CATTLE DEPOSITS OF THE LATE COPPER AGE AND EARLY BRONZE AGE IN HUNGARY

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Discussed here are the cattle deposits, and the assemblages associated with them, of the Baden period in Hungary, with a look at earlier and later similar phenomena. A comparison is made between the Baden and the relevant European deposits in order to highlight the similarities and differences. I also review those research inadequacies and difficulties that have constrained major new advances in the study of these deposits, and propose potential new lines of enquiry in this field.[1]

Key words:
Cattle deposits, paired burials, animal-drawn vehicles, complementary environmental studies

Introduction (general remarks)

Since the moment of their domestication, cattle have played a prominent role in the life of human communities. The study of cattle/animal deposits[2] – earlier labelled 'burials'[3] – is a difficult task because, in order to provide an appropriate framework, the phenomenon itself should also be set in a meaningful context.[4] It is exactly the construction of an adequate framework that seems virtually impossible at the current state of research. We are principally searching for archaeological phenomena (in this case, cattle remains) with a set of shared traits, which form a specific group in space and time, as well as culturally, ritually and zoologically/species-wise, justifying their treatment as an archaeologically distinct group in the hope that, after reaching a certain point in our studies, we will be able to come up with an explanation. However, the determination of even the most basic categories or criteria seems impossible at the moment, owing to the lack of the necessary data, the many unpublished finds and the quality of excavations. The problem of cattle burials is chaotic and enigmatic exactly because even the creation of basic categories is not a simple task.

Some of the publications describing cattle burials are archaeological studies lacking even a rudimentary zoological determination.[5] Examples of the opposite also abound: archaeozoological studies with a bare minimum of archaeological data.[6]

1 The article was supported by FWF, Lise Meitner fellowship, M 2003-G25 project.

2 E.g. Pollex 1999 and Szmyt 2006: deposits; Pluskowski 2011: Associated Bone Groups/ABGs, following the term originally introduced by Hill 1995, 27 (Articulated/Associated Animal Bone Group, abbreviated as ABG).

3 E.g. Korek 1951; Banner 1956; Bondár, Raczky 2009; György 2013.

4 Horváth 2006; 2009, 118-119; 2010; 2012; 2014, Section 3.2.

5 See, e.g., Alsónémedi, Baja-Dózsa György street, Balatonboglár, Balatonkeresztúr-Réti-dűlő, Balatonlelle-Felső-Gamász, Balatonlelle-Országúti-dűlő, Budaörs-Kamaraerdei-dűlő, Budapest-Királyok útja, Budapest-Rákoscsaba-Major hegy alja, Dunakeszi-Alagi-major, Dunaszentgyörgy, Ecser Site 6, Esztergom-Szentkirályi Duna-dűlő, Hódmezővásárhely-Bodzás-part, Kaposújlak-Vár-domb, Kétegyháza, Kunpeszér-Téglaházi-dűlő, Mezőkövesd-Nagy-Fertő, Monor-Berek, Orosháza-Bónum, Öszentiván Site VIII, Pécs-A/1 laktanya, Solt-Erdélyi-tanya, Szabadszállás-Ágostonhalmi-dűlő, Szeghalom-Dió-ér, Szentes-Nagyhegy, Szigetcsép-Tan-gazdaság, Szigetszentmiklós-Üdülő-sor, Tiszavasvári-Nyíregyházi út, Üllő-Gulya-legelő. For detailed description and cited original publications, see Horváth 2006; György 2013.

6 See, e.g., Káloz-Nagyhörcsög-puszta, Tahitótfalu-Váci-rév, Tiszapolgár-Basa-tanya. For detailed description and cited original publications, see Horváth 2006; György 2013; Csippán 2012; for the most recent summary, see Horváth 2014, Section 3.3.3.

I do not know of any Hungarian publication presenting the ideal combination of both sets of data aside from the assessment of the cattle deposits from Balatonőszöd–Temetői-dűlő.[7] Even the archaeological publications are often incomplete: either the drawings lack a north arrow or the scale is unknown, and the individuals in one feature are not always clearly differentiated. Sometimes we have a drawing, but no photo; or a photo without an accompanying drawing. This is unacceptable, because the two complement each other: each is important for different reasons to scholars who turn to the publication for information. Most archaeological articles are restricted to the description of the deposit, but often fail to even mention the finds found in addition to the cattle remains, not to speak of the nature of the pit's fill or the other finds or features unearthed near the pit that are possibly associated with the burial. We learn little about the site itself or its broader context, even though this would be crucial. If we have no inkling of what proportion the described deposit represents in relation to the whole, we shall continue to stumble around in the dark and shall never be able to decipher the social and religious motives underlying these deposits.

