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ORIGINAL RESEARCH PAPER

The paradigm shift in the later fourth millennium BC.
Why did life change in the Middle Copper Age in the heartland of the Carpathian Basin?

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ABSTRACT

The fourth millennium BC, particularly its second half, saw the advent of major innovations that still affect our life today, sometimes as artefacts still used in a virtually unchanged form. Among these, the most important are wheels and wheeled vehicles, the innovations introduced as part of the Secondary Products Revolution, and the new technologies of metalworking. Initially surrounded by an aura of mystique and reverence, these innovations gradually became part of everyday life and their benefits, such as a more secure livelihood engendering new subsistence strategies, were enjoyed by a growing number of communities. Better life circumstances stimulated population growth, which in turn sparked an increase in the number of settlements as well as an incipient socio-economic hierarchy between them. Improving life circumstances, receptiveness to new ideas and increasingly dynamic contacts with distant regions brought a change in previous norms and social values. This paradigm shift can be best traced in the mortuary realm: various objects signalling the status and/or prestige of a community's prominent members began to be deposited in burials. Daily life became more predictable and was accompanied by a certain measure of wealth accumulation, which, however, also stimulated frugality. Hard-to-obtain exotic commodities were highly prized and usually only their down-scaled versions fashioned from clay accompanied the dead instead of the real-life animal or prestige item. Described and briefly discussed in the present study are certain aspects of this complex process.

KEYWORDS

Copper Age, innovations, wheel and wheeled vehicle, Copper metallurgy, Central Europe

THE INVENTION OF THE WHEEL, THE APPEARANCE OF WHEELED VEHICLES AND THE INNOVATIONS OF THE SECONDARY PRODUCTS REVOLUTION

I have covered this theme in several previous studies,[1] highlighting the point that in contrast to a still widely held misconception, the wheel and wheeled vehicles were not invented in a single centre, in Mesopotamia, whence it spread to Europe.

Following Gordon Childe's comprehensive overview,[2] the wheel and wagon models of the Carpathian Basin were surveyed by István Bóna.[3] As a result of the growing interest in the appearance and spread of wheeled vehicles, the number of finds increased manifold: in

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[1]Bondár (1990); Bondár (2004); Bondár (2006); Bondár (2012); Bondár (2018); Bondár and V. Székely (2011).
[2]Childe (1951).
[3]Bóna (1960).

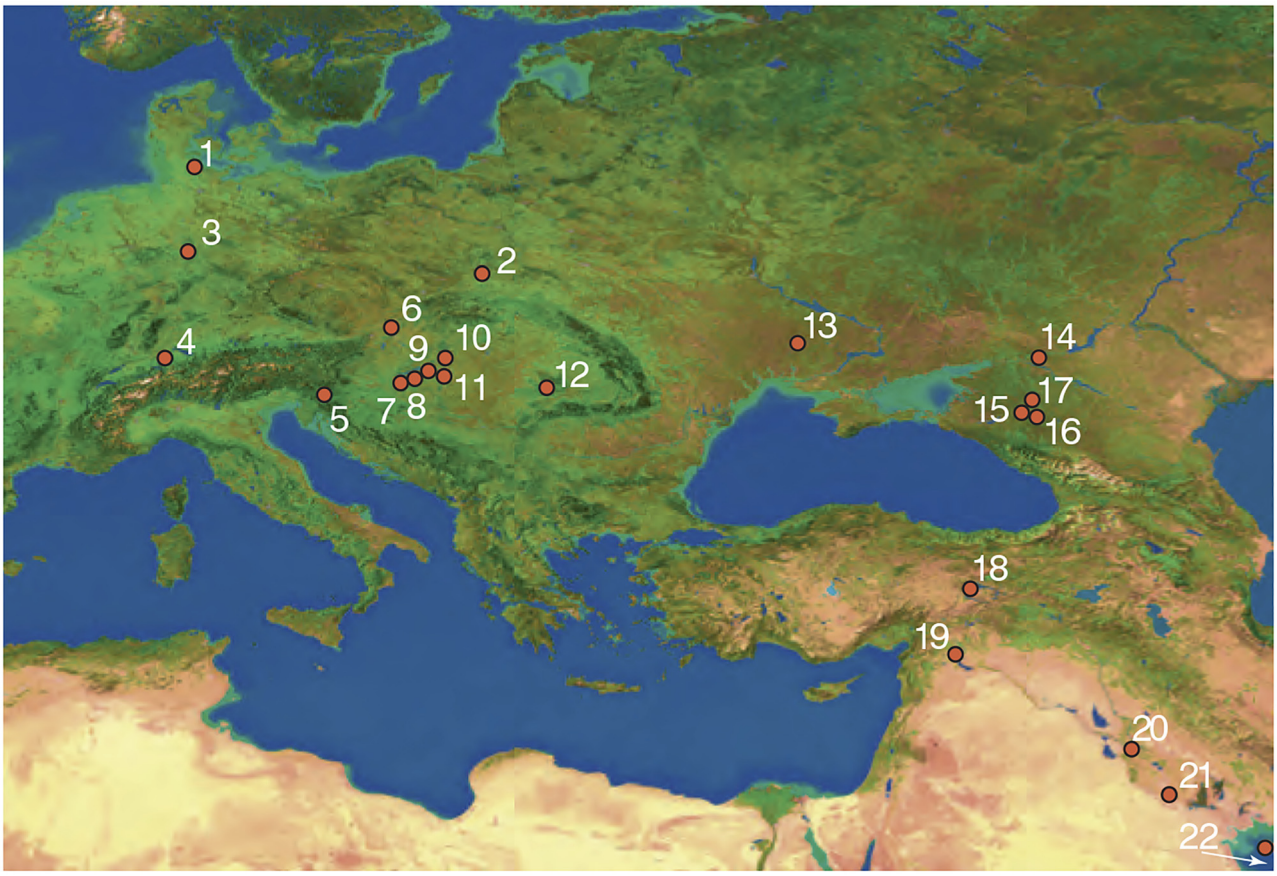

Fig. 1. Evidence for familiarity with and the use of wheels and wheeled vehicles in the fourth millennium BC (after Burmeister, 2011, Abb. 25). **1**: Flintbek, **2**: Bronocice, **3**: Lohne-Züschen, **4**: Zürich-AKAD (sic!), **5**: Stare gnajme, **6**: Radošina, **7**: Balatonberény, **8**: Boglárlelle, **9**: Budakalász, **10**: Szigetszentmárton, **11**: Moha-Homokbánya, **12**: Brad-Ţebea, **13**: Tripol'e-Kultur (sic!), **14**: Konstantinovskoe, **15**: Čišcho, **16**: Psekujchable', **17**: Novokorsunskaja, **18**: Arslantepe, **19**: Ǧebel Aruda, **20**: Tell-al 'Uqēr, **21**: Uruk, **22**: Harappa

addition to genuine wagon burials, the remains of trackways, wooden wheels and axles as well as depictions on vessels and rock carvings, the traction-induced stress pathologies on cattle bones provided conclusive evidence that wheeled vehicles were widely known across several regions in different periods. The geographic distribution of the currently known finds and the potential routes of their diffusion have been presented and discussed at various conferences. In his study on early wheeled vehicles, Stefan Burmeister listed 22 sites yielding evidence for wheels and wagons (Burmeister 2011, Abb. 25; Fig. 1).[4]

New finds brought to light during the past decades have shed exciting new light on their origins. The largest body of evidence for the appearance of four-wheeled heavy wagons after the invention of the wheel and sledge comes from the Carpathian Basin and the neighbouring regions. In my study on wagon models, I cited the incontestable material evidence for the familiarity with and use of wagons in the fourth and third millennia BC, such as wagon models, animal figurines with representation of the harnessing mode, depictions/pictograms of wagons, miniature clay wheels, wooden wheels, cart tracks/trackway remains, travois (for transporting produce), wooden axles and wagon burials.[5] I listed 60 sites yielding 67 finds evidencing the familiarity with wheels and wagons in the fourth millennium BC (Table 1, Fig. 2). The well-datable relics[6] strongly support that one of the centres probably lay in Central Europe.

I would agree with scholars who claim that this major innovation appeared in several centres at roughly the same time, in regions with more complex societies, which were receptive to ideas and innovations that would make daily life easier and more predictable, were prepared and willing to traverse greater distances, and were keen to inspire and/or adopt innovations. Although the exact location of where the very first wheeled vehicle was made continues to elude us, the essential point is less the actual location, but rather the very fact that this new conveyance had spread across immense regions within the span of seven to eight generations.[7]

The overwhelming majority of the finds in question were recovered from burials. Instead of placing the real-life, full-size

[4]Burmeister (2004) Abb. 3; Burmeister (2011) Abb. 25.

[5]Bondár (2012) Fig. 37.135–145: Appendix. Most important data of the sites shown on the map.

[6]Bondár (2018) Table 1.

[7]Burmeister (2011) 340.

