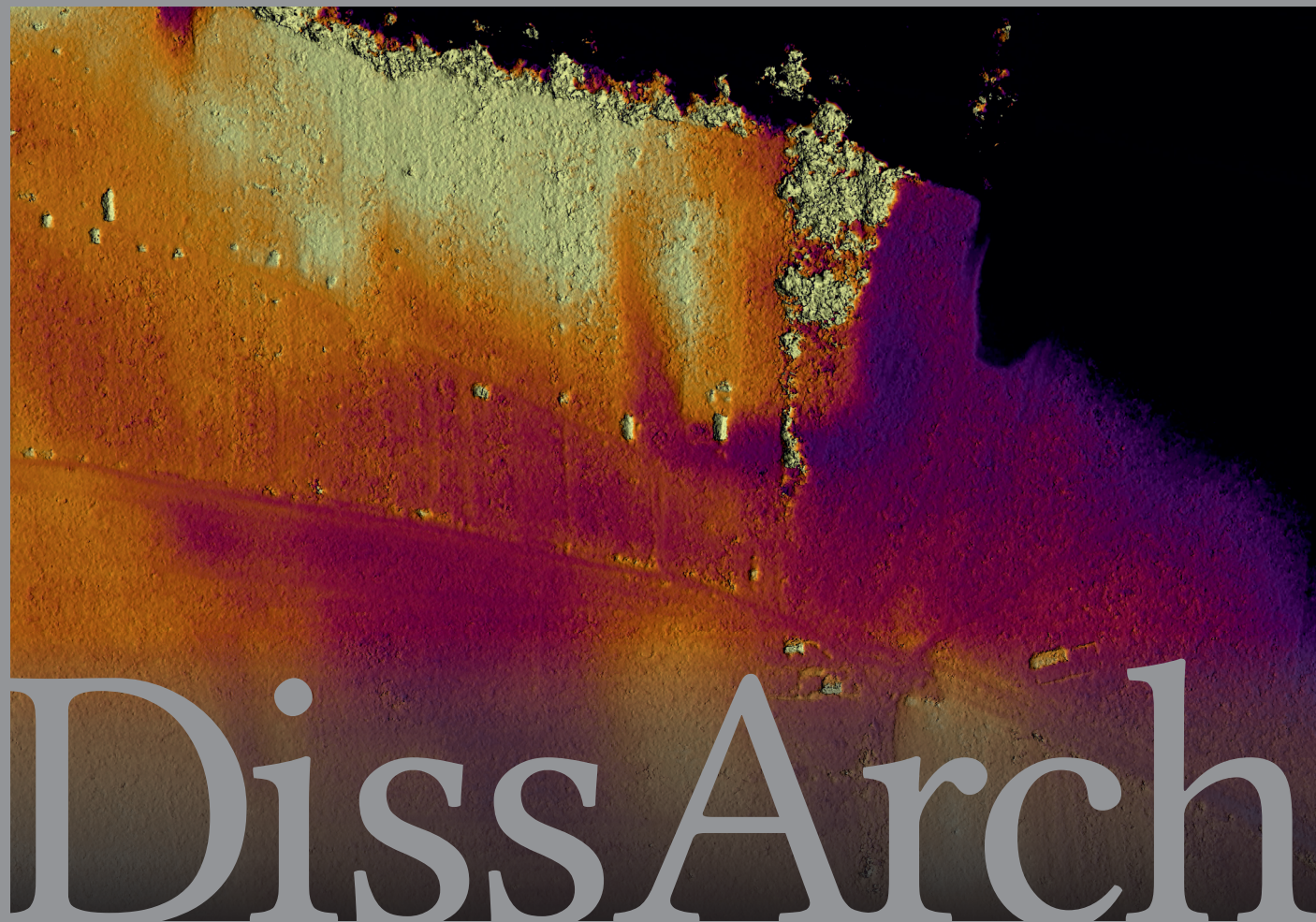


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Celtic plough and land use based on agricultural tool finds from the *oppidum* of Velem-Szent Vid

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Abstract: The paper focuses on a group of finds obtained recently in a metal detector survey in the area of Velem-Szent Vid. Most artefacts found in the late La Tène *oppidum* are agricultural tools. They are the most important archaeological evidence available to us for reconstructing the agricultural equipment used during the Late Iron Age and, based on them, food production techniques. Diverse tools were utilised in specific agricultural processes. The plough, the most important tool of soil cultivation, and its components are discussed in the study, and an attempt is made to draw conclusions about the ways of land use in the Late Iron Age based on plough part finds from Celtic contexts.

Keywords: plough, agricultural tool, depot, tillage, *oppidum*, Late Iron Age

Brief overview of the site and its research history¹

Velem-Szent Vid is an emblematic site of Hungarian archaeology; continuous research has been carried out there, with longer and shorter interruptions, since the 19th century.² The fortified site is located in the Kőszeg–Rohonci Mountains, one of the easternmost reaches of the Alps (Fig. 1). According to our current knowledge, the first humans occupied the area in the Late Bronze Age,³ establishing (based on the vast number of discovered finds and features) a large and intensive Late Bronze Age settlement. Most finds from this period indicate that the earliest fortifications were also erected during this time.⁴ The size of the inhabited area and the intensity of the inhabitation decreased considerably during the Early Iron Age. The relationship between the two periods has remained unclear, as excavations have not yielded conclusive evidence of the continuity of the Late Bronze and Early Iron Age settlements.⁵

1 For a detailed summary of previous research, see CZAJLIK 1993, 317–327; FEKETE 2008a; ILON 2013, 7; ILON 2015b, 9–14. Site ID in the National Register of Archaeological Sites of Hungary: 38732.

2 KÁRPÁTI 1896, 295–304; MISKE 1896; HAMPEL 1896, Tabs 235–261; MISKE 1908; FOLTINY 1958, Anm. 1–2; BÁNDI – FEKETE 1974; FEKETE 1986, 59–63; SZABÓ 2003; GUILLAUMET 2000; BUCHSENSCHUTZ et al. 1990a; BUCHSENSCHUTZ et al. 1990b; SZABÓ et al. 1994; MARTON 1995; MARTON 1996a; MARTON 1996b; BARRAL et al. 1996; MARTON 1998; GUILLAUMET et al. 1999, 383–408; CZAJLIK 2000; ILON 2006; ILON 2007; ILON 2013; ILON 2015a.

