu, s fragmenti žlindre in latenske keramike, odkrita leta 1979 po večletnih zaščitnih izkopavanjih poznoantičnih stavb znotraj železnodobnega naselja na Kučarju pri Podzemlju. Zaradi manjše dimenzije jame in uničenega zgornjega dela domnevne peči naj ne bi služila taljenju železove rude, temveč nadaljnji predelavi železa v uporabno železo. Datirana je na konec mlajše železne dobe.[22]

Na lokalno predelavo železa kažejo tudi posamične najdbe vmesnih produktov taljenja, kot so železne pogače ali "volki" in železova žlindra z drugih območij Slovenije (*sl. 4*). Med železarske polizdelke seveda sodijo tudi ingoti, ki so med redkejšimi najdbami pri nas. Pripadajo različnim obdobjem, lahko so rezultat domače predelave železa ali pa sodijo med standardne oblike polizdelkov v trgovanju z železom. Med arheološkimi izkopavanji v drugi polovici 20. stoletja sta bila odkrita dva verjetno železnodobna ingota. Majhen železen ingot v obliki bloka izvira iz železnodobne naselbine na Kučarju.[23] Drugi železni ingot nepravilne oblike je površinska najdba z naselbine na Špičastem hribu nad Dolami pri Litiji, ki je živela v halštatskem in nato v poznolatenskem obdobju.[24] Ostali primerki so bolj ali manj naključne najdbe (*sl. 5*). Med izstopajočimi je nedvomno velik ulit železen dvojnopiramidalen ingot s kovanima paličastima zaključkoma z Ledin pri Lescah, dolg 67 cm in težak 7 kg (*sl. 5:* 1). Bil je odkrit kot zadnji od treh ingotov istega tipa leta 2007 ob geološkem obhodu gorenjske avtocestne trase Vrba–Peračica. Ingot ima dobre analogije v podobno velikih in težkih keltskih dvojnopiramidalnih ingotih iz latenskodobnega drugega depoja iz Sauggarta v Würtembergu.[25] Ingoti te vrste so se razširili po Evropi med začetkom 5. in sredino 1. st. pr. n. št. na območjih, kjer so prebivali Kelti, ali pa so bila pod keltskim vplivom. Značilno kovane zaključke

[19] Dular, Tecco Hvala 2007, 214–216.

[20] Dular, Pavlin, Tecco Hvala 2003, 188.

[21] Dular, Križ 2004, 228–229; Mušič, Orengo 1998, 157–186; Dular, Tecco Hvala 2007, 184, 217.

[22] Dular, Ciglenečki, Dular 1995, 54–55; Dular, Tecco Hvala 2007, 216–217.

[23] Dular, Ciglenečki, Dular 1995, 62–63, 69–70, t. 76: 18; J. Dular vidi odlične analogije v ingotih iz Manchinga.

[24] Dular, Pavlin, Tecco Hvala 2003, 175–176, sl. 24.

[25] Pleiner 2006, 28–29, sl. 7: 1–6.

pojasnjujejo kot zunanji dokaz odlične kovnosti in razteglјivosti železa v takšnem ingotu. Njihova posebna oblika je podobna starejšim ingotom, ki pa imajo pogosto navrtano luknjo in so bili razširjeni v osrednjih predelih Evrope. Datirani so v pozno halštatsko obdobje (med 6. in 5. st. pr. n. št.) in zdi se, da posnemajo dvojnopiramidalne ingote iz novoasirskega obdobja. Ti imajo praviloma navrtane luknje zaradi lažjega transporta in so bili prvič odkriti v palači v Khorsabadu (Irak) v zakladni najdbi Sargona II., datirani v pozno 8. st. pr. n. št.[26] Tudi manjši ingot podobnega tipa s krajšimi zaključki, najden nad Bukovco blizu Laškega (*sl. 5:* 2), ima analogije v latenski depojski najdbi Sauggart.[27] Ingot v obliki kvadra, najden na Gradcu pri Mihovem na Dolenjskem (*sl. 5:* 3), in ingot v obliki kocke z Glinjeka nad Polšnikom (*sl. 5:* 4) pa se zdita po teži, velikosti in obliki bolj podobna rimskim ingotom – masivnim blokom – s koroške Štalenske gore (Magdalensberg) ali iz Siska in Hrvatske Dubice.[28]