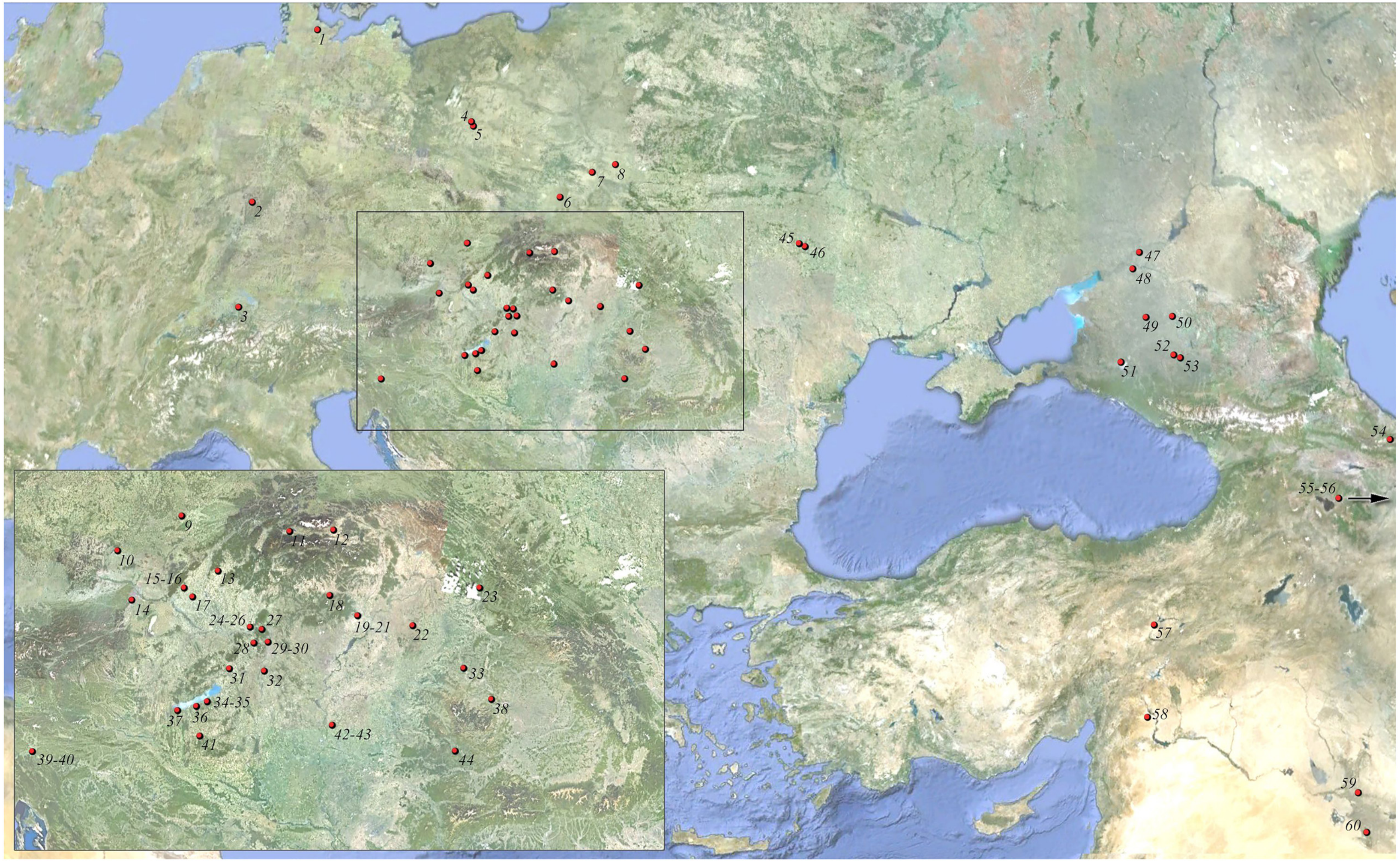

Fig. 2. Distribution of finds reflecting the use of wheeled vehicles in the fourth millennium BC (after Bondár, 2012, Fig. 37) (Computer graphics: Sándor Ősi and Zsóka Varga). **1**: Flintbek, **2**: Dieburg, **3**: Zürich-AKAD, **4**: Bytýn, **5**: Dopiewo, **6**: Bronocice, **7**: Ostrowiec, **8**: Krežnica-Jara, **9**: Opatowice, **10**: Pleissing, **11**: Lisková Cave, **12**: Velká Lomnicá, Burhbrich, **13**: Radošina, **14**: Mödling, **15–16**: Pezinok, **17**: Chorvátsky Grob, **18**: Ózd-Kőaljatető, **19–21**: Csincse, **22**: Oros, **23**: Rakovec, **24–26**: Esztergom, **27**: Pilismarót, **28**: Piliscsév, **29–30**: Budakalász, **31**: Moha, **32**: Szigetszentmárton, **33**: Bădăcin, **34–35**: Balatonőszöd-Temetői dűlő, **36**: Boglárlelle, **37**: Balatonberény, **38**: Floresti, **39–40**: Ljubljana, Stara gmajne, **41**: Kaposvár, **42**: Hódmezővásárhely-Gorzsa, **43**: Hódmezővásárhely-Kopáncs, Olasz tanya, **44**: Ţebea (Cebe)/Brad-Tebea, **45**: Nemirov, **46**: Karolina, **47**: Konstantinovskoe, **48**: Koldyri Mound 14, Grave 7, **49**: Novokorsunskaja Kurgan 2. Grave 18, **50**: Novoaleksandrovskij I, Kurgan 6, Grave 16, **51**: Starokorsunskaya Mound 2, Grave 18, **52**: Čišcho, **53**: Psekujchabl’, **54**: Vladimirovka, **55–56**: Altyn-Depe, **57**: Arslantepe, **58**: Jebel Aruda/Gebel Aruda, **59**: Kish, **60**: Uruk-Eanna IVa

object in the grave beside its one-time owner, its symbolic, miniature version modelled from clay was deposited. Miniaturisation is a distinctive trait of the mortuary rites of ancient civilisations. In the Carpathian Basin, certain members of the community enjoyed the prerogative of possessing special objects – either as a reflection of their status in the community or because of their personal prestige – whose miniature versions were deposited in their burials as symbolic tokens.[8]

The assessment of the animal bone samples from the major South-East European Neolithic settlements in the 1970s indicated that the bones of the domesticates of the first wave of domestication such as pig, goat and sheep mostly came from young individuals no more than a few months old, reflecting the practice of slaughtering the animals for their meat before they reached adulthood. In contrast, the archaeozoological assemblages of communities familiar with wheeled vehicles were largely made up of the bones of older cattle since only oxen, castrated bulls, over four years old could be yoked as draught animals. The animals were not only kept for a longer time, but were also trained to wear yokes and to pull wagons, an indication that animal husbandry had entered a new phase: in the wake of the training they underwent, the value of these domesticates increased and the range of their exploitation was considerably broadened and transformed. The realisation that animals need not be immediately slaughtered led to more selective breeding practices and the eventual exploitation of the animal's traction power, which also left its imprint in the form of pathological alterations on the bones.

This process of experimentation and innovation, the realisation that there were other means of exploiting domesticates, was described as the Secondary Products Revolution (SPR) by Andrew Sherratt in a seminal study.[9] The most salient element of the SPR model is that the milk, wool and traction power of domestic species are renewable resources that can be repeatedly exploited, making the community's life easier and more prosperous in addition to providing them with the benefit of planning ahead.

CHANGES IN METALWORKING

Studies on the period's metallurgy and metalwork have proliferated in the wake of major international research projects. However, no comprehensive survey or broader study on the Late Copper Age metallurgy of the Carpathian Basin has been published during the past decades. Generally, only the spectacular gold discs and the heavy copper axes of the Middle Copper Age from the central areas of this region are known to international archaeological scholarship, while the copper diadem from Vörs, found in a burial of the Baden culture in 1952, has disappeared from archaeological view and has been all but forgotten.[10] Most studies on early metallurgy devote no more than a few sentences to the metalwork produced during the centuries of the Late Copper Age. The region has become a blank spot, a *terra incognita* in this respect (Fig. 3).

The period is usually described as one in which the volume of metalwork declined drastically owing to the exhaustion of the surface ore deposits or, according to another commonly invoked explanation, because of the shifts in the earlier networks of raw material acquisition.

Yet, is it feasible that following the metal richness of the Middle Copper Age, our ancestors had become oblivious of the body of collective knowledge regarding different techniques of metalworking and the locations of the ore deposits accumulated for several hundred years, and then, after a lull, had again begun to produce various metal tools, jewellery and weapons on an almost industrial scale from the Middle Bronze Age onward?

Is it feasible that the Carpathian Basin, which had been an important and dynamic hub in the trade between East and West, and had played a significant role in innovation and in the transmission of technical knowledge, as well as in the creation and maintenance of communication networks between various communities in every period, would not have occupied an equally prominent position during the Late Copper Age?

The answer is obviously negative. In the assessment of the Copper Age cemetery of Budakalász,[11] I reviewed the jewellery items and the tools and implements found in the burials,[12] and I have also re-published the Vörs diadem together with the results of its archaeometallurgical analysis.[13]

A finely made bracelet of hammered sheet copper, a previously unencountered metal type of the Late Copper Age, has recently come to light at Balatonlelle.[14] It was recovered from a burial that is highly unusual in several respects.[15] Summing up my previous research in a book covering the metallurgy and metalwork of the Late Copper Age in Hungary,[16] I listed a total of 231 artefacts from 30 sites.[17] I reviewed the currently known finds and I also gathered the results of the previously published archaeometallurgical analyses, even if these were no more than a footnote or a few lines in a particular study. Very often, only the percentage compositions were specified, without an interpretation of the results. I tabulated the relevant data of earlier and more recent metal analyses scattered through various publications after converting the ppm (parts per million) values into percentages in order to enable comparisons between the published data as well as their visualisation, aiding interpretation and their accessibility for international research.

The earlier analyses covering 27 artefacts from seven sites were complemented with the modern examination of

[8] Bondár (2015a). 215–216.

[9] Sherratt (1981).

[10] Rosenstock et al. (2016).

[11] Bondár and Raczky (2009).

[12] Bondár (2009) 290–297.

[13] Bondár (2015b); Gresits (2015).

[14] Bondár (2019) Pl. 1.7.

[15] Bondár (2020).

[16] Bondár (2019).

[17] Bondár (2019) Table 1.