3 BÁNDI – FEKETE 1974; FEKETE 2008a, 85.

4 ILON 2006; ILON 2007; ILON 2015b.

5 MARTON 1995; MARTON 1996a.

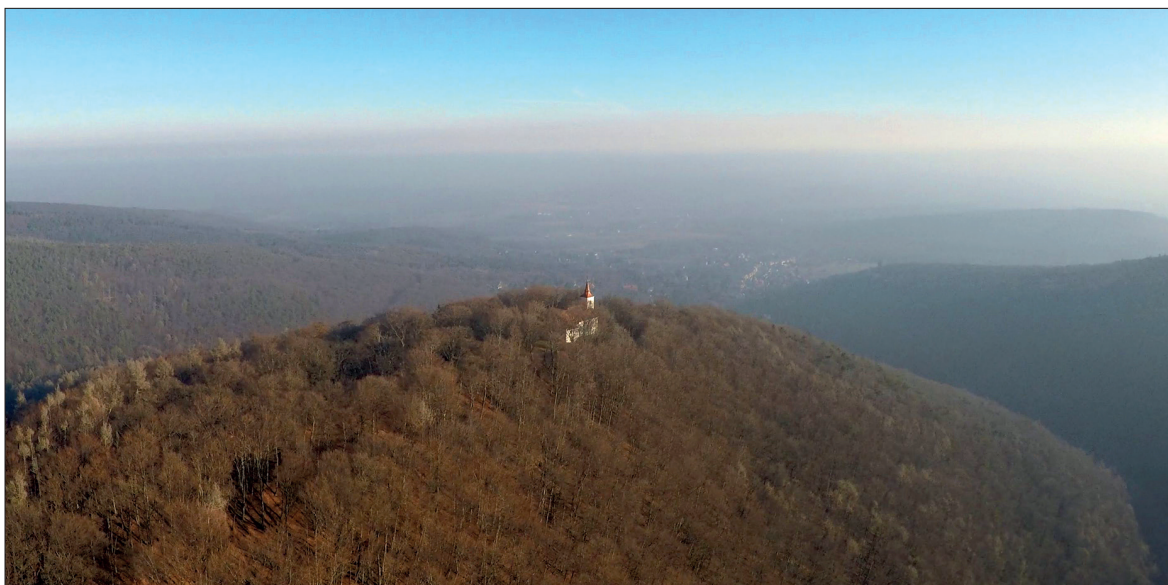


Fig. 1. Velem-Szent Vid. The archaeological site and its surroundings (photo by K. Tankó)

A significant change occurred in the utilisation of the area during the Middle and Late La Tène periods of the Late Iron Age. Previously and newly discovered artefacts suggest a substantial Celtic settlement on the site; besides, the find material indicates significant industrial and economic activity there. The stepped terraces and imposing ramparts were likely also constructed in this period. Based on these characteristics, Velem-Szent Vid fits the classification of *oppida* north of the Alps well.⁶ The *oppidum* was inhabited from the 3rd to the 1st century BC.⁷

Roman imperial artefacts are extremely scarce in the record of the site, raising the possibility that the Celtic inhabitants of Szent Vid abandoned the *oppidum* at the time of the Roman conquest, presumably in connection with the founding of Savaria. As for the later historical periods, no settlement that covered the entire site was ever established again; the few known stray finds could be linked with various peoples appearing in the region during the Migration Period. In medieval times, only the top of the mountain was used. The first written mention of the mountain, as *Uitinesberc/Uitanesberc*, appears in a Carolingian perambulation from AD 860.⁸ Excavations on the eastern summit revealed the foundations of a 9th-century AD Carolingian church, which may have had a Roman precursor, perhaps a watchtower. What the surface forms at the highest point of the western rampart outline might have been a small fort in the Árpád Age—a theory that has yet to be proven by excavation. In the Middle Ages, a palisade fort was built on the plateau, which was likely besieged, judging from the numerous crossbow arrowheads scattered amongst its remains. In modern times, a chapel was built on the mountaintop, around which religious events still take place today.⁹

Previously, the area of Velem-Szent Vid was predominantly used for viticulture, with only a small part dedicated to grain and potato cultivation in the Modern Period. Today, most of the 30-hectare hillfort settlement is covered by forests, and intensive foresting activity represents its biggest threat. Besides, illegal metal detectorists looking for Bronze Age artefacts and Celtic coins frequently visit the covered, undisturbed parts of the site.

6 FICHTL 2000, 12–16, 184.

7 GUILLAUMET et al. 1999.

8 FEKETE 2008a, 85, with further references.

9 FEKETE 2008a; FEKETE 2008b.

The Eötvös Loránd University has conducted archaeological research at Velem-Szent Vid for decades,¹⁰ including a metal detector survey programme between 2017 and 2023. The primary objective of collecting metal finds from the surface and a shallow depth was to improve our understanding of the site and mitigate the damage caused by illegal metal hunters frequenting the area of Szent Vid. The research, carried out in several campaigns, yielded a significant number of metal finds. The findspot coordinates of every collected item were recorded, and the find circumstances were documented according to pre-established protocols. Most finds (about 70%) could be dated to the Late Bronze Age, followed in number by the relics of the late La Tène period (around 20%). Early Iron Age artefacts comprised only a small part of the recovered find material (approximately 5–6%). Items from the Roman and Carolingian periods were scarce, comprising only 1–2% of the finds. Medieval and modern artefacts (2–3%) were found predominantly near the top, particularly around the Baroque chapel.