Nadaljevanje železarjenja v naslednjih obdobjih, ki mu prav tako še ne sledimo v sistematičnih arheometalurških raziskavah, si razlagamo z bogatimi zalogami železove rude pri nas, ki so morale biti v prazgodovini zelo obsežne glede na njihovo dolgo trajanje še globoko v novi vek. Po dragocenih izdelkih italskih delavnic, najdenih predvsem v grobovih veljakov dolenjske halštatske skupnosti v 7. st., sklepamo, da so zaloge našega železa pritegnile gospodarski interes sosedov, predvsem bližnjih severnoitalskih skupnosti in posredno morda tudi Etrurije. O morebitnih prednostih naše železove rude glede na njeno kvaliteto in lahko dostopno površinsko lego v primerjavi z rudo na bližnjih rudnih območjih avstrijske Koroške, Štajerske in drugje lahko samo ugibamo, ker še nimamo načrtnih mineraloških in metalografskih raziskav rude in žlindre. Isto velja za zahtevne postopke pri pridobivanju kovnega železa, o katerih domnevamo, da so jih lokalni kovači obvladovali, pa jih še nismo preverili. Kot smo že poskusili prikazati na začetku tega prispevka, navezujemo naše domneve na prihod tujih rudosledcev in metalurgov iz Egeje, ki so svoje dragoceno tehnološko znanje posredovali najprej v južne predele Italskega polotoka, kjer se je metalurgija železa uveljavila s pomočjo Etruščanov v 9. in 8. stoletju in se nato postopoma širila med lokalne skupnosti proti severu v Padsko nižino in od tam v alpske predele.[29]

Poleg dolenjske halštatske skupnosti, ki je zavzemala eno od dveh velikih železarskih območij – Dolenjsko z Belo krajino in Zasavjem – je imela izstopajoči družbeni in gospodarski položaj tudi posoška (svetolucijska) halštatska skupnost. Kot naslednica tolminske skupnosti je poleg Posočja obvladovala tudi Bohinj s Triglavskim pogorjem, ki je bilo drugo veliko železarsko območje. Arheološke najdbe kažejo, da je bila Bohinjska kotlina naseljena konec 7. stoletja pr. n. št., torej v času, ko je bilo železo pri nas že v uporabi. Naseljenci so gotovo prišli s Tolminskega – po najtežjih poteh čez visoke prelaze Spodnjih bohinjskih gora, verjetno tistih med Rodico in Lanževico, kjer so dostopi najbližji. Na njihovo pripadnost posoški skupnosti in gospodarskemu središču Mostu na Soči kaže enako grobno obredje in ženska noša s svetolucijskimi fibulami iz grobov v Bitnjah, Lepencah in Jereki. V Bohinju so se naselili načrtno kot rudarji in železarji, kar kažejo ostanki železarskih talilnih jam in precejšnje količine žlindre z dveh prazgodovinskih postojank v dolini – na Ajdovskem gradcu pri Bohinjski Bistrici in Dunaju pri Jereki.[30] Zaradi bogate železarske tradicije je v Bohinju poleg prazgodovinske žlindre mogoče najti tudi žlindro iz poznejših obdobij (do konca 19. st.), ko se je ruda zaradi odkritja vpihavanja zraka v plavž na vodni pogon talila le v dolini. Zato bi bile še posebej pomembne za dokazovanje prazgodovinskega železarjenja najdbe žlindre in talilnih jam ali peči v visokogorju. Kajti železodobni rudarji, ki so zbirali bobovce po visokih bohinjskih planinah podobno kot Zoisovi 2400 let pozneje, so morali železo s Triglavskega pogorja dostavljati matični skupnosti na Mostu na Soči. Ker je najvažnejša zveza s tolminsko stranjo še v 19. stoletju potekala čez 1900 m visok prelaz Škrbina,[31] je mogoče predpostavljati enako pomembno vlogo tega in sosednjih prelazov tudi v starejši železni dobi, npr. prelaza Globoko, s katerega se z bohinjske strani celo odpira pogled na Tolmin. Vabljiva je torej

[26] Pleiner 2006, 23–32, sl. 5: 1–10, 6 : 4–5, 7: 6.

[27] Pleiner 2006, 28–29, sl. 7: 2.

[28] Pleiner 2006, 39–43, sl. 17: 6,7.