This article will focus on these problems through various examples, drawing mainly on the findings from the full assessment of the Balatonőszöd site, the largest currently known Boleráz-Baden settlement with intra-site animal and human burials in Hungary, and the circle of the European 'Baden complex' (covering the independent Boleráz culture, Baden culture, Kostolác culture and/or pottery style in one *conundrum* after Martin Furholt and Tünde Horváth).[8]

Problems in the exclusive zoological or archaeological determination instead of parallel multidisciplinary research

Let me begin with the zoological/species determination. Early studies in this field claimed that, being a natural habitat for aurochs, the Carpathian Basin was a secondary centre of domestication for the region's Neolithic cultures.[9] Recent genetic analyses have refuted this theory and have shown that the domestic cattle raised by European prehistoric cultures originate from a single Anatolian genetic centre, and that there was no secondary domestication in the Carpathian Basin during prehistory.[10]

Previous zoological determinations have described various types of prehistoric cattle.[11] Obviously, it is important to determine the cattle type represented by the remains, as well as their sex and age. Bull sacrifices could have been part of special male rites, cows of female rites. Young calves (as firstling sacrifices) and older animals (see below) probably also had an important meaning for those who chose them for ritual purposes. The choice of the animals may have been influenced by considerations of this type. The cattle deposits of the Baden culture are usually assigned to the ancient *primigenius* type and are identified as cows. However, this could only be conclusively proven if it were possible to compare the cattle burials to the complete animal bone sample of the site and of the entire cultural complex. This is not possible, owing to the lack of site assessments.

At the same time, the zoological data are often contradictory. For a very long time, the identification of animal bones was not a routine exercise in archaeological research, while later the lack of trained specialists meant that zoological remains were identified by people such as veterinarians, who were capable of identifying animal species from their bones. While these scholars were proficient in animal anatomy, they were not familiar with archaeology. For example, if the skeleton in question came from a cow or a castrated bull, the smaller size often resulted in an erroneous sex or morphological determination. The re-examination of the "cows" from Pilismarót–Szobi-rév and of the "oxen" from Üllő–Gulya-legelő revealed that the animals in question had been bulls.[12] A reliable assessment of a site can only be achieved if, in addition to the cattle burials/deposits, the zoological material of the entire site and the entire cultural complex is known, providing the framework into which the burials/deposits can be fitted.

At Balatonőszöd–Temetői-dűlő, the number of animal bones recovered from the 440 Late Copper Age Baden complex features totalled 15,400; of these, the 5,879 cattle bones came from 525 individuals. We separated the animal bones according to the Boleráz and Baden horizons within the Baden complex (Table 1).

A heterogeneity could be noted among the individuals based on the horn-cores and the height at the hindquarters.[13] Small-bodied (dwarf) cattle appear during the Baden period in Europe,[14] but large-sized and very large-sized cattle breeds are also known. A short-horned *brachyceros* breed and a *frontosus* breed with wide forehead could be distinguished on the basis of the skull, the horn-cores, and the heights at the withers and the hindquarters. The *frontosus* and small-bodied *brachyceros* breeds are forest and mountain ecotypes, while the large-bodied *brachyceros* and *primigenius* breeds represent lowland ecotypes.[15] The cattle at Balatonőszöd were milk breeds, and the proportion of the sexes was even.[16] There was no apparent preference for a particular type among the cattle selected for sacrifice. The sacrificial animals included individuals of both sexes and all age categories: embryos, newborn and older calves, cows and bulls. However, we did note a 12.3% increase among young individuals selected for consumption and sacrifice in Baden culture compared to Boleráz culture within the Baden complex.[17]

7 Horváth 2014, Sections 3.2, 3.3.3.

8 Furholt 2008; Horváth 2014.

9 E.g. Bökönyi 1974, 110.

10 E.g. Bollongino, Burger, Alt 2003; Edwards et al. 2007.

11 For a summary of the history of the research, see István Vörös in Horváth 2014, Section 3.3.3.

12 Vörös 1979; Honti, Horváth 2013/DVD 1/The Late Copper Age site/Tables/Zoological sum Tables.

13 Horváth 2014, Section 3.3.3, 302-304, 320-322.

14 E.g. Andocs-Nagytoldipuszta-Eperfás: Honti, Horváth 2013/DVD 1/The Late Copper Age site/Tables/Zoological sum Tables; Horváth 2014, Section 3.3.3.