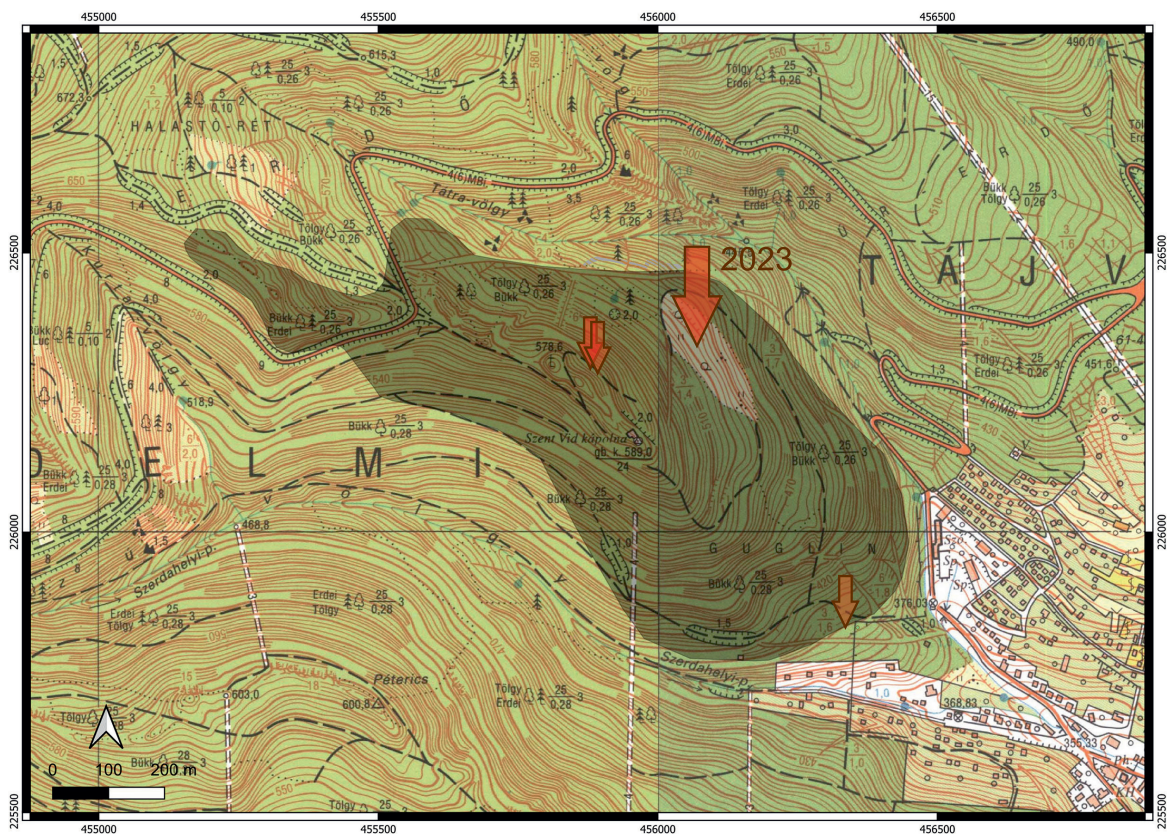


Fig. 2. Velem-Szent Vid. The largest extent of the archaeological site; red arrows mark the findspots of agricultural tool depots (red arrows)

The finds

Iron tools are predominant among the metal detector finds of the late La Tène period. During the 2017–2018 campaign, three agricultural depots were systematically unearthed, and numerous stray finds were recovered from the surface or a shallow depth. In 2023, the list was completed with another depot containing agricultural iron tools (Fig. 2). The evaluation of the first three (meticulously documented) depots was published in a study in 2019.¹¹ The iron

10 BUCHSENSCHUTZ et al. 1990a; BUCHSENSCHUTZ et al. 1990b; SZABÓ et al. 1994; MARTON 1995; MARTON 1996a; MARTON 1996b; BARRAL et al. 1996; MARTON 1998; GUILLAUMET et al. 1999, 383–408; CZAJLIK 2000; GUILLAUMET 2000; SZABÓ 2003.

11 TANKÓ – SZABÓ 2019.

tool depot presented in this study was found on the mountaintop, approximately 300 m northwest of the iron depots discovered in 2017, on a lower, horizontal terrace in the spring of 2023 (Fig. 3). It comprised an iron ploughshare and an iron spoon auger. The small depot was found on the bedrock layer at a depth of 50 cm, i.e., relatively deep below the current surface (Fig. 4).¹²

In the archaeological record of the La Tène period, agricultural implements appear primarily in settlement depots, and Velem-Szent Vid is no exception. A comprehensive survey has revealed that most agricultural depots were interred in the late La Tène period (LT C2 and D1), predominantly within or near fortified settlements,¹³ and the discovery of such tools in a non-settlement context, e.g., a grave or a sanctuary, counts as exceptional.¹⁴

In the following, a detailed description of the depot unearthed in Velem-Szent Vid in 2023 is presented (Figs 5–6).

Spoon augers are common in agricultural iron tool depots, indicating advanced woodworking technology. Several specimens similar to the one from the depot in focus are known from the site, albeit in different sizes.¹⁵ While a detailed evaluation of the spoon auger is beyond the scope of this study, it is worth noting that based on its size it may have been used in carpentry, e.g., for securing large beams together with wooden nails.

The studied Late Iron Age depot also contained a large iron ploughshare, closely similar to previously discovered ones from the site (Figs 6–7).¹⁶ However, the ploughshares known from Velem-Szent-Vid differ from earlier plough types from other sites in both size and the quantity of iron used up. Delving into the similarities in design and find context of the related findings, this study focuses primarily on iron ploughshares, the plough, and its role in landscape use.



Fig. 3. Depot of agricultural iron tools excavated in Velem-Szent Vid in 2023 (photo by G. V. Szabó)

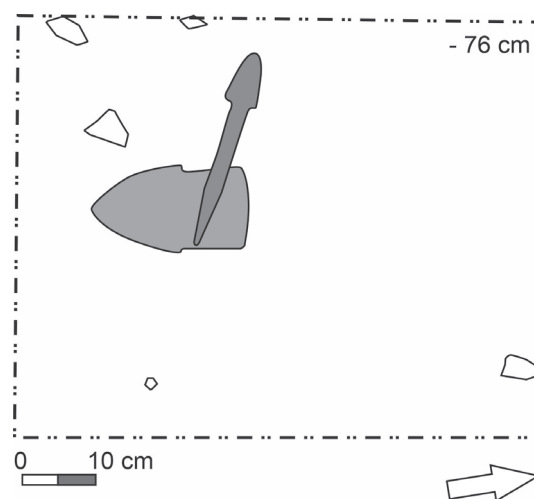


Fig. 4. Depot of agricultural iron tools excavated in Velem-Szent Vid in 2023 (drawing by K. Tankó)

12 The authors are grateful to Gábor V. Szabó, Dániel Urbán, Marcell Barcsi, and Sándor Lajos for their contribution to the fieldwork. The research was supported by grant no. 138768 by the National Research, Development and Innovation Office. On other results of the project *Social and environmental crises during the Early Iron Age (10th–7th century BC) in the Carpathian Basin: Causes, events and consequences*, see V. SZABÓ 2022.

13 BATAILLE – GUILLAUMET 2006; MACHARA 2016, 30–32, Tab. 4, Graf 5.

14 PIETA 2015, 67. In grave finds, only sickles/scythes were found: e.g., Malé Kosihy (BUJNA 1995, Taf. 41.A.1) and Ludas (SZABÓ – TANKÓ 2012, 129, Pl. 28.6, Pl. 49.1).

15 MISKE 1908, Pl. 47.16, Pl. 52.19.

16 TANKÓ – SZABÓ 2019.



Fig. 5. Iron ploughshare and spoon auger discovered in 2023 in Velem-Szent Vid (before conservation; photo by K. Tankó)

The plough, the most important tool of tillage in the Late Iron Age

The wooden plough reinforced with a metal ploughshare was a significant innovation in farming in the Late Iron Age. The ard or scratch plough¹⁷ is a simple agricultural implement for working the soil that comes in many types.¹⁸ For example, in a classification developed based on finds from Gaul, ploughs were categorised based on the extent of useful surface, the method of fastening, and the angle at which they closed with the ground while in use.¹⁹ As for the finds from the territory of Hungary, the works of Iván Balassa, Róbert Müller and László Rupnik may serve as a starting point.²⁰ However, the disadvantage of any typological classification is that the individual categories are often defined based on tools from completely different regions and, eventually, are not comparable.²¹ How reliably the type of the one-time agricultural tool can be determined based only on its metal parts is also a question.²² In the evolution of tillage tools, the introduction of the ploughshare and the coulter represented significant technical advancements, while the design of the tool they were mounted on underwent only minor changes. Various types of iron ploughs were widespread in the Late Iron Age, which likely spread to distant parts of Europe on the wings of Celtic influence, alongside other elements of civilisation. With its pointed shape, the angled ploughshare could break up the soil easily, enabling more efficient soil turning than previously possible. Simultaneously, the coulter created a narrow and deep furrow, which likely had to be cross-ploughed. These innovations probably contributed to the emergence of rectangular fields, often called ‘Celtic fields.’²³

17 ŠACH 1968; PAVELKA et al. 2017; SPEHR 1992; SPEHR 2021, 49: Arl, *Ard-Hakenpflug* in German.