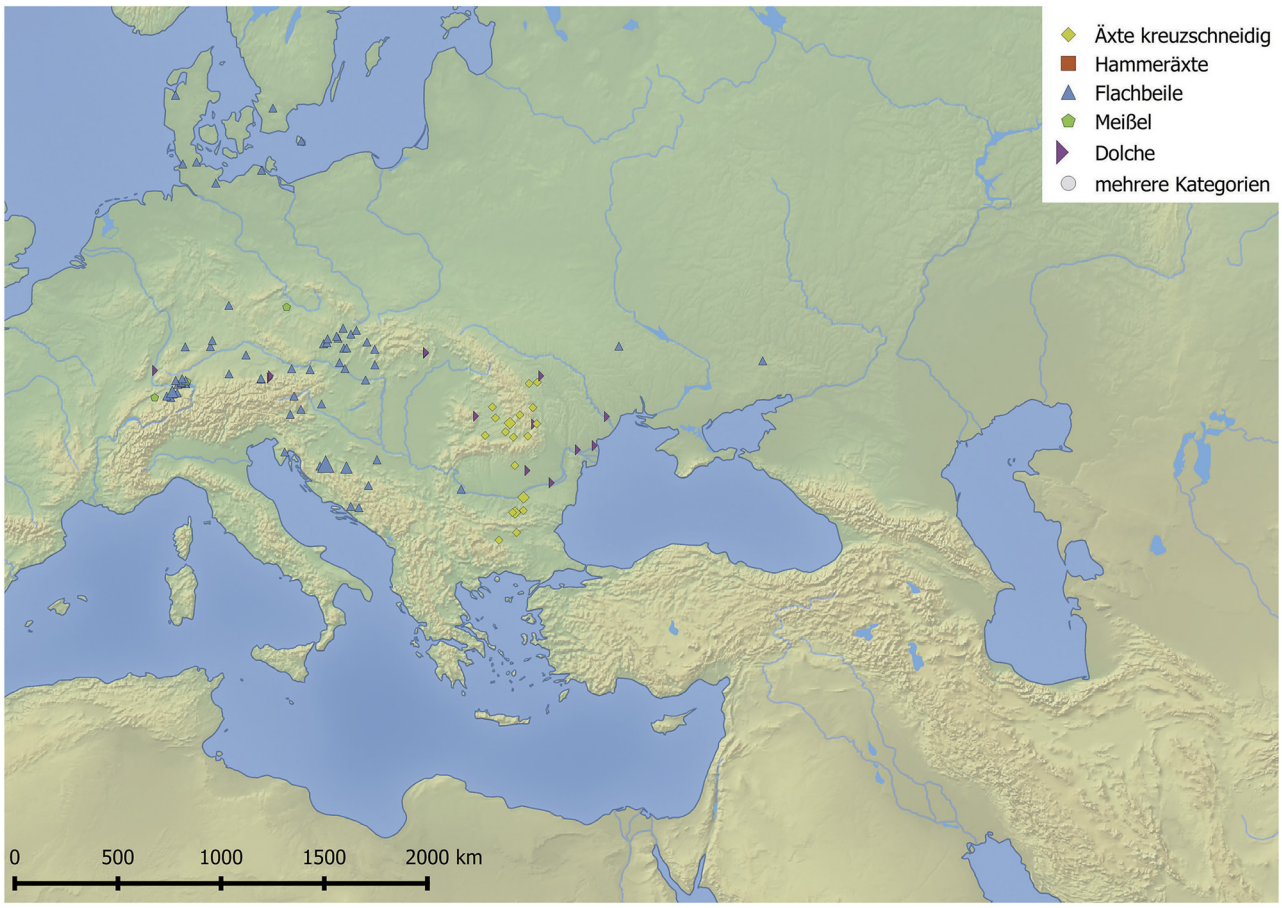

Fig. 3. Distribution of heavy copper tools, 3800–3400 calBC (after Rosenstock et al., 2016, Abb. 18)

nine artefacts from four new sites and the results of the metallographic examination of the Vörs diadem, bringing the total number of analysed finds to 36 (from 11 sites), and thus we now have metal analyses covering about 15% of the finds from one-third of the sites.[18] In the discussion of the trace element composition, I also covered the problem of arsenic copper. It was earlier believed that copper artefacts containing arsenic copper linked the Carpathian Basin to eastern Alpine metallurgy; however, this is not the case because there is increasing evidence that there were more substantial links with the easterly regions of Europe.

I mapped the findspots of the metal products of Late Copper metallurgy (beads, jewellery items, axes, awls, pins, knives and needles) as well as of the few known moulds.[19] Thus, we can no longer regard this region as a blank spot, a *terra incognita* on the maps showing the distribution of the relics of metalworking between 3600/3500 and 3000/2800 BC (Fig. 4).

Late Copper Age artefacts were not mass-produced, standardised items. The joint assessment of the archaeological and archaeometric data indicates that the period's metallurgy was not geared to production on an "industrial" scale and, on the testimony of the current record, it cannot even be conceptualised as a rudimentary craft industry, as the production of small series in various workshops. The finds rather reflect the activity and individual work of local or itinerant craftsmen, some of whom were truly masters of metalworking commanding a greater range of skills (such as the ones who crafted the Vörs diadem, the Balatonlelle bracelet and the "buttons" from Ózd-Center and Fajsz), while others were less proficient, and despite their familiarity with various metalworking techniques, they were only capable of producing simpler awls, chisels and beads. The metalwork of the Baden culture is restricted to a few types, whose analogies are known from a diverse range of archaeological contexts, which reflect contacts across immense territories from the Alps to the Caucasus and from Germany to Italy. The few surviving, but nevertheless significant finds reflect a highly diverse, colourful metallurgy and an intricate network of contacts. The period's metalsmiths were familiar with casting and cold hammering requiring minimal exposure to heat. The solid metal figurines portraying yoked animals, yet another indication of the familiarity with wheeled vehicles,[20] would suggest that they had been made using the lost-wax technique, which in the Caucasus was employed for the creation of finely

[18] Bondár (2019) Table 2.

[19] Bondár (2019) Pls 1–9.

[20] Bondár (2019) 109–112, with further literature.

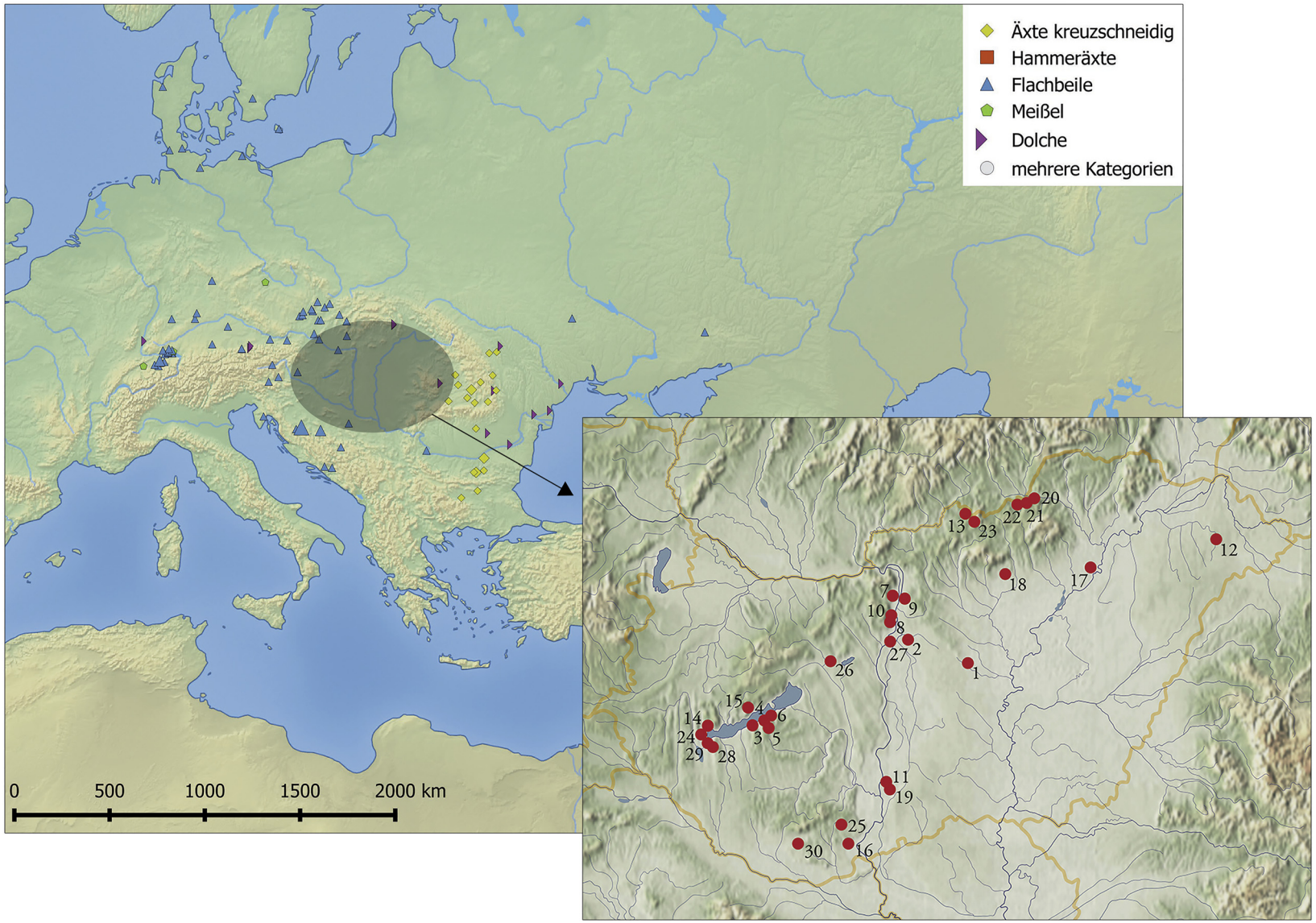

Fig. 4. Sites yielding evidence for Late Copper Age metallurgy projected onto the map in Fig. 3 (after Bondár, 2019, Fig. 5) (Computer graphics: Sándor Ősi and Zsóka Varga). **1**: Abony, **2**: Alsónémedi, **3**: Balatonboglár, **4**: Balatonlelle-Felső-Gamász, **5**: Balatonlelle-Rádpuszta, **6**: Balatonőszöd, **7**: Budakalász, **8**: Budapest-Andor u., **9**: Budapest-Káposztásmegyer, Farkaserdő, **10**: Budapest-Kőérberek, Tóvárosi lakópark, **11**: Fajsz-Garadomb, **12**: Kántorjánosi, **13**: Karancslapujtő(?),**14**: Keszthely, **15**: Köveskál, **16**: Lánycsók, **17**: Mezőcsát, **18**: Nagyfüged, **19**: Nemesnádudvar, **20**: Ózd-Center, **21**: Ózd-Kőaljatető, **22**: Ózd-Sportstadion, **23**: Salgótarján, **24**: Sármellék, **25**: Szebény, **26**: Székesfehérvár(?), **27**: Szigetcsép, **28**: Tikos, **29**: Vörs, **30**: Zók

crafted, magnificent silver and gold statuettes, as shown by the finds from the Maikop cemetery dating from the same centuries.[21]