15 Horváth 2014, 303.

16 Ibid., 322.

17 See the detailed information in Honti, Horváth 2013, DVD 1/The Late Copper Age site/Tables/Zoological sum Tables and Archaeozoological remains, Table 50; Horváth 2014, Sections 3.2.1-3; 3.3.1, 322-323, Fig. 234.

FEATURES	NO. OF FEATURES	NO. OF CATTLE BONES	NO. OF CATTLE INDIVIDUUMS	NO. OF CATTLE BURIALS
No. of features	440	15400	149	47
No. of Boleráz cattle burials	173	1350	210	0
No. of Boleráz/Baden cattle burials	4	148	5	4
No. of Baden cattle burials	229	4381	310	29
Sum of cattle	0	5879	525	33

TABLE 1. Cattle bones in Balatonőszöd (made by T. Horváth, 2019).

Chronology and cultural affiliation

Let us now take a look at the chronological framework. The cattle burials/deposits of Central Europe show greatest chronological concentration between 3600/3500 and 2200/2000 BC (Late Copper Age until 2800 BC, Transition Period 2800–2600 BC, and Early Bronze Age 1–3 periods from 2600 BC in Hungary).

Regarding Hungary, it is difficult to pinpoint the appearance of these deposits. Our only starting point is the general cultural attribution of the sites; however, this can often be misleading, because most of the sites in question have not been completely excavated, and they have been assessed only partially or not at all. Additionally, many of them are multi-period and multi-cultural sites investigated during large-scale salvage excavations (e.g. the M7 Motorway along the southern shore of Lake Balaton).

The chronological sequence of Hungarian archaeological cultures is based on their relative chronology, generally established on the basis of ceramic styles, whose correlation with absolute dates has only begun recently and has often involved radical changes in the earlier accepted schemes.[18] In the case of Baden culture, for example, we now know that the culture survived into the Early Bronze Age and that the relationship between Boleráz and Baden within the Baden complex was not clearly linear, but rather parallel, from 3350 BC until 3000/2800 BC.[19] None of the cattle skeletons have been submitted for radiocarbon dating, save for those uncovered at Balatonőszöd.[20] Although most cattle deposits are automatically assigned to the Baden culture or horizon, this cultural attribution is often wrong. At Balatonőszöd, we encountered this problem twice: the radiocarbon dates for the burials of two large-sized mammals indicated a date in the Late Iron Age Celtic period, while the animal remains themselves turned out to be equine. (Pit 229 was tested by radiocarbon measurement.)

Cattle deposited in a contracted position have been reported from the early Lengyel site at Csabdi and from the Early Copper Age Tiszapolgár site at Endrőd 130.[21] One is known from an archaeological publication lacking a zoological description, while the other has no archaeological description. All that can be known about the Csabdi burials is that they were recovered from settlement pits and that the incomplete, but articulate, remains were aligned to the side of the pit, suggesting a deliberate positioning/deposition, although the remains could equally well be interpreted as structured kitchen refuse. Their relative age is around 4500 BC, predating by far the Late Copper Age / Early Bronze Age Baden period.

A horizon directly preceding the Baden complex / Late Copper Age in Hungary from 3600/3500 to 2800 BC, of which it could be a direct continuation, can only be found among the cultures coloured or mixed by *Furchenstich* pottery.[22] However, the cattle deposits/burials or just ABGs (animal bone groups) from these sites represent a different ritual: they are not independent cattle burials, but part of the large stratified sacrificial pits. The preliminary reports reveal nothing more about these sites and their finds.