18 WHITE 1967, 126–128.

19 MARBACH 2001; MARBACH 2004a; MARBACH 2004b; MARBACH 2008.

20 BALASSA 1973; MÜLLER 1982; RUPNIK 2014.

21 ŠACH 1968, 2–3.

22 HENNING 1987, 65.

23 PIETA 2010, 230–231, Abb. 103.1–7; PIETA 2015, 69.



Fig. 6. Iron ploughshare and iron spoon auger discovered in 2023 in Velem-Szent Vid (photo by K. Tankó)

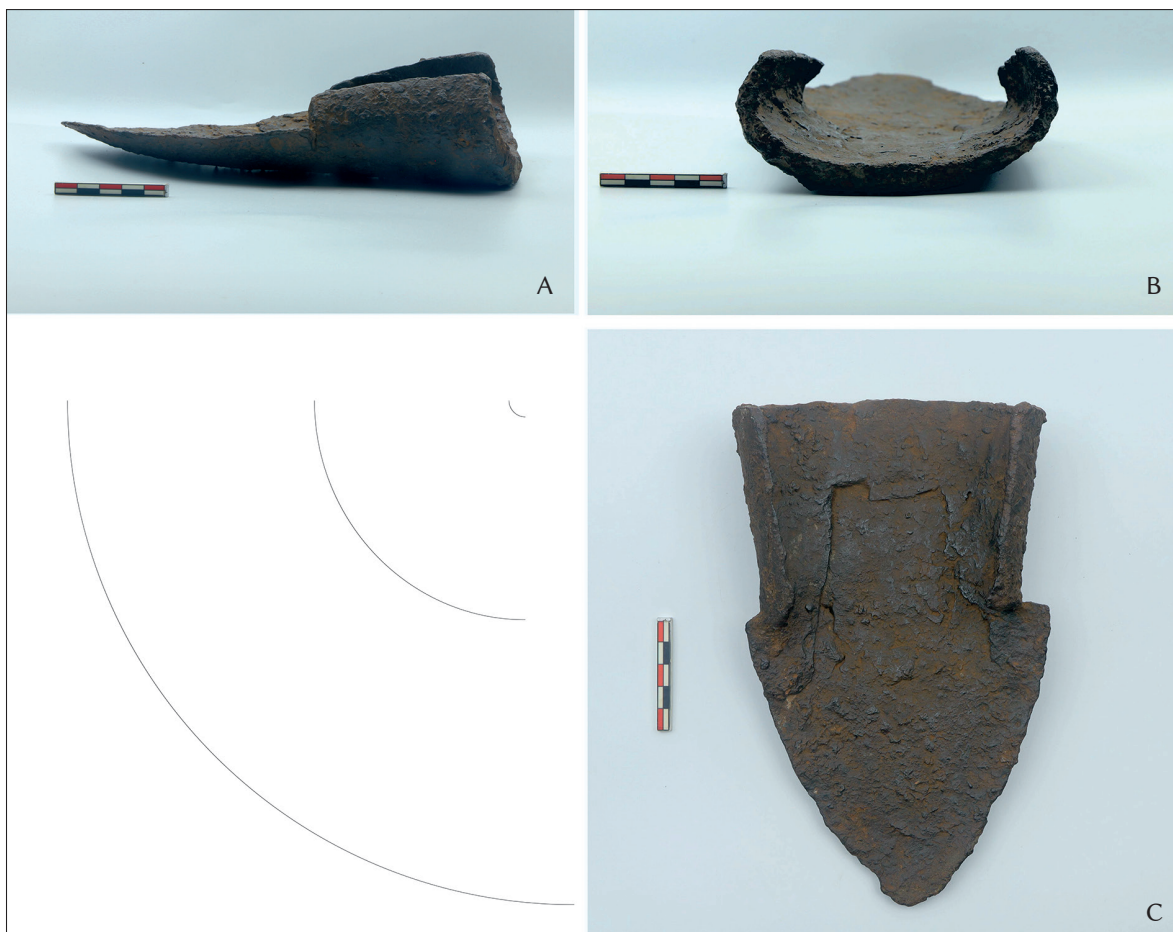


Fig. 7. Different views of the iron ploughshare (photo by K. Tankó)

The body of archaeological data on the plots cultivated by the Celts in Central Europe is extremely thin. In contrast, the study of the ‘Celtic fields system’ has a long history in northwest Europe (i.e., the Northwest European Plain) and the British Isles.²⁴ Recent research results have provided insight into prehistoric agricultural systems. Most identified arable lands were part of perpendicular cultivation systems consisting of extensive clusters of square and rectangular fields separated by low earthbanks. This cultivation practice seems to have emerged in the late Bronze Age, continued in the Iron Age, and persisted until the Roman Period, more precisely the 1st–2nd century AD.²⁵

Recent research has also revealed that the parcels were often fenced off, and continuous efforts were made to clear them of weeds and enhance the soil by manuring it with excrement or household waste.²⁶ However, similar parcels have yet to be identified in the Carpathian Basin, a task made considerably more difficult by the significant changes in land use over the past two millennia. The condition of archaeological sites has been impacted notably by contemporary alterations in the landscape caused by several factors, including an intensive tillage practice and the resulting extensive soil erosion. It must be noted, though, that our conclusions drawn from investigations of agricultural iron tools corroborate the results of research on cultivation in Western Europe. The scratch plough, widely used from the late Bronze Age to the end of the Iron Age, appears to have been well-suited for cultivating Celtic field parcel systems.