Although few in number, the metal articles of the Baden culture are nevertheless impressive and clearly indicate that there were many dimensions to the period's metalwork, both in terms of social demand and metalworking techniques.

Moving beyond the customary explanations of the exhaustion of surface ore deposits and the realignment of the raw material procurement networks, a more plausible answer can be offered to the question of why metal finds are so scarce in this period. The Carpathian Basin is not the sole region where copper artefacts, whether made by cold hammering or cast, are few and far between. The trace element composition of the metalwork analysed using modern analytical techniques has revealed that these metal articles had been made from almost pure copper, the implication being that they could be easily and relatively quickly produced by hammering copper wire. These finds were preserved in the period's burials, which also indicate that some members of the community were privileged enough to retain possession of their jewellery or other metal articles in death.

In my view, many more copper artefacts had been made during this period, too, but if they were damaged or became worthless, they were simply melted down with various other articles and made into new utilitarian artefacts and jewellery. The realisation that metal from different regions could be recycled poses one of the greatest difficulties in modern provenance studies. If copper ores from different sources were mixed, the identification of their geological sources becomes virtually impossible.[22]

One feasible explanation for the "decrease" in the number of metal articles would be the discovery of new metalworking technologies, namely smelting and casting. Copper and gold are still valuable commodities on modern stock exchanges because they can be repeatedly recycled. We may therefore reasonably assume that the body of metalwork was considerably larger and that when an item was damaged or became useless, it was not discarded, but melted down. This is the main reason that the period's metal inventory is principally made up of objects deposited in burials as grave offerings. The range of metal artefacts representing Late Copper Age metallurgy with its different production techniques and wide range of connections is truly impressive.

HOW WERE THE LIVES AND SOCIAL VALUES OF LATE COPPER AGE COMMUNITIES TRANSFORMED?

The ebb and flow of history is often punctured by dynamic shifts and changes: flourishing economies and powerful centres disappear in the wake of a realignment of external circumstances or wars, to be replaced by something wholly new. The exhaustion of various resources, the realisation of new opportunities, climate change, population booms and various other factors no doubt contributed to the shifts in power relations during this innovative period of prehistory, in which symbols expressing the new paradigm replaced previous sets of values. The factors underlying these changes in the Late Copper Age can be sought in the innovations of the later fourth millennium BC.

Taken together, the elements reviewed and discussed in the foregoing led to profound changes in the daily lives of the period's communities and also transformed their social values within a relatively short period of time.

Diverse breeding strategies ensured a stable and continuous supply of meat; the amount of meat available for consumption no longer depended on hunting luck, and hunted species now merely added variety to the diet. This inspired communities to develop different subsistence strategies. The amount of meat provided by domesticates, which could be slaughtered anytime, promoted experimentation with, as well as the perfection of, various techniques of cooking, roasting, preservation and seasoning. Traditional methods of leather- and bone-working were also enriched with new procedures: the complicated process of tanning was probably also an innovation made at this time. The use of animal milks enabled the production of milk-based products such as cheese and butter that were already known by this time.

Sherratt convincingly argued that the changes in the earlier fourth millennium BC could in magnitude be compared to those brought on by the Neolithic Revolution as envisioned by Childe: the period saw the birth and diffusion of a number of new inventions and innovations (such as the plough and wheeled vehicles), alongside the appearance of new domestic species (such as horse, ass and woolly sheep). Sherratt later expanded his original model into the Secondary Products Scenario (SPS), a sweeping vision in which he conceptualised the period's communities as part of gigantic industrial societies.[23]

Sherratt's model has been and still is heavily critiqued and many of its points have been convincingly refuted, principally based on the findings of various archaeometric analyses. As a result, several elements of Sherratt's original SPR and SPS models have been discarded and are now regarded as outdated and no longer tenable on several counts.[24]

The many new scientific advances made during the past years have had an impact on archaeological studies, too, as shown by the DNA and stable isotope analyses on animal remains, studies on milk protein and a spate of similar studies. However, it must in all fairness be added that these analyses and their broader implications were not available to archaeological scholarship at the time Sherratt constructed his comprehensive model.

The increasingly widespread use of wheeled vehicles called for the construction of trackways, which, on the testimony of

[21] Hansen (2014a) Figs 13–15.

[22] Pernicka (2014) 256–258.

[23] Sherratt (1983); Sherratt (1997); Sherratt (2004).

[24] Bondár (2018) 279, with further literature.

the archaeological record, were indispensable in mountain regions where wagons and carts could only navigate the rain-washed, rugged terrain if wooden trackways or at least some road sections were built of timber. Vast amounts of trees had to be felled, de-limbed and fitted together using the period's tools and implements to build these roads. Tree felling and the construction of roads are an indication of the division of labour within the communities and also reflect a high degree of coordination and organisation as well as a specialist knowledge for choosing the appropriate timber type and a mastery of the necessary construction techniques.

The new arteries of communication that withstood severe weather and also led through mountains opened up new trade and communications channels and provided the routes for regular exchanges. Immense distances could now be overcome and down-the-line trade meant that most commodities could be procured through this trade. This opened previously unknown channels of information exchange and also promoted the broadening of cultural connections. Our ancestors traversed much greater distances than before, gathering information on the resources of distant lands as well as about the lifeways, customs and beliefs of their populations. They did not merely obtain a wealth of new information, but doubtless forged many personal contacts through friendships, marriages and relocations.

Among the innovations of the Late Copper Age, the wheel and wheeled conveyances sparked an early "industrial revolution". The inventions and innovations of the Late Copper Age precipitated a series of further discoveries with a lasting influence. These innovations had a positive impact on the life of period's communities. Better life circumstances led to the emergence of rudimentary forms of individual wealth accumulation (taking the form of various valuables and prestige items), differences in social status became more visible and were displayed through these articles. At first, wheeled vehicles were the prerogative of the community's elite and only after a longer time did they become more widely used, genuine mediums of travel and transport.

The appearance of wheeled vehicles and various prestige articles in the mid-fourth millennium BC (or slightly earlier) are a clear indication that in addition to Mesopotamia, the late Tripolye culture in southern Ukraine, the Maikop culture in the Caucasus region and the Baden culture in Central Europe were made up of communities whose needs, economy and social receptiveness gave rise to new inventions and innovations, or to their adoption and adaptation to their own needs.

A population growth can be noted in the wake of the improved life circumstances in Central Europe and southern Scandinavia.[25] A definite hierarchy emerged between settlements: some grew into large central places surrounded by smaller farmstead-like satellite settlements. The period also saw the rise of a new elite whose members were no doubt the privileged owners of four-wheeled vehicles, one of the "wonders" of this age.

[25]Müller (2015) 210, Fig. 17. 5; Müller and Diachenko (2019) Figs 4–6.

SPECIAL, UNUSUAL RELICS IN THE PERIOD'S BURIALS

The Carpathian Basin, and especially the territory of modern Hungary, was the heartland of the Baden distribution. Although the currently known number of excavated graves is relatively low compared to the roughly 2000 settlement sites of the Baden complex, these burials reflect a colourful diversity of mortuary practices.

Very few formal cemeteries have been fully uncovered: Fonyód-Bézsenypuszta (11 graves),[26] Alsónémedi-Kenderföldek (40 graves),[27] Budakalász-Luppa csárda (435 graves),[28] Mezőcsát-Hörcsögös (14–17 graves),[29] Pilismarót-Basaharc (110 graves),[30] and Balatonlelle-Felső Gamász (23 graves)[31] represent this category. The culture's most recently investigated burial ground is Balatonszentgyörgy-Faluvégi-dűlő, Site 2 (75 graves),[32] A few cemetery sections are also known from Szentes-Nagyhegy (10 graves),[33] Palotabozsok-Hirschberg (8 graves),[34] Ózd-Center (8 graves),[35] Balatonmagyaród-Hídvégpuszta (4 graves)[36] and Szentsimon (2 graves),[37] alongside a handful of remarkable individual burials such as Vörs-Majorsági épületek (Grave 2),[38] Szigetszentmárton[39] and Balatonlelle-Rádpuszta, Site 67/5 (Grave 415).[40] Mention must be made of the symbolic burials and of the vessel hoards, the latter previously interpreted as cremation burials. This mortuary diversity reflects the colourful beliefs and social complexity of the Baden culture. Although the practice of dumping one or more bodies into settlement pits is also attested during this period, these can hardly be regarded as genuine burials. While there is no consensus on what constitutes a regular burial in the archaeological literature, most scholars engaged in the study of mortuary practices tend to agree that the joint incidence of human remains and demonstrably associated funerary rites as well as visibly recognisable forms of the treatment of the dead are key elements.[41]

The paradigm shift in the realm of beliefs can also be traced in the cemeteries of the Late Copper Age. In our

[26]Banner (1956) Site 37, pp. 28–32, Taf. XI–XII.