Like the date of the appearance of the deposits, their disappearance is also elusive. Cattle remains were uncovered in several Bronze Age settlement pits at Soroksár–Botanikus-kert, suggesting that this archaeological phenomenon can be traced up to the Nagyrév-Vatya transition, the transition between the Early and the Middle Bronze Age in Hungary.[23] However, there are no radiocarbon dates for the pits, and a zoological description is also lacking. In the Aunjetitz cemetery of Veľký Grob / Magyargurab (Slovakia, Early Bronze Age), Grave 50 contained a calf with a vessel.[24]

18 Horváth 2009; 2012a; 2014; 2016.

19 Horváth 2014, Section 3.3.15; 2016.

20 Pits 203 and 1143: ^{14}C for cattle skeletons; Pits 426 and 1612: ^{14}C measurements for other human and animal skeletons from the pits, see Horváth 2014, Section 3.3.15, Table 19.

21 Zalai-Gaál 1998, 2005.

22 E.g. the sites in the Abony area, dated before 3700 BC, end of the Middle Copper Age, Fábián, Serlegi 2008; Rajna 2011.

23 Kalicz-Schreiber 1981.

24 Bátora 2005, 527-528.

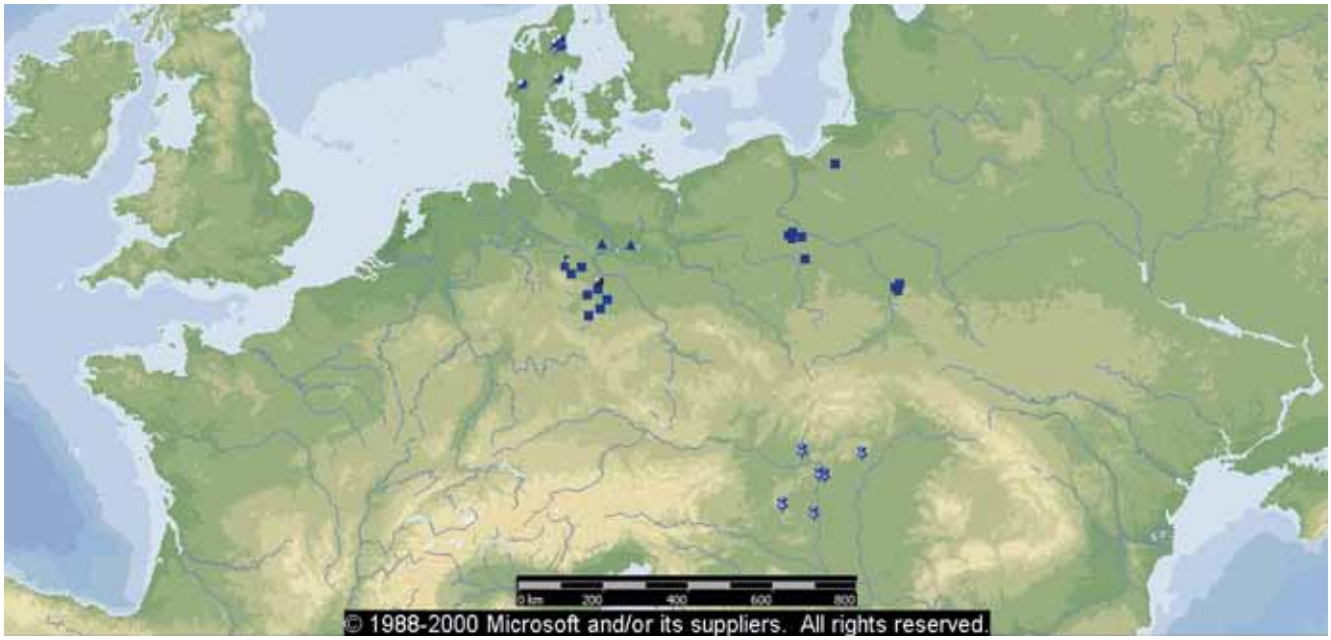


FIGURE 1. Distribution of paired cattle deposits in Europe, 3600 – 2000 BC (made by T. Horváth).

LEGENDS: pin: Baden; rectangular: Globural Amfora; circle: Walternienburg; rectangular with flag: Bernburg; triangle: Elbe-Havel; circle with line: Corded Ware

Returning to Balatonőszöd, one thing seems to be certain: cattle deposits, burials or remains (ABGs) are exclusively associated with the classical Baden horizon and do not occur in Boleráz and Kostolác features. Cattle deposits are thus specific to a culture and can only be linked to the classical Baden culture/horizon within the Baden complex.