Compared to the pointed ploughshares, the introduction of wide ones represented a technological leap forward. These large iron implements, featuring a broad, shovel-like working part, were forged or crafted by forging and welding multiple pieces together (Fig. 8) to enhance the plough’s efficiency by increasing the surface that cuts and turns the soil (Fig. 9). The broad ploughshare was fastened to the wooden beam with two handles on the sides, which facilitated its attachment and operation (Fig. 10).²⁷ This plough could turn and furrow the soil effectively; the related plough type likely represented an innovation that resulted in a more efficient soil cultivation practice, enabling farmers to work larger plots of land. This heavy plough type was invented around the end of the Iron Age and became widespread during the Roman Period; it facilitated involving new areas into cultivation and the efficiently cultivating larger plots than the ones of the existing parcel systems. In essence, this development made various farming methods possible, including intensive cultivation on smaller parcels, extensive farming on larger fields, or a combination of the two, leading to a highly diverse cultivation practice.²⁸

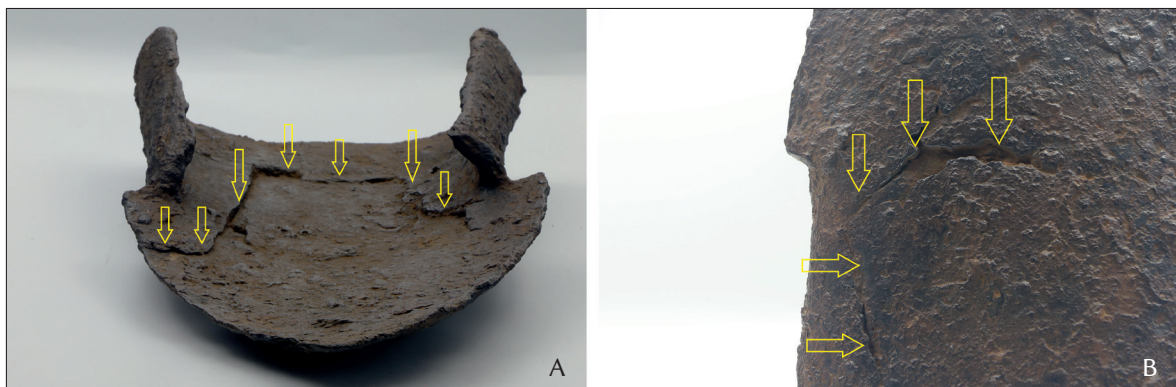


Fig. 8. Traces of forge welding on the surface of iron ploughshare (photo by K. Tankó)

24 FOKKEN 1998, 119–120; ARNOLDUSSEN – VAN DER LINDEN 2017, 551–552 (with further references).

25 GERRITSEN 2003, 167–170; ARNOLDUSSEN 2021.

26 ARNOLDUSSEN – VAN DER LINDEN 2017, 562–567.

27 PIETA 2010, 231.

28 DANIELISOVÁ et al. 2015, 194.

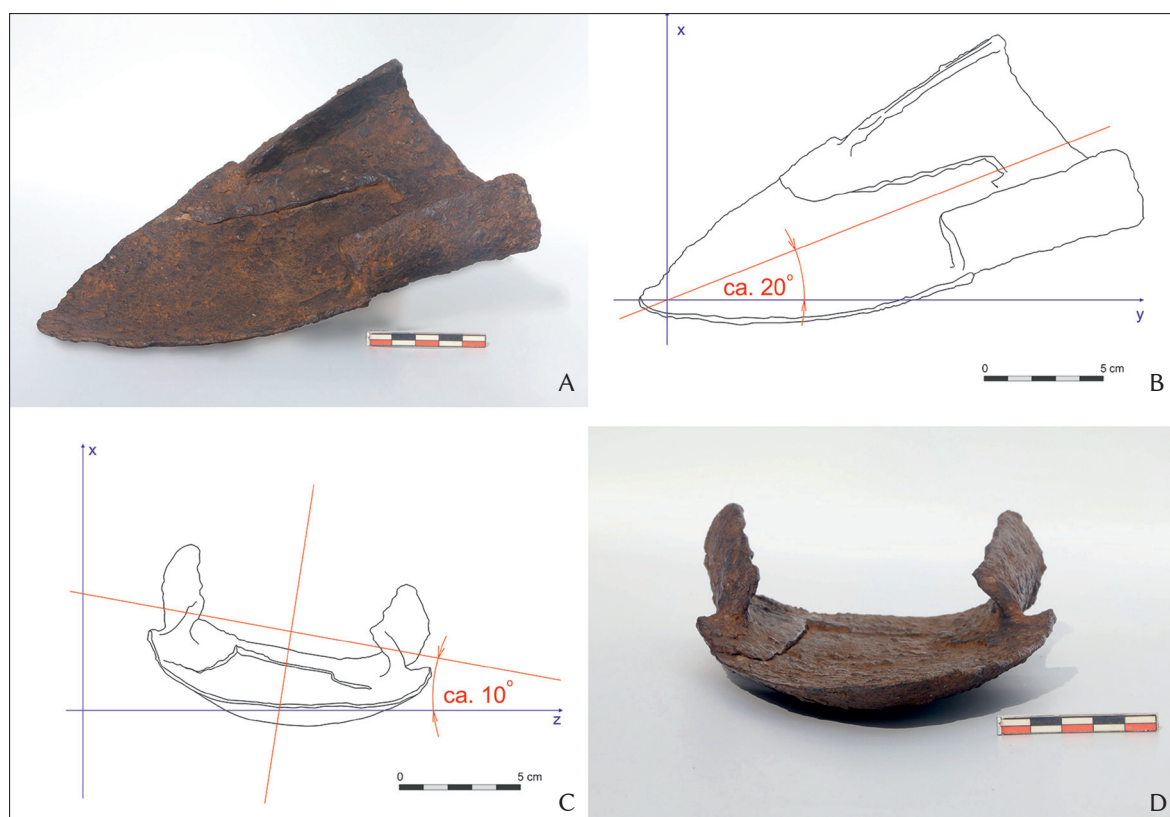


Fig. 9. Asymmetry on the iron ploughshare (photo and drawing by K. Tankó)

The Late Iron Age agricultural innovations that became widespread in the Roman Empire brought about the emergence of a diverse array of tools for land cultivation, crop harvesting, food gathering, and food preparation. Ploughs with either narrow-pointed or wide, shovel-like iron shares commonly came with robust coulter. Iron-mounted hoes and spades were used for more delicate soil work. Besides, wooden ploughs and rakes with iron teeth were also used. A comprehensive range of harvesting tools was employed for gathering seed crops and hay for fodder, including reaping knives, sickles, and scythes of various sizes and designs.²⁹ While central European archaeology has seen numerous studies on agricultural tools, only a few of those focus on the development and utilisation of particular tool types.³⁰

While the design of the iron implements from the Late Iron Age site of Velem-Szent Vid is closely similar in many respects, some details differ. For example, the large, flat iron ploughshare was an innovation attributed to the La Tène culture. Pliny's writings corroborate the Celtic origin of this type of iron ploughshare and that it counted as a novelty in his time: "In a fourth kind of plough, this spike is broader and sharper, ending off in a point and using the same blade both to cleave the soil and with the sharp edge of the sides to cut the roots of the weeds. An invention was made not long ago in Grison (Raetia, Gallia), fitting a plough of this sort with two small wheels—the name in the vernacular for this kind of plough is *plau morati*; the share has the shape of a spade. This method is only used for sowing in cultivated land and land that is nearly fallow; the breadth of the share turns the turves over; men at once scatter the seed on it and draw toothed harrows over the furrows."³¹

29 PIETA 2015, 67.

30 BERANOVÁ 1980; PIETA 2015.

31 Pliny the Elder, *Naturalis Historia* XLVIII.172–173. English translation by Rackham, H. (1950): *Pliny Natural History*, 297.