[27]Korek (1951).

[28]Graves 1–115: Soproni (1956) Site 327, pp. 111–128, Taf. LXXXVIII–CVI; full assessment: Bondár and Raczky (2009).

[29]Kalicz (1999).

[30]Bondár (2015a).

[31]Nagy (2010).

[32]Bondár and Somogyi (2022).

[33]Banner (1956) Site 249, pp. 89–90, Taf. LVIII–LX.

[34]Török (1956) Site 145, pp. 128–134, Taf. CVII–CXII.

[35]Kalicz (1963).

[36]Bondár (1987).

[37]Koós (1994).

[38]Banner (1956) Site 324, pp. 111, Taf. LXXXVII; Bondár (2015a).

[39]Kalicz (1976).

[40]Bondár (2020); Bondár and Szécsényi-Nagy (2020).

[41]Boulestin (2012).

detailed assessment of two major burial grounds, Budakalász-Luppa csárda[42] and Pilismarót-Basaharc, we found evidence for the existence of central funerary sites that only contained the burials of the period's elite.[43] The analysis of the special, rare artefacts deposited in the graves enabled the identification of a set of articles that signalled status and prestige: spools, clay cones, animal figurines, miniature vessels, stamps, wagon models and a few ceramic types (breast pots, suspension vessels, terrine-like vessels and certain ceramic forms represented by a single piece only). Some burials contained no more than one of these special artefacts, while two or more had been deposited in others.[44] The distribution of these artefacts within the cemetery indicated that burial locations had most likely been pre-allocated.[45] The same insights could be drawn from the meticulous multi-stranded analysis of the biritual cemetery at the Balatonszentgyörgy-Faluvégi dűlő site Nr. 2. excavated in 2017.[46]

There was a strikingly high number of rare and unusual artefacts in the Pilismarót cemetery: a total of 66 uncommon grave goods were found in 37 graves (accounting for over 33% of the burials)[47] which included a high number of miniature items. Miniaturisation was a prominent feature of the Pilismarót cemetery, as shown by vessels, various small finds, animal figurines and wagon models. In literate ancient societies, down-scaled versions of various artefacts were quite evidently associated with the mortuary realm, for which the most compelling evidence comes from ancient Egypt.[48]

The age of the deceased could be determined in the case of seven cremation burials containing miniature vessels in the Pilismarót cemetery: the results indicated that miniature vessels had been placed in adult burials, two of which could also be sexed and turned out to be males. This makes a strong case against the assumption that miniature vessels had been toys – in fact, they were clearly funerary goods associated with adults.

Animal figurines are generally interpreted either as ritual objects or toys in the archaeological literature. Obviously, both can be valid depending on the context. The animal figurines of the Pilismarót cemetery had been deposited in adult burials in four cases. Although a physical anthropological assessment is not available for all the burials, it seems quite obvious that the figurines were not associated with children.

When assessing the miniature vessels recovered from the cemetery's burials, I found that the prestige indicator of some burials was enhanced by the presence of additional artefacts. This seems to be case for burials with animal figurines, in which various other artefacts underscored the importance of the burials in their own times. Mention must be made of Grave 434, which contained two horse bones from an individual less than three years old, identified by Erika Gál during her assessment of the animal bone sample.[49] Several other special artefacts had been deposited in this burial, namely a clay spool and a miniature vessel, the latter imitating a rare jug type.[50] These prestige articles reflected the special status of the interred person. Being rare creatures in the Carpathian Basin at this time, the two horse bones placed in the grave again highlight the prominent status of the deceased.

The miniature artefacts in the Pilismarót cemetery played not only a ritual, but also a substituting role, standing for insignia signalling economic wealth (rare animals) or social status (such as wheeled vehicles and emblems of status and rank) that were not deposited in the grave, but were instead represented by their down-scaled, miniature versions. Aside from their symbolic significance, miniature artefacts also reflect a tendency for economizing, an attitude that was essential to wealth and prosperity: the accumulation of various goods and of a more predictable life.

Aside from miniaturisation and artefacts denoting status/prestige, another interesting symbolic element in the Pilismarót cemetery is the principle of *pars pro toto* in the selection of the grave goods.

The ritual significance of deliberately broken vessels has since long been known. The burials of the Pilismarót cemetery yielded broken animal figurines (sometimes only a single fragment), broken rhyta, fragmentary small finds (such as spools and clay cones) and lithic tools broken in two.[51] The same holds true for animals, of which only a certain part was placed in the grave. Very few burials contained animal bones, most of which came from small ungulates, red deer, sheep/goat, dog, horse, cattle and wild boar.[52] Curiously enough, the *pars pro toto* selection can also be noted in the case of human remains: Kitti Köhler's assessment of the anthropological material revealed that only the remains of certain bodily parts (the skull and the long bones) were placed in the graves.[53] It seems to me that these calcined bone fragments were deliberately selected and collected from among the cremated remains when they were still in "anatomical order" and the remainder were intentionally rejected.

A new aspect of the same *pars pro toto* symbolism apparent in the mortuary practices of the Pilismarót cemetery is the selection of the deceased: only the chosen ones, certain members of the Late Copper Age community, were accorded a place in the elite's resting place.

We witness major changes during the centuries of the Late Copper Age compared to the preceding Middle Copper Age. In the later fourth millennium BC, social status and prestige were no longer expressed though heavy copper axes, often weighing as much as 20 kg, and copper or gold pendants of sheet metal in the Carpathian Basin. A closer look

[42] Raczky (2009).

[43] Bondár (2015a) 281–290.

[44] Bondár (2015a) 285–286, Table 11.

[45] Bondár (2015a) Figs 20–33.

[46] Bondár and Somogyi (2022), in print.

[47] Bondár (2015a) Figs 14–16.

[48] Allen (2004); Colin et al. (2014); Bondár (2015a) 225–226.

[49] Gál (2015) 368.

[50] Bondár (2015a) Pl. 42.1–10.

[51] Bondár (2015a) 288.

[52] Gál (2015) 375.

[53] Köhler (2015) 332.

at the diverse mortuary practices revealed that only select members of various communities were interred in the burials of the Budakalász and Pilismarót cemeteries. This is confirmed by the spatial organisation of the two burial grounds, the contemporaneous burials lying far from each other and the finds themselves. Borbála Nagy came to a similar conclusion in her assessment of the Balatonlelle-Felső Gamász cemetery.[54]

The paradigm shift in the economic, social and ritual sphere is reflected in the appearance of new symbols and new objects representing social value such as miniature wagons, unique jewellery items and utilitarian implements linked to specific individuals, which also signal the emergence of a new elite.

The role of metals also changed during the Late Copper Age. In contrast to earlier views, the period's finds reflect not a decline, but – quite to the contrary – that a range of various techniques began to be employed in metalworking. The explanation for the "decrease" in the number of metal finds could be the realisation that metal can be recycled, marking yet another important advance in metallurgy, rather than a regression.

CONTACT WITH DISTANT REGIONS

Travel over larger distances with relative ease and within reasonable time could be achieved during these centuries and as a result – or through down-the-line trade – exotic raw materials and artefacts as well as the mortuary rites of distant lands reached the Carpathian Basin. The following section offers a few examples of these.

1. Anthropomorphic vessels

A distinctive mortuary rite, the deposition of the cremains into anthropomorphic vessels serving as urns, was solely practiced in north-eastern Hungary, in the Sajó valley, documented on sites both in Hungary and Slovakia: Ózd-Center and Szentsimon in Hungary, and Méhi/Včelince and Sajógömör/Gemer in Slovakia.

Seven graves with a stone packing were unearthed at Ózd-Center during a rescue excavation in 1958. Nándor Kalicz uncovered three anthropomorphic vessels in Grave 3. Another grave containing an anthropomorphic vessel was unearthed in 1963. These vessels bore a striking formal resemblance to vessels brought to light from Level V of Troy, which to Nándor Kalicz suggested their contemporaneity,[55] and he invoked population groups fleeing Troy as an explanation. This relative chronology for the Late Copper Age of the Carpathian Basin was accepted for many decades in Hungarian prehistoric studies. However, radiocarbon dating eventually demonstrated that Level V of Troy represents a much later period than the Late Copper Age of the Carpathian Basin and the debates over the nature of the small community that had purportedly arrived from Troy were laid to rest.

The two Late Copper Age inurned burials of Szentsimon similarly came to light during a rescue excavation conducted in 1998. One of the burials contained three different, strongly fragmented anthropomorphic vessels used as urns.[56]

Similar vessels were uncovered by István B. Kovács in Grave 1 of the Méhi-Feketesár site in 1982. The vessels formed three clusters: Groups A and B were made up of three anthropomorphic urns of different sizes each, while Group C comprised an urn and a figurine.[57] István B. Kovács excavated 21 Late Copper Age burials at Sajógömör in 1983–1984. He uncovered three strongly fragmented anthropomorphic urns in Grave 13.[58] He offered a detailed assessment of the burials, suggesting that the groups of three anthropomorphic urns perhaps represented a divine triad. Although the origins of the communities practicing this particular burial rite remain unresolved, it seems quite certain that they were not a local group, but had arrived from some distant land. Although neither the Ózd-Center burial ground, nor the cemeteries at Méhi and Sajógömör could be fully excavated because earth-moving operations on all three sites destroyed a part of their areas, it would nevertheless appear that this mortuary rite was restricted to a few burials only, implying that only the privileged members of the respective communities were accorded this special treatment.