Distribution, mapping

Let us now take a look at the spatial distribution in Europe.[25] Cattle deposits have been reported from the *Altmärkische Tiefstichkeramik*, the Salzmünde, Bernburg, Wartburg, Walternienburg, Elbe-Havel groups of the Funnel Beaker culture, the Baden, the Złota and the Globular Amphora cultures, the Mierzanowice culture and the Schönfeld group of the Corded Ware culture. Their time-span covered the same interval as the independent Baden culture or, more likely, the entire period of the Baden complex, corresponding to the Hungarian Late Copper Age and Early Bronze Age periods. These cultures flourished during the same time interval as the Baden culture and the Baden complex, spanning the period between 3600/3500 and 2200/2000 BC, filling the Late Copper Age and surviving into the Early Bronze Age.

There are considerably fewer paired cattle burials than cattle deposits (Fig. 1). The southernmost sites with cattle deposits are known from Croatia (Koprivnička Rijeka–Rudina,[26] Aljmaš–Podunavlje, Osijek–Retfala,[27] and Vučedol[28]). Paired cattle are attested at Balatonőszöd (Baden complex); the northernmost sites are Klostergård and Torup Høje (Denmark, Corded Ware), the westernmost are Remlingen (Germany) and Tringhøj (Denmark), while the easternmost is Husynne Kolonia, with paired cattle known from Klementowice (Poland, Globular Amphora). The distribution shows clusters of cultures, with a concentration towards the north rather than the south (meaning the Mediterranean in this case) in continental Europe. There can be large spatial and even chronological gaps between the major clusters. We need many more radiocarbon series to address this issue.

Unclarified problems

The deficiencies arising from the lack of published data, or from only partially published data, as well as the outdated nature of some available data sets, is especially striking in the following areas:

1. The nature of the site (settlement, cemetery, other);
2. The relation between the published phenomenon and the site (context within the site);
3. The nature of the cattle remains/deposits (complete/partial skeleton, other ABG, kitchen refuse);
4. The nature of the cattle burial/deposit (single burial / single burial with other animal burial(s) / cattle burial with human burial(s) / cattle burial with human burial(s) and other finds, or lacking other finds);
5. Paired/unpaired burials within one feature (with paired burials perhaps indicating a wagon or yoking);
6. Relation between the cattle burial/deposit and other finds;
7. Cattle depictions on other find types and their possible relation to the burials/deposits;
8. Secondary exploitation of animals and its possible visible traces (traction);
9. Dating of the burials/deposits and the levels within one feature.

25 Horváth 2009, Fig. 15.

26 Marković 1979, 1981.

27 Pasarić, Trbojević Vukičević 2016.

28 Jurišić 1990 (the cattle deposit belongs to the Kostolác culture).

1. The nature of the sites (unknown site types lacking the possibility of a traditional archaeological evaluation, classification, interpretation, with focus on Hungary)

As with the curious human burials with a stone packing and a wooden, coffin-like frame typical of the Baden culture, possibly representing the latest burials (belonging chronologically to the Bronze Age as a surviving Baden tradition),[29] the lack of published material and the lack of information on the proportion of the excavated to the unexcavated area of a site does not enable even an educated guess as to the nature of the site on which a cattle burial/deposit was found. Examples can be quoted from Baja–Dózsa György út, Budaörs–Kamara-erdő, Budapest–Királyok útja, Kajárpéc–Pokolfa-domb, Orosháza–Bónum, Pécs–Alaktanya, Szabadszállás–Ágostonhalmi-dűlő, Tahitótfalu–Vácirév and Üllő–Gulya-legelő, all sites on which cattle burials were uncovered. It seems likely that the sites in question were settlements, but this can only be confirmed by further investigations. (These were all rescue excavations, focusing only on the features containing cattle.)