This source clearly pertains to the Roman Period, offering a brief insight into the role of ploughing in agriculture. Unfortunately, neither Pliny the Elder nor Columella, Varro, or Cato have given us precise descriptions of the ploughs used in their time. Nevertheless, scratch ploughs had been in use for centuries, and the mouldboard plough seems to have been invented just before the Roman Period, more precisely in the late phase of the La Tène Period, the focus of this study.

A revolutionary change in agriculture can be attributed to this new tool. As Pliny mentions, the mouldboard plough with coulter enabled turning even previously unbroken lands suitable for grain cultivation. The significance of Late Iron Age agricultural developments, including the draining of fields and the cultivation of clay soils, enabled people to settle in areas with marginal soils.³² The expansion of cultivated land led to a substantial increase in grain production for both food and fodder and an improvement in quality.³³ This likely contributed to the production of a significant food surplus, which in turn triggered population growth and facilitated economic specialisation³⁴ as craftspeople could focus exclusively or mainly on their work while the community supplied them with food.³⁵ Moreover, the food surplus likely promoted wealth accumulation, thus contributing to a growing social inequality. Intensive agricultural production can be considered a prerequisite for the emergence of *oppida*, as it was the only way to provide sufficient food for a large number of people not engaged directly in subsistence.³⁶ Besides, the formation of an *oppidum* is usually accompanied by the construction of extensive earthwork systems, the emergence of a multilevel settlement network in the area, the forging of long-distance trade relations, and the rise of hierarchical societies. Securing a constant supply of food and goods for these proto-urban centres pre-necessitated the changes that agricultural methods and work organisation had undergone; undoubtedly, the surplus produced in rural settlements in their area of influence was the key to maintaining these centres.³⁷ Initially, surplus brought about population growth, while later, according to the law of diminishing returns, labour input must have been increased to maintain living standards. Eventually, this could have led to social stress, which, together with other political and economic factors, may have contributed to a population decline.³⁸

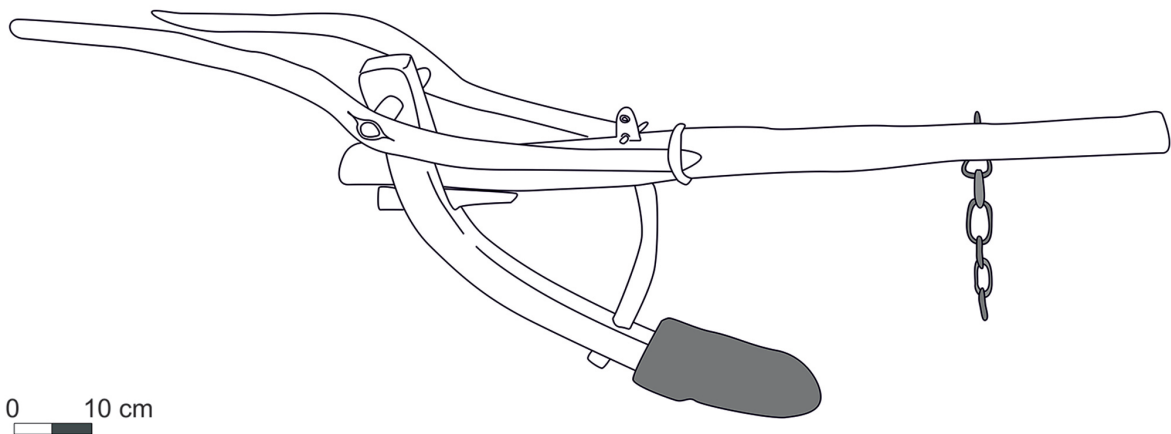


Fig. 10. Pre-industrial tilling implement from Miklušovce/Miklós-vágása (Slovakia) (after ŠACH 1968, Fig. 3)

32 E.g. SALAČ 2006, 233–243; HILL 2007, 16–38; DANIELISOVÁ et al. 2015, 184.

33 VAN DER VEEN 2010, 1–10.

34 DANIELISOVÁ et al. 2015, 184.

35 LODWICK 2017, 1–2.

36 BRUN 1995, 113–123; DANIELISOVÁ et al. 2015, 207.

37 LODWICK 2017, 1–2.

38 DANIELISOVÁ et al. 2015, 210–213.

The evolution of the plough during the Late Iron Age was driven by a demand for a more efficient utilisation and transformation of the natural environment, that is, a wish for higher yields with less labour. The invention and spread of iron plough components represented a significant advancement in the development of the tool. As different landscapes and soil types demanded diverse tillage tools and techniques, archaeological findings include a variety of iron plough parts tailored for specific purposes.³⁹ The depot published by Martin Schönfelder is particularly interesting. It included not only scythes and axes but also implements used for ploughing, such as a coulter and several ploughshares representing distinct types widespread in the late La Tène Period.⁴⁰

This find assemblage is a strong argument for the hypothesis that several iron ploughshares of different types were used in the same area simultaneously. A particular type was selected based primarily on soil type and cultivation method.⁴¹ For example, cereals widely cultivated in the Late Iron Age—emmer (*Triticum dicoccum*), einkorn (*Triticum monococcum*), barley (*Hordeum vulgare*) and millet (*Panicum miliaceum*)⁴²—have relatively small seeds and require relatively shallow, only 1–3 cm deep furrows, which can even be made with a scratch plough equipped with a long, thin ploughshare, a type invented back in the Bronze Age. A relatively large number of long, narrow, winged iron ploughshares for scratch ploughs were found in sites of the La Tène culture. Their length varies between 31 and 43 cm; their width is mostly 5–6 cm.⁴³ This primitive ploughshare type was used from the Bronze Age with minor changes until the Middle Ages. The reasons for its widespread and long use are its simplicity and functionality. The scratch plough is versatile, cost-effective, and easily repaired. However, it is less efficient for breaking new ground or thoroughly clearing the ploughed land of weeds, as it loosens only the top few centimetres of the soil and optimal results often require cross-ploughing. Ploughing depth was adjusted using conical ploughshares of diverse lengths: shorter ones for shallow ploughing and longer ones for deeper penetration. Evidence from Petneháza (Hungary) supports this hypothesis, as the difference in inner diameters measured along the edges of ploughshares of four different lengths does not exceed 6 mm (Fig. 11).⁴⁴

In contrast to the basic scratch plough, the depots discovered in Velem-Szent Vid contain iron ploughs with slightly asymmetrical shovel-shaped shares designed to be used with mouldboards. These are particularly well-suited for turn ploughing.