[29] de Marinis 2004, 66–68.

[30] Gabrovec 1974, 299; Gabrovec 1987, 30–35; sodobne geofizikalne raziskave Ajdovskega gradca z magnetometrijo so še potrdile obstoj in obseg metalurških aktivnosti – gl. Mušič 1999, 401–402.

[31] Kot poroča Rutar (1882, 272), so tedaj čez Škrbino najpogosteje hodili in tudi izvažali bohinjsko živino na Tolminsko. Ob današnjem poznavanju razmer je vendar treba pripomniti, da je ta prelaz z bohinjske strani za živino težko dostopen.

predpostavka, da bi bilo rudo tedaj bolj smotrno taliti na višinah, kjer je bila nabrana, kot pa jo nositi v dolino in nato ponovno tovoriti čez visoko gorsko verigo na tolminsko stran.[32] Na talilne peči v visokogorju je prvi pomislil A. Rjazancev, zdravnik, ki je s strokovno ekipo geologov, mineralogov in kemikov prvi iskal višinske sledove rudarjenja, železarjenja ter nahajališča preostalih bobovcev na planinah Triglavskega pogorja za Tehniški muzej Železarne Jesenice v 60. letih 20. stoletja.[33] Takrat so namreč na Komni našli do sedaj edino žlindro z visokogorja, ki so jo tudi analizirali. Najdba, ki bi jo bilo treba danes identificirati, utemeljuje smiselnost nadaljnega preiskovanja bohinjskih planin, da bi tam odkrili dokaze tako morebitnega visokogorskega prazgodovinskega železarjenja kakor tudi prazgodovinskih povezav s Tolminsko. Z arheološkimi topografskimi pregledi in sondiranji planin na Pokljuki, Zadnjem Voglu, Lepi Komni, Jelovici in drugod pa je pred leti prvič začela Mija Ogrin (Gorenjski muzej) in odkrila sledove občasnega bivanja iz bronaste dobe in predvsem iz rimskega obdobja.[34]

Rjazancev je z ekipo izvedel tudi prva poskusna taljenja rude v vetrni peči, ki so bila za tedanji čas zelo napredna. Dokazala so, da dajo določeni bobovci z velikim deležem železa (več kot 80 %) in primernim deležem kremena, ki so jih nabrali na Dednem polju, železo, podobno jeklu. Šele pred desetimi leti se je ponovnih poskusov taljenja lotil metalurg I. Cundrič iz Bohinja in rezultate tudi objavil (2002). V vetrni peči ni uspel staliti rude, morda tudi zato, ker je uporabil limonitno rudo, nabrano na Mrzlem studencu na Pokljuki, ki je revnejša z železom. Uspešen je bil drugi preizkus taljenja, pri katerem je uporabljal vpihavanje zraka z ventilatorjem. Taljenje je trajalo sedem ur, rezultat je bil 5 kg težak volk, očiščen žlindre. Vseboval je jeklo s feritno strukturo in cementitom.[35]

Raziskave začetkov našega železarstva so žal neprimerljivo skromnejše v primerjavi z vplivom, ki ga je imelo železo na razvoj železnodobnih skupnosti na Slovenskem, in s poznejšim pomenom domačega železarstva, ki je ostalo ena bistvenih gospodarskih panog pri nas do začetka 20. stoletja. Prvi arheolog, ki je začel raziskovati železarjenje, je bil A. Müllner konec 19. stoletja. Prispeval je temeljno delo o zgodovini železarstva, v katerem je obravnaval problematiko rudišč in železarskih obratov od arheoloških obdobij do 19. st.; njemu dolgujemo tudi popis prazgodovinskih železarskih postojank (med drugim tudi Vače, Magdalenska gora pri Zgornji Slivnici, Cvinger pri Stični, Cvinger pri Dolenjskih Toplicah, Vinji vrh, Kučar pri Podzemlju, Breznik pri Dragatušu itd.).[36] Müllnerjevo problematiko je nadaljeval W. Schmid v 30. letih 20. st. z raziskovanjem nekaterih naselbin s talilnicami in kovačnicami (Kučar v Beli krajini, Ajdovski gradec in Dunaj pri Jereki v Bohinju, Vače). Žal je svoja izkopavanja navadno slabo dokumentiral, objavil pa je raziskave stavb in analize žlindre na Spodnji in Zgornji kroni pri Vačah.[37] Nato je zanimanje za načrtne raziskave železa takorekoč zamrlo, razen posamičnih pobud, ki pa se niso nadaljevale v obširnejše raziskave.