2. The Vörs diadem

One of the professionally excavated graves at Vörs yielded a unique jewellery item, a copper diadem that was found on the skull of the deceased.[59] This remarkable find was all but forgotten during the past decades, this being the reason that I republished the finds, alongside a new assessment that involved the identification of its findspot, the determination of the deceased's sex and various non-invasive analyses of the diadem itself. I also reviewed the archaeological evidence on headbands and copper "buttons" of different sizes and proposed a plausible explanation for their function.[60]

Very few similar finds were known at the time the Vörs diadem was first published: a few comparable pieces from the Aegean and Anatolia (Byblos, Crete, Alacahöyük) dating from the local Bronze Age and an earlier piece from Vukovar in Croatia. Today, several other like finds can be cited from the Middle Copper Age onward in the Carpathian Basin (Čepin, Horodnica, Moigrad, Ercsi, Veľká Lomnica) as well as from the renowned Varna cemetery in Bulgaria.

However, only two headbands dating from the Late Copper Age are known from the Carpathian Basin: one is the Vörs diadem, the other was found at Kakaslomnic/Veľká Lomnica in the High Tatra Mountains in Slovakia.[61] The latter is an oval band broken in two with the occasional

[54] Nagy (2010) 426–427.

[55] Kalicz (1963).

[56] Koós (1994) Abb. 2.

[57] B. Kovács (1986); B. Kovács (2002) Figs 19–21.

[58] B. Kovács (2002) Fig. 26.

[59] Banner (1956) Site 324, p. 111, Taf. LXXXVII.

[60] Bondár (2015a), with further bibliography.

[61] Novotná (1984) Kat. Nr. 362, Taf. 61.362.

perforation along its edges, but without the horn-like terminals, and it differs substantially from the Vörs diadem.

When reviewing the known diadem finds in a study written on the unusual ornamentation of a vessel from Bátaszék,[62] I found that the known headbands were of differing lengths: some were shorter, while others were longer, which to me suggested that some were genuine tiara-like adornments (such as the Vörs diadem and the metal crowns, although of a different type, of the Bronze Age) and others were smaller than the circumference of a human head such as the rounded oval band from Kakaslomnic.

One feasible explanation for this duality is offered by a recently published assemblage from Kültepe. The findings of the excavations resumed at Kültepe in 2009 were presented in a Turkish-language catalogue written by the researchers participating in the site's investigation. Published in the catalogue was a skull onto which various adornments of sheet gold had been placed: a diadem on the forehead, small square sheets on the two eyes and a delicate oval sheet on the mouth,[63] the latter virtually identical to the piece from Kakaslomnic.

The context of the finds from Kültepe would suggest that the paraphernalia of funerary display included three important accessories: the diadem worn on the head, the gold sheets covering the eyes and the smaller sheet placed on the mouth, the latter sometimes mistaken for a headband or a diadem if found by itself. This would imply that the broken or short bands had an entirely different function and were not diadems.

3. Copper eye-pieces (earlier interpreted as copper "buttons")

The gold sheets covering the eyes on the Kültepe skull[64] provide a possible explanation for the function of the "buttons" found in the Ózd-Center cemetery[65] and for two similar pieces recovered from a settlement pit at Fajsz.[66] The latter are poor-quality, porous pieces, which would explain why they were discarded and not deposited in burials. The most recent comparable find came to light from the Baden burial ground uncovered at Balatonszentgyörgy-Faluvégi dűlő.[67]

One possible function of these delicate, almost weightless articles was their use as eye-pieces in the mortuary rite. The small perforations along the edges suggest that they had perhaps been secured to some organic material and had not been placed directly on the eyes. The similar finds described as eye- and mouth-pieces recently published from Kültepe-Kaneš were typically made from gold, alongside the occasional piece crafted from electrum or bronze.[68]

4. The Fajsz copper wire and a dagger from Nagyfüged

In addition to the copper eye-pieces, a copper wire fragment (probably raw material intended for re-melting, an "ingot") was found at Fajsz,[69] and a small dagger tip at Nagyfüged.[70] Its function could be clarified by similar finds from Bulgaria.[71]

5. The horse bones from the Pilismarót cemetery

The two horse bones found in Grave 434 of the Pilismarót-Basaharc cemetery are yet another indication of the contact with distant lands. Archaeozoologist Erika Gál identified the two bones as the right astragalus and calcaneus of a young animal. She submitted a sample from one of the bones to the Debrecen laboratory for radiocarbon dating.[72] The 1σ calibrated dates correlate well with the dates for the human cremains. The animal was under 3 years old.[73]

Regrettably, a comprehensive study on the Late Copper Age horse remains of the Carpathian Basin is still lacking. In his assessment of the animal bone sample from the multi-period site of Balatonőszöd, István Vörös reviewed the published archaeozoological record, citing a total of 415 horse bones (*Equus caballus*) from 17 sites. Based on estimated withers height, the horse remains came from small- (131.7–136.0 cm) and medium-statured (138.6–143.0 cm) animals, while the *mc* index indicated that they were thin- (12.9) and medium thin-boned (15.6).[74] The 17 sites span the centuries from the Boleráz period to the late Baden culture and it seems likely that several other sites investigated since have also yielded horse bones; nevertheless, given that some 2000 Baden sites are known, any new finds would not significantly alter the general picture. It would appear that domestic horses were still rare creatures in the Late Copper Age. In contrast to earlier assumptions, it is now believed that the domestication of the horse took place in the Botai region in the Caucasus in the fourth millennium BC[75] and it is therefore likely that they reached the Carpathian Basin from that region. However, only isotope studies can determine whether the horse from Grave 434 of the Pilismarót cemetery had been born locally or had arrived from another region; regrettably, analyses of this type could not be undertaken as part of Erika Gál's research project. The grave also contained various special, rare artefacts such as a clay spool, a miniature suspension vessel and a rare jug type,[76] all prestige items reflecting the prominent status of the interred person, as did the two horse bones. In Erika Gál's view, the role of the two horse bones found in the grave was most probably symbolic. The tarsal bones did not have any economic value, but given that horse was not a common species in the Copper Age, its presence no doubt symbolised privilege and prestige. It must also be borne in mind that a horse

[62] Bondár (1998).

[63] Kulakoğlu, F. and Kangal, S. (2011) Katalog No. 319–322, pp. 300–301.

[64] Bondár (2019) Fig. 7.

[65] Bondár (2019) Pl. 3.16–17.

[66] Bondár (2019) Pl. 3.14–15.

[67] Bondár and Somogyi (2022) Pl. 13.6.

[68] Heffron (2020) Pl. 1.

[69] Bondár (2019) Pl. 6.4.

[70] Bondár (2019) Pl. 7.3a–3b.

[71] Bondár (2019) 58–59.

[72] Gál (2015) 370. The analysis was performed as part of the OTKA NF 104792 research project. The AMS measurements were made by Mihály Molnár (Isotop Zrt., Debrecen).

[73] Gál (2015) 368.

[74] Vörös (2013) Table 51.

[75] Outram et al. (2009).

[76] Bondár (2015a) Pl. 42.1–10.

can yield several hundred kilograms of good quality meat and that the greater portion of the slaughtered or killed animal was most likely consumed by the community and only the dry limb was taken to the cemetery.[77]

6. The role of animals in the life of Late Copper Age communities

The miniaturised objects deposited in the burials of the Pilismarót cemetery had both a ritual and a substituting role: rare animal species representing wealth and symbols of social status such as wheeled vehicles, living animals and other emblems of rank were not buried with the deceased, but were replaced with their miniature replicas.

I noted a rather curious duality in the Late Copper Age in this respect: a closer look at the period's settlements and burials as well as its metalwork reveals both a substantial waste of resources and palpable efforts to economise. The period's cattle cult has been amply documented. Immense numbers of these animals were slaughtered and skinned, with their remains either dumped into refuse pits or, less frequently, carefully buried in anatomical order. Some cattle bodies were found together with human bodies in settlement pits, others were placed beside human bodies in regular burials. The animal bone assemblages from Late Copper Age settlements are dominated by cattle, an indication that this species was very much part of daily life.

Very few animal depictions are known from the Late Copper Age. Similarly to the colourful assortment of the period's metalwork, these depictions reveal a richly diverse imagery, ranging from a zoomorphic vessel, an exceptionally elegant artistic creation in its own right, to small, plain animal figurines, the sheep figurines from Pilismarót, the animal head protomes whose species often eludes identification and cast metal figurines depicting how the animals were yoked to wheeled vehicles (known from Polish, Slovakian and German sites) as well as various theriomorphic depictions applied to vessel rims and vessel bodies whose species remains uncertain.[78]

The animal figurines deposited in the Pilismarót burials are unusually large and depict rather sturdy animals.[79] Their modelling suggests that they either portray fanciful creatures drawn from the imagination or animals that were not a daily sight and were therefore recreated from memory.

While cattle were consumed regularly and were part of daily life (although it has also been suggested that their remains represent animals that had been ritually slaughtered for community feasts during festivities), the clumsy animal figurines from Pilismarót, whose form best recalls sheep, apparently depict a rarely seen creature that had been held in high esteem by the community. Woolly sheep made their appearance around this time and it seems quite possible that the figurines represent the translation of this species into the stocky clay figurines.

These animals were thus both expressions of prestige and a highly valuable commodity, explaining why they were not slaughtered before their time and were not buried with their owner. In this case, miniaturisation solved the problem: a scaled-down clay replica of the animal was placed in the grave and thus the master and his animal remained companions in death, too, signalling at the same time the special status of its owner and his right to the ownership of this animal.