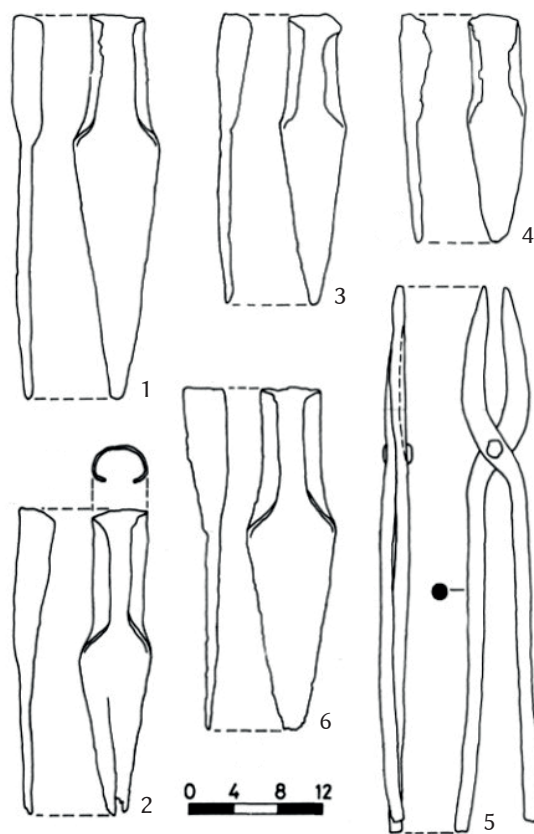


Fig. 11. Possible depot of agricultural iron tools from Petneháza (after MÜLLER 1983)

39 E.g., MARBACH 2004a; MARBACH 2008.

40 SCHÖNFELDER 2006, 112, Fig. 1.6–8. It should be noted here that the assemblage also contained a spoon auger similar to the one in the Velem depot.

41 PIETA 2015, 72.

42 LODWICK 2017, 15–17; GYULAI 2001, 128–129.

43 PIETA 2015, 69–72.

44 MÜLLER 1982, 68; MÜLLER 1983, 61–72.

Previous research has linked the adoption of these tools to the arrival of the Romans in the Carpathian Basin.⁴⁵ The shovel-shaped ploughshares found in Velem-Szent Vid are suitable for ploughing deeper and wider than with a scratch plough. This technology represented a major advance in tillage as it made it possible to break previously uncultivated lands with heavy soils. Moreover, this method of soil cultivation not only prepares the seed bed but also aids in draining wet soils. These innovative tools opened the way for a more efficient and large-scale reshaping of the landscape than ever before, enabling cultivation in previously unbroken marshlands and areas with heavy soils. Besides, mouldboard ploughs with coulter and asymmetrical spade-shaped ploughshares effectively enhanced the productivity of already cultivated lands. Therefore, the introduction of the mouldboard plough brought about several changes in plant cultivation techniques. By efficiently cutting through weed roots and overturning soil slices, weed coverage was reduced, thus diminishing competition from weeds. These factors combined contributed greatly to a more uniform plant distribution per plot and increased yields, particularly evident from the late La Tène period. Upon closer examination, the asymmetrical shape of the ploughshares seems to result from uneven wear caused perhaps by tilting the entire plough, possibly to turn over ploughed soil and create furrows.⁴⁶ Thus, the mouldboard plough with coulter and asymmetrical shovel-shaped iron ploughs contributed to the spread of more efficient farming practices with higher yields than before.⁴⁷

The lighter and simpler scratch plough remained in use on newly broken land, either for repeated ploughing or simply for seedbed preparation. This change in the way of use is reflected in the distribution of the related pointed iron ploughshares: while most appear in middle La Tène contexts,⁴⁸ they are also present in late La Tène settlements.⁴⁹ No wonder, as the two types may complement each other in tillage, thus practical considerations likely played a role in using them side by side. Heavier mouldboard ploughs required more hauling power and were more difficult to operate and transport. As their production required significant resource and labour investment, the iron ploughshares and coulters of these heavy ploughs were produced in limited quantities and represented a substantial value. These valuable tools could have been so important for the community that while they were nominally the leader's property, they were used by the whole community. Along this line, it cannot be excluded either that the mouldshare ploughs of a community were used in all cultivated lands and farms under the authority of the same central power, but they were stored mostly in the fortified settlements. The concentration of such tools in the areas of such centres (*oppida* and hillfort settlements) supports this hypothesis, especially in contrast with their extreme scarcity in the record of agrarian settlements. Besides, the ploughshares and coulters discovered in the area of Velem-Szent Vid were unlikely used within the *oppidum* due to their size and the considerable hauling power they required (usually two or four draught animals)⁵⁰—mouldboard ploughs were better suited for extensive, predominantly flat areas than the relatively narrow terraces of the *oppidum*.

45 PIETA 2015, 69.

46 PIETA 2015, 72.

47 The permanent tilting of the plough is only a theoretical possibility. On weed-ridden, dry, or compacted soils, the ploughman's full power had to be exerted with weight on the plough so as the plough not to jump out of the furrow. In addition, attention must also be paid to the straightness of the furrow, which is difficult to maintain if the plough is permanently tilted (see TAKÁCS 1976, 92).

48 RYBOVÁ – MOTYKOVÁ 1983, 135–137, Abb. 23–24.

49 JACOBI 1977, 24; PIETA 2010, 231.

50 MANE 1994, 171–172.

Hauling power

The new, larger mouldshare plough required considerably more hauling power than the scratch plough. As for the research on hauling power, the work of Patrice Méniel must be mentioned, who came to important conclusions upon evaluating animal remains found in France. Based on his measurements, several types of cattle were kept simultaneously in both the Late Iron Age and the Roman Period. In La Tène settlements, the so-called Gall cattle, a small and short-horned breed, was predominant. The withers height of these animals ranged from less than 110 cm for cows to about 120 cm for oxen or bulls.⁵¹ Cattle were kept for milk and meat, while bulls and oxen were used as draught animals.⁵² In addition to archaeozoological evidence, a text by Columella may be cited, where he considers it more economical to acquire large oxen.⁵³ Besides, there are passages by Caesar and Tacit where cattle (and horse) appear as a currency, equivalent in exchange, or a gift.⁵⁴ Archaeozoological research has revealed that Celts' livestock included large cattle breeds with massive muscles, bred certainly for meat and hauling power, from the 1st century BC. This variant seems to have been selectively bred in Italy, spread most likely to Gallia first, and reached the dwelling area of Celts from there.⁵⁵