Another difficulty is posed by the description, as graves, of settlement features containing skeletons. Although described as a grave, the cattle burial or deposit uncovered at Szentes–Nagyhegy was found in a settlement feature.[30] Neither were the sites at Kétegyháza, Mezőcsát–Hörcsögös, Szeghalom–Dió-ér and Tiszavasvári–Nyíregyházi út cemeteries.[31] The latter were animal and human burials on a Baden settlement with a Pit Grave kurgan raised over them, as shown by our investigations at Tiszavasvári–Gyepáros.[32]

Classical cattle graves in a regular, extra-site cemetery (single, paired, or paired cattle with a human pair as a multiple burial)

Let us now take a look at the cattle graves uncovered in cemeteries. Three sites can be assigned to this category.

– Alsónémedi

The site was excavated in 1949 by József Korek, who found a male and a female burial, and two cattle burials, in Grave 3.[33] The idea that this grave represented a wagon burial was first proposed by József Csalog in 1961, who suggested that the leading couple of the community had been interred with a pair of yoked cattle, which had drawn the funerary wagon.

A similar interpretation was proposed for Grave 3 in the Budakalász cemetery.[34] The animal skeletons were examined by Sándor Bökönyi, who identified them as an eight-year-old cow and a one-and-a-half-year-old calf, which had been deposited with their heads touching.[35] The grave was displayed in the old permanent exhibition on the prehistory of Hungary in the Hungarian National Museum, but it can no longer be seen in the new one. It might be useful to re-examine the animal remains again, but unfortunately it is not known where the grave is housed at present.

Grave 28 of the Alsónémedi cemetery contained the remains of a six-year-old cow and a ten- to twelve-month-old calf with the heads turned toward one another.[36]

– Balatonlelle–Felső-Gamász

One of the eighteen graves uncovered in the 2002 excavation season in the separate Boleráz-Baden burial ground near the associated settlement (Balatonlelle–Országúti-dűlő) contained two cattle skulls as grave goods. Grave 291 was a richly furnished male burial. Part of the body, from the waist downwards, had been re-deposited in another pit lying some 1.5–2 metres away (Pit 117), the first archaeologically documented case of a *post mortem* manipulation in a Baden cemetery.[37]

– Budakalász–Luppa-csárda

The initial publication by János Banner and Sándor Soproni described Grave 3 as containing a male and a female burial, an eight- to ten-month-old calf and the skull and parts of the trunk of an adult bovine, i.e. an incomplete skeleton.[38] According to the Budakalász monograph published in 2009, the skeletal remains can no longer be found in the Ferenczy Museum in Szentendre and could thus not be re-examined.[39]

The idea of wagon burials can be discarded: the size of the feature (whether a grave pit or a sacrificial pit) excludes the possibility of the deposition of a wagon in addition to the bodies, and no remains whatsoever indicating the one-time presence of a wagon were found (soilmarks from decayed parts, wagon fittings). In the case of paired cattle burials, the re-examination of the skeletal remains – if still available – revealed that they came from an older cow and a young calf (e.g. at Balatonőszöd,[40] and perhaps at Alsónémedi), which, owing to their different ages, are unsuitable for yoking, which calls for two young castrated oxen. However, none of the re-examined skeletal remains came from oxen. Still, in all fairness, it must be added that, in many cases, the skeletal remains in question can no longer be found (e.g. in the cases of Alsónémedi and Budakalász), and thus their re-examination is no longer possible.

However, we have a positive example for zoological re-examination from Svodín/Szőgyén in Slovakia. The settlement was excavated by V. Němejcová-Pavúková through several seasons between 1971 and 1983. The pathological alteration of two cat-

29 E.g. Lichtenwörth and Leobersdorf in Austria, see, e.g., Hahnel 1992.

30 Banner 1956, 159-162.

31 Summary in Horváth 2006.

32 Dani, Horváth 2012, 77-78.

33 Korek 1951, 37-38, Fig. 1; Piggott 1983, 47, Fig. 17.

34 After Csalog 1961 and, e.g., Fettich 1969.

35 Their very different ages excluded the possibility that they were paired cattle; it was a simple cow-calf operation, see e.g. https://en.wikipedia.org/wiki/Cow-calf_operation

36 With a male burial, Korek 1951, 39.

37 Nagy 2010; Horváth, Köhler 2012, 461, Fig. 10.

38 Soproni 1956, 113, Pl. XC.1, 3 in Banner 1956: the cattle were interpreted as grave goods.

39 Bondár, Raczky 2009, 33-34, Fig. 9, Pls. III-IV; Gál 2