The differential role of cattle, slaughtered in immense numbers, and of the species portrayed by the miniature animal figurines are a clear indication that the value attached to various species differed in the Late Copper Age and that they had diverse roles in daily life and mortuary rites.

7. A necklace strung of dog canines from Balatonlelle

Grave 367, a burial lying some 3 m from Grave 415 (discussed below), was unusual in that it did not contain "genuine" grave goods. The burial contained the interment of an adult woman and the skull fragments of a 1–7-year-old child. Lying among the human remains were 13 drilled dog canines used for adorning the deceased's garment or some other object, or elements of a separate piece of jewellery.[80] The radiocarbon measurements yielded a Late Copper Age date for the burial containing the unusual find to which countless eastern parallels could be cited.

8. The bracelet, the bead and the skulls from Balatonlelle

Grave 415, one of the two Copper Age burials uncovered at Balatonlelle-Rádpuszta, Site 67/5, in 2005 contained the burial of an 8–9-year-old child wearing a bracelet hammered from sheet copper on its wrist. The bracelet with a diameter of 3.7 cm and a weight of 14 g was fashioned from sheet copper and has two perforations at either end.[81] It is unparalleled among the currently known copper finds from the Carpathian Basin.

This grave is unique in several respects.[82] An additional five skulls were placed beside the interred child. Aside from the copper bracelet, the grave goods comprised a black bead made of exotic raw material and a bead of sheet copper found by the neck, alongside common types of Baden pottery such as a jug and a cup.

Even though the deposition of skulls is attested in the Carpathian Basin from the Neolithic onward, it was not a typical mortuary custom during the Baden period.[83]

The black bead was made of organic material. Its analysis indicated that its raw material is jet and it is presently the earliest jet find from the Carpathian Basin. The archaeometric analysis of the black bead suggested that it had arrived to the shores of Lake Balaton from the Iberian peninsula or southern France.[84]

[77] Gál (2015) 370.

[78] Bondár (2015a) 236–241, with further literature.

[79] Bondár (2015a) Pl. 55.

[80] Gál and Bondár (2022).

[81] Bondár (2019) 74–76, Pl. 1.7; Bondár (2020) 9, Fig. 14.

[82] Bondár (2020).

[83] Bondár and Szécsényi-Nagy (2020).

[84] Bondár and Demény et al. (2021).

9. The bioarchaeological record

The ever-improving analytical procedures enable not only the increasingly accurate dating of human burials, but also provide a wealth of other information. For a long time, it remained unknown whether the Vörs diadem had been worn by a man or a woman. The analyses revealed that the genetic sex of the interred individual was female.[85]

The archaeogenetic examination of the child in the Balatonlelle burial indicated that the grave contained the interment of a boy and also that kinship relations could be demonstrated between the human remains deposited in the burial: the skull fragments deposited in the grave came from the offspring of two different women.

Similarly to the jet bead found in the burial, the genetic make-up of the 8-9-year-old boy shares the greatest similarity with the Neolithic populations of France.[86] The remarkable jewellery items and the skull fragments placed in his burial suggest that the boy interred in the grave reflected and preserved the rites and artefacts of a distant land.

CONCLUSION

The above overview of the archaeologically visible imprints of the most important changes during the later fourth millennium BC in the heartland of the Carpathian Basin reveals that this region has been rather under-represented and neglected in international archaeological scholarship. Yet, following a closer look at the main developmental trajectories and their salient features as well as the collation and mapping of the relevant data, the region is no longer a *terra incognita* in Copper Age studies, as amply proven by the finds reflecting a familiarity with wheeled conveyances (Figs 1–2) and the relics of the period's metallurgy (Figs 3–4).

In the wake of more recent research as described and discussed in the foregoing, we now have a much clearer idea of the emergence of metalworking and of the period's metalworking tools and implements. I have been able to identify the salient traits of the metallurgy of the Baden culture in the later fourth millennium BC as well as the metalworking techniques of the distant relatives and contemporaries of Ötzi, the renowned iceman. The metal articles and their technological traits have also revealed an intricate and complex of network of connections and have also shed light on the environmental damage caused by metallurgy and how it impaired human health, alongside highlighting social differences within and between the period's communities.

A meticulous assessment of the information provided by the period's burials provides insights into the world of beliefs and mortuary rites, as well as into individual lives and the life circumstances of the period's communities. Complementing these diverse strands of evidence with the findings of various scientific analyses yields a wealth of new, previously unavailable information that open new perspectives in the assessment of a burial or an entire cemetery. In this study, I principally focused on the artefacts surviving in grave inventories and other burial phenomena, with the goal of offering a new interpretation and the evidence reflecting the paradigm shift. The key arena where communities lived their daily lives were the settlements, whose publication and complex assessment will no doubt enrich our knowledge of the changes in economic strategies and the hierarchy between different settlements, and furnish new evidence on the elements of the period's paradigm shift.

The picture that unfolds from the archaeological record is one of a diverse and dynamic society, with indications that there were certain differences between the settlements of the period's communities. These divergences are reflected in the size of individual communities, in their economic strategies as well as in the nature and size of their settlements. We know that genuine mega-settlements already existed in the fourth millennium BC (the megasites of the Tripolye culture).[87] The Carpathian Basin saw the gradual emergence of a settlement hierarchy during the same period, one made up of large central settlements surrounded by smaller satellite sites and chains of dispersed farmsteads and intermittently occupied sites. The decades-long stereotyped image of the Baden culture as a mobile pastoral population needs to be revised in the light of more recently excavated extensive settlements with many hundreds of pits. Their economy was much more complex and the period's communities cannot be simply divided into groups engaged in arable farming and/or animal husbandry.

On the testimony of the current record, the period saw an economic, social and spiritual paradigm shift that also involved a change in the previous role of metals. The various articles made of good-quality copper and gold, so widespread in the preceding period, appear to have lost their attraction to the period's communities. During the 600–800 years of the Late Copper Age, status and prestige as well as accumulated wealth were no longer embodied by these raw materials and the copper axes and gold jewellery items made from them, whose production called for sophisticated manufacturing techniques, but by new tokens of wealth and power.

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[85] Lipson et al. (2017) 380: Extended Data Table 1, https://www.nature.com/articles/nature24476

[86] Gerber et al. (2022) preprint, Supplementary Information Fig. S.2.1.1, Supplementary Information section 5.

[87] Hansen (2014b); Müller et al. (2016); Nebbia et al. (2018); Gaydarska and Chapman (2022).

Table 1. Most important data of the sites shown on the map in Fig. 2

Site	State	Number on the map	Finds	Age	Cultural context/Date	Reference (archaeological find)	Calibrataed age (BC)	Archaeologically estimated age (BC)	Reference (date)
Altyn-Depe	Turkmenistan	55	wagon model	Copper Age	late 4th/early 3rd millennium	Bondár (2012) Fig. 2.3.			
Altyn-Depe	Turkmenistan	56	clay wheel	Copper Age	late 4th and early 3rd millennium	Kirtcho (2009) Fig. 1.6.			
Arslantepe	Turkey	57	clay wheel	Copper Age	3374 ± 30 (Late Uruk period)	Bakker et al. (1999) 781, Fig. 5.	3264–2901	>2901	Bakker et al. (1999) 778, 780, tab. 1, Mischka (2011) Table 3.13.
Bădăcin (Szilágybadacsony)	Romania	33	wagon model	Copper Age	Coţofen III	Băcuet (1998) Pl. 1.			
Balatonberény	Hungary	37	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 11.	3650–3350	>3350	Mischka (2011) Table 3.33.
Balatonőszöd-Temetői dűlő, Feature 1417	Hungary	34	clay wheel	Copper Age	Baden culture	Horváth (2010) Fig. 4.1.			
Balatonőszöd-Temetői dűlő, Feature 1565	Hungary	35	clay wheel	Copper Age	Baden culture	Horváth (2010) Fig. 4.3.			
Boglárlelle	Hungary	36	wagon model with applications of cattle figurines	Copper Age	Boleráz	Bondár (2012) Fig. 8.2, Fig. 9.	3650–3350	>3350	Mischka (2011) Table 3.32.
Bronocice	Poland	6	wagon depiction on the vessel/pictogram on pottery	Copper Age	Funnel Beaker (TRBK) culture, 3300–3100	Kruk and Milisauskas (1982) Abb. 1; Bakker et al. (1999) 788; Rad und Wagen (2004) Abb. 2.	3631–3380	>3380	Mischka (2011) Table 3.1.
Budakalász, Grave 158	Hungary	29	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 6.	2877–2679	>2679	Mischka (2011) Table 3.29.
Budakalász, Grave 177	Hungary	30	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 5.	3246–2605, 3350–2679	>2679	Rad und Wagen (2004) Abb. 34; Mischka (2011) Table 3.24.
Bytýn	Poland	4	animal figurines showing the modes of harnessing	Copper Age	Funnel Beaker (TRBK) culture	Bondár (2012) Fig. 17.8.	second half of the 4th millennium		Rad und Wagen (2004) Abb. 110.
Chorvátsky Grob (Magyargurab)	Slovakia	17	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 16.1.			
Čišcho	Ukraine	52	clay wheels	Copper Age	4th millennium, Maikop culture	Trifonov (2004) 168; Burmeister (2011) 223.		>3370	Mischka (2011) Table 3.22.
Csincse	Hungary	19	wagon model		Baden culture	Bondár and Gucsi (2022) in print			

(continued)