Plough chain

Iron ploughs and coulter are easily identified components of agricultural tools in the find material. However, the hauling power of the animal had to be transmitted to the tool, which was made with chains in pre-industrial times.⁵⁶ Chains with a nail at one end and a large ring at the other appeared first in Late Iron Age assemblages (Fig. 10). These artefacts, which we interpret as plough chains, vary in size but usually consist of three links (two smaller twisted dumbbell-shaped links with an oval ring in-between).⁵⁷ Interestingly, while ploughshares and coulter are common in agricultural depots, plough chains are mostly independent finds. A rare exception to this is the tool assemblage discovered at Kaposmérő, which contains a plough chain in addition to several ploughshares (Fig. 12).⁵⁸ The different chains also deserve attention because they were significantly more exposed to wear, damage, or loss than the larger, more valuable parts. Their appearance in the archaeological record may indicate ploughing and soil cultivation even in lack of other

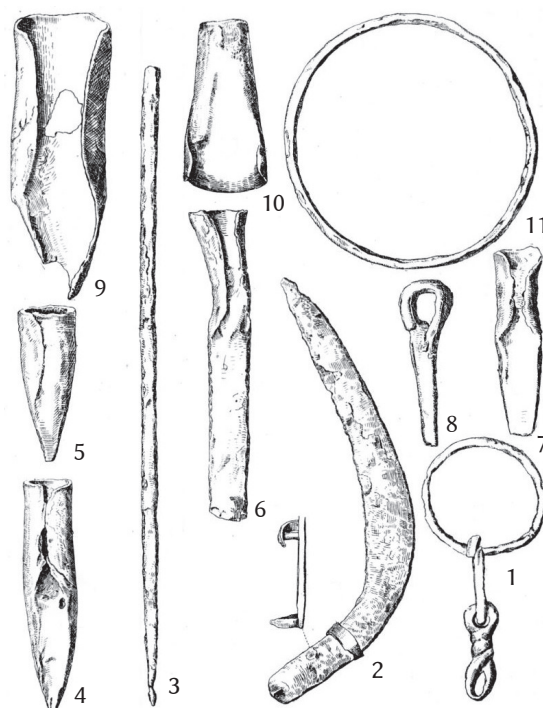


Fig. 12. Depot of agricultural iron tools excavated in Kaposmérő (after DARNAY 1910)

51 MÉNIEL 1984, 18–22; MÉNIEL 1987, 12–16.

52 ROYMANS 1990, 109.

53 MATOLCSI 1970.

54 ROYMANS 1990, 109, 136 (with further references); ROYMANS 1996, 47.

55 MÉNIEL 1987, 12–16; MÉNIEL 1992, 88; MÉNIEL 1994, 101–102.

56 ŠACH 1968, 25, Fig. 3.

57 BALASSA 1973, 121.

58 DARNAY 1910, 137–138.



Fig. 13. Iron plough chains from Velem-Szent Vid in the collection of Kálmán Miske (photo from the archive of the ELTE Eötvös Loránd University)

plough-related finds. As for Velem-Szent Vid, an iron plough chain is known from the collection of Kálmán Miske (Fig. 13).⁵⁹

Chronology and long-term use

Almost all authors agree that typo-chronological classification is inconveniently uncertain for iron agricultural equipment as most known tools are stray finds or came from a context that cannot be linked unequivocally with absolute dates. Also, these tools may have remained in use for a long time, even for several generations, which further erodes their dating value. An iron plough is a heavy iron tool that may have been of great value to its owner(s). Even though the ploughshare was likely subjected to considerable stress while in use, the damage it suffered was usually minimal, and its wear negligible even with frequent use (albeit there are exceptions, like, e.g., the iron ploughshare from Velem-Szent Vid, analysed here, which probably became deformed and cracked due to a heavy but undefined impact; see Figs 6–7). In summary, it is logical to assume that a plough could be used for several generations or even several archaeological periods.

Several things indicate that the plough type invented in the late La Tène period remained in use even after the Roman conquest and was widely used by the Romanised Celtic population. This may also mean that the iron ploughs and other advanced plough parts previously believed to be of Roman origin can primarily be linked to the local Celtic population. In other words, the advanced mouldboard plough used in the Roman Period and the related iron ploughshare types, the coulter, and the plough chain can be considered La Tène innovations. It cannot be ruled out either that a particular iron implement of significant mass, i.e., an iron plough or a coulter recovered from an assumed Roman context, was made back in the La Tène period but remained in use for several generations—a possibility that may arise in context with heavily worn instruments in the first place. In any case, we consider it justified to draw attention to the possible Celtic origin of some iron ploughs previously believed to be Roman.

Conclusion

The late La Tène period saw a significant development in agricultural technology. As a result of several simultaneous innovations, a series of iron tools with a new design tailored for particular tasks were developed, including harvesting knives, sickles, scythes, rakes, etc. As part of this agricultural technological boom, the plough also became equipped with new types of iron parts. Pointed or wide, shovel-like ploughshares, coulters, and plough chains together represented a major technological leap forward, leading to the emergence of more efficient tillage techniques, cultivation on previously unbroken lands, and higher yield. The food produced in better quality and greater quantity

59 MISKE 1908, Pl. 48.11–12.

than ever contributed greatly to major social, economic, and political changes. Archaeological evidence has outlined a direct connection between the widespread appearance of iron-mounted ploughs and the emergence of Celtic *oppida* and hillfort settlements. At the same time, these changes had a negative effect on the environment and, eventually, society. Arable land grew at the expense of previously uncultivated areas, forests, and marshy meadows. The shrinking of forests could also cause a decrease in the amount of precipitation at a regional level. More intensive land use, especially in hillside areas, increased the effect of erosion, resulting in the deterioration of soil quality. The newly broken lands became exhausted relatively quickly due to a lack of nutrient replenishment (fertilisation), and the previously high average yields became significantly reduced, probably leading to significant social, economic, and political problems at the end of the Iron Age.⁶⁰

Usually, only the iron parts of the plough are found in archaeological sites in the Carpathian Basin, mostly in tool depots in or around Late Iron Age *oppida* and hillfort settlements. The find contexts of the four agricultural tool depots from Velem-Szent Vid indicate that only the iron parts of the ploughs had been hidden. The wooden parts of the late Iron Age plough can only be reconstructed based on ethnographic analogies from the pre-industrial era. In light of those, it seems logical to assume that the massive, short iron chains ending in a nail and a large ring were plough chains; such artefacts are known from the Kaposméről depot and surface collections from Velem-Szent Vid. Many questions have remained unanswered about the development of agricultural tools in the Late Iron Age and the economic and political consequences of the more efficient food production they brought about. As for the research on the topic in the Carpathian Basin, significant progress could only be achieved through extensive geological, soil morphological and archaeobotanical analyses already applied throughout Europe. It would also be worth investigating the similarities between the tools used by the Celts and the Romans—in other words, the role of Celtic agriculture in the Romanisation of Pannonia.

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60 DANIELISOVÁ et al. 2015, 212.

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