Enakovrednih arheoloških dokazov o železarjenju tako v mlajši železni dobi kakor tudi v rimskem in sledečih srednjeveških obdobjih še nimamo. Vrzel bi lahko zapolnile načrtne metalografske raziskave železove rude, žlindre, polizdelkov in izdelkov, ki pa se še vedno niso začele. Med arheologi pri nas take preiskave niso preveč priljubljene, ker zaenkrat odvzem precej velikega vzorca za domačo metalurško preiskavo predmet precej poškoduje. Kljub

[32] Spomin na nekdanje vezi s posoško stranjo se je do danes ohranil v eni izmed bohinjskih šaljivih pripovedk in v ustnem izročilu iz Volč pri Tolminu. Oba vira se navezujeta na nekdanje pokopavanje Bohinjcev na primorski strani v Volčah. Pripovedka (Cvetek 1993, 216) govori o pomoti pri tovorjenju bohinjskega pokojnika čez prelaz Bača na Primorsko – njegov zaboj so zamenjali z zabojem suhih hrušk – in o fari Volče. Ustno izročilo iz Volč pri Tolminu (Rutar 1882, 34; Duša 1995, strani neoštevilčene) pa tudi pravi, da so nosili prvi kristjani celo iz Bohinja svoje mrtve pokopavat k Sv. Danijelu v Volče. Sv. Danijel je bila namreč najstarejša cerkev v zgornjem Posočju, Volče pa njegova pražupnija v poznem 10. stoletju (Höfler 2001, 21, 82). Ob istem času je bohinjska župnija, nasprotno, spadala v okvir rodinsko-radovljiške pražupnije (Höfler 1988, 207–209). Obe ustni izročili torej sporočata določeno neskladnost bohinjskega grobnega obredja s cerkveno ureditvijo, namreč da so Bohinjci nekdaj pokopavali v Volčah namesto v Rodinah ali Radovljici. To, da so pri tem morali prečiti celo gorske prelaze, kaže na globoko duhovno povezavo Bohinjcev s Posočjem, ki bi jo lahko pojasnili s predkrščanskim prazgodovinskim izročilom.

[33] Rjazancev 1963; številne strokovne razprave in poročila (tudi njegovih sodelavcev) o tem projektu so izšle v ostalih Tehničnih prilogah Železarja 4/2 (1962), 5/2 (1963), 6/1 (1964) in v 8/1 (1966), v kateri Pibernik in Ravnik (str. 80) omenjata najdbe žlinder na Komni.

[34] Ogrin 2006, 96–106.

[35] Cundrič 2002, 109–119.

[36] Müllner 1909.

[37] Schmid 1939. Le z njegovih izkopavanj so znani železarski polizdelki – ostanki zavrženega železa ("svinje") in železove pogače ("volki").

obilici značilnega latenskega železnega orožja in orodja, ki se je pojavljalo od 4. stoletja pr. n. št. dalje, tako še ne poznamo tehnoloških lastnostih teh izdelkov, niti morebitne kvalitete železa, ki se pripisuje izpričanemu slovesu keltskih kovačev. Izjemo predstavlja arheometalurška študija petih kosov železnega rimskega orožja iz rimskega republikanskega obdobja (3./2. st. pr. n. št.) iz zaklada z Gradu pri Šmihelu, v kateri je pojasnjena različna tehnološka kakovost rimskih izdelkov.[38] Zato pa nam še vedno ni jasno razmerje do znamenitega noriškega železa, ki naj bi se pridobivalo le na Koroškem in Gradiščanskem in je bilo pravzaprav že jeklo. Morda pa bodo pridobivanje prazgodovinskega jekla odkrile metalurške preiskave železnih fragmentov iz zaščitnih izkopavanj najdišča Maregova guna na Mostu na Soči?[39]

[38] Kmetič, Horvat, Vodopivec 2004.

[39] Mlinar, Klasinc, Knavs 2008 (M. Mlinar, ustna informacija: železni fragmenti so bili najdeni v železnodobni plasti SE 10 in niso objavljeni).

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