Table 1. Continued

Site	State	Number on the map	Finds	Age	Cultural context/Date	Reference (archaeological find)	Calibrataed age (BC)	Archaeologically estimated age (BC)	Reference (date)
Csincse	Hungary	20	wagon model		Baden culture	Bondár and Gucsi (2022) in print			
Csincse	Hungary	21	wagon model		Baden culture	Bondár and Gucsi (2022) in print			
Dieburg	Germany	2	animal figurines showing the modes of harnessing	Copper Age	late 4th and early 3rd millennium (?)	Bondár (2012) Fig. 17.4.			
Dopiewo	Poland	5	wagon depiction on the vessel/pictogram on pottery	Copper Age	Funnel Beaker (TRBK) culture	Przybyl (2015) Fig. 9.1.			
Esztergom	Hungary	24	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 13.1.			
Esztergom	Hungary	25	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 13.2.			
Esztergom	Hungary	26	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 13.3.			
Flintbek	Germany	1	cart tracks	Copper Age	Funnel Beaker (TRBK) culture, 3460–3385 cal. BC	Zich (1992); Zich (1993); Rad und Wagen (2004) Abb. 1.	3423–3390	>3390	Mischka (2011) Table 3.2, Tab. 7.
Floresti	Romania	38	animal figurines showing the modes of harnessing		Precucuteni III	Boghian (2009) Fig. 5.1,4.			
Hódmezővásárhely-Gorzsa	Hungary	42	3 clay wheels (?)	Copper Age	Baden culture	unpublished, RKM (2009) site 222.			
Hódmezővásárhely-Kopáncs, Olasz tanya	Hungary	43	3 clay wheels (?) fragments	Copper Age	Baden culture	unpublished, RKM (2009) site 224.			
Iraq, unprovenaced	Iraq		stone relief	Copper Age	mid-4th millennium	Rad und Wagen (2004) Abb. 12.			
Jebel Aruda/Gebel Aruda	Syria	58	clay wheel	Copper Age	Late Uruk Period	Bakker et al. (1999) 778, Fig. 4.	3335–3103; 3333–3101; 3315–2916	>3103, >3101, >2916	Bakker et al. (1999) 778, 780. tab. 1, Mischka (2011) Table 3.12.
Kaposvár	Hungary	41	wagon model with applications of cattle figurines	Copper Age	Boleráz	Bondár (2012) Fig. 14			
Karolina	Ukraine	46	wagon model	Copper Age	Tripolje B2-C1	Matuschik (2006) Fig. 2.1, Bondár (2012) Fig. 3.1.		>3500	Maran (2004) 436; Mischka (2011) Table 3.36.

(continued)

Table 1. Continued

Site	State	Number on the map	Finds	Age	Cultural context/Date	Reference (archaeological find)	Calibrataed age (BC)	Archaeologically estimated age (BC)	Reference (date)
Kish	Iraq	59	wagon model		early 3rd millennium	Rad und Wagen (2004) Abb. 27.			Rad und Wagen (2004) Abb. 27.
Koldyri Mound 14, Grave 7	Russia	48	wooden wheels		Maikop culture			>3370	Mischka (2011) Table 3.20.
Konstantinovskoe	Ukraine	47	clay wheels	Copper Age	Maikop culture	Trifonov (2004) 168. Abb. 3.	3500–3200 cal BC		Burmeister (2011) 223.
Krežnica-Jara	Poland	8	animal figurine attached to the wagon	Copper Age	Funnel Beaker (TRBK) culture	Bondár (2012) Fig. 6.	3651–3392		Rad und Wagen (2004) Abb. 114.
Lisková Cave (Liszkófalu)	Slovakia	11	free-standing animal figurine	Copper Age	Middle Copper Age	Bondár (2012) Fig. 17.7.			
Ljubljana, Stara gmajne	Slovenia	40	wooden axle with wooden wheels	Copper Age	4th millennium BC, the period between the Retz–Gajary and the Baden cultures, 3600 and 3332 BC	Velušček (2002), Rad und Wagen (2004) Abb. 41; Velušček (2006).	3357–3116	axle: >3116, wheel: 3099	Velušček (2002, 2006); Mischka (2011) Table. 4.
Lubljana, Stara gmajne	Slovenia	39	wooden wheel with axle	Copper Age	4th millennium BC, the period between the Retz–Gajary and the Baden cultures, 3600 and 3332 BC	Velušček (2002); Rad und Wagen (2004) Abb. 41, Velušček (2006).	3328–3116	axle: >3116, wheel: 3098	Velušček (2002, 2006); Mischka (2011) Table. 3.4.
Moha-Homokbánya	Hungary	31	wagon model with applications of cattle figurines	Copper Age	Boleráz	Bondár (2012) Fig. 12.			
Mödling	Austria	14	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 1.			
Nemirov	Ukraine	45	wagon model	Copper Age	Tripolje B2-C1	Matuschik (2006) 280, Fig. 2.2; Bondár (2012) Fig. 3.2.		>3500	Maran (2004) 436; Mischka (2011) Table 3.36.
Novoaleksandrovskij I, Kurgan 6, Grave 16	Ukraine	50	grave with wagon		Maikop culture	GEJ 2004, 187.			Mischka (2011) Table 3.35.
Novokorsunskaja Kurgan 2. Grave 18	Ukraine	49	grave with wooden wagon	Copper Age	Maikop culture	Trifonov (2004) 168, Abb. 2; Burmeister (2011) Abb. 19.1.		>3370	Mischka (2011) Table 3.23.
Opatowice	Poland	9	clay wheel	Copper Age	Funnel Beaker (TRBK) culture	Przybyl (2015) Fig. 9.2.			
Oros-Nyírjes	Hungary	22	clay wheel (?)	Copper Age	Baden culture	unpublished, RKM (2008) Site 278.			

(continued)

Table 1. Continued

Site	State	Number on the map	Finds	Age	Cultural context/Date	Reference (archaeological find)	Calibrataed age (BC)	Archaeologically estimated age (BC)	Reference (date)
Ostrowiec	Poland	7	wagon depiction on the vessel/pictogram on pottery		Funnel Beaker (TRBK) culture	Vosteen (1999) Taf. 93. 56.			
Ózd-Kőaljatető	Hungary	18	clay wheel	Copper Age	Baden culture (?)	Banner (1956) Taf. 75.8.			
Pezinok (Bazin)	Slovakia	15	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 16.2.			
Pezinok (Bazin)	Slovakia	16	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 16.3.			
Federsee/Alleshausen/ Grund-wiesen	Germany		wooden wheel	Copper Age?	Goldberg III culture	Vosteen (1999) Taf. 73.4; Schlichtherle (2006) Fig. 3.4.	3008–2803, 2925–2760, 2883–2705, 2855–2621, 2832–2579, 2865–2844	>2832 BC, >2844	Mischka (2011) Table 3.18.
Federsee/Seekirch/ Stockwiesen	Germany		wooden wheel	Copper Age?	Horgen culture	Vosteen (1999) Taf. 73.12; Schlichtherle (2006) 167. Fig. 3.5.	3012–2904, 3083–2890, 3010–2881, 2904–2698, 2890–2875	>2698 BC, >2875	Mischka (2011) Table 3.17.
Gnarrenburg	Germany		wooden wheel		ca 2919–2601	Vosteen (1999) Tab. 5, site 35.			
Piliscsév	Hungary	28	wagon model		Baden culture	unpublished			
Pilismarót-Basaharc, Grave 445	Hungary	27	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 8.3.			
Pleissing	Austria	10	wagon model	Copper Age	Boleráz	Bondár (2012) Fig. 10.2.			
Psekujchabl'	Ukraine	53	clay wheel	Copper Age	Maikop culture	Trifonov (2004) 168; Burmeister (2011) 226.			
Radošina (Radosna)	Slovakia	13	wagon model with applications of cattle figurines	Copper Age	Boleráz	Bondár (2012) Fig. 8.1, Fig. 7.	3650–3350	>3350	Mischka (2011) Table 3.31.
Rakovec	Ukraine	23	wagon model	Copper Age	Tripolje B2-C1	Matuschik (2006) Fig. 2.3; Bondár (2012) Fig. 3.3.		>3500	Maran (2004) 436; Mischka (2011) Table 3.36.
Starokorsunskaya Mound 2, Grave 18	Russia	51	wooden wheels		Maikop culture			>3370	Maran (2004) 436; Mischka (2011) Tab. 3.19.
Szigetszentmárton	Hungary	32	wagon model	Copper Age	Baden culture	Bondár (2012) Fig. 15.2.	3246–2605; 3350–2679	>2679	Rad und Wagen (2004) Abb. 35; Mischka (2011) Table 3.25.

(continued)

Table 1. Continued

Site	State	Number on the map	Finds	Age	Cultural context/Date	Reference (archaeological find)	Calibrataed age (BC)	Archaeologically estimated age (BC)	Reference (date)
Ţebea (Cebe)/Brad-Tebea	Romania	44	clay wheel	Copper Age	Coţofen III	Dinu (1981) Fig. 6.6; Bakker et al. (1999) 781, Burmeister (2011) Abb. 23.	3500–3000	>3000	Mischka (2011) Table 3.27.
Uruk-Eanna IVa	Iraq	60	two clay tablets with pictograms	Copper Age	mid of the 4th millennium	Bakker et al. (1999) 778, 780. Tab 1.1–4	3641–3381, 3519–3375, 3515–3371, 3505–3369	>3381, >3376, >3373, >3370	Mischka (2011) Table 3.11.
Velká Lomnică, Burhbrich	Slovakia	12	clay wheel	Copper Age	Baden culture	Novotny (1990) 128, Obr. 56.4.			
Vladimirovka	Ukraine	54	wagon model		Tripolje B2-C1	.		>3500	Maran (2004) 436; Mischka (2011) Table 3.36.
Zürich-AKAD	Switzerland	3	wooden wheel	Copper Age	find on top of Pfyn layer, probably related to early Horgen culture	Burmeister (2011) Abb. 17.	3430–3175	>2800	Mischka (2011) Table 3.26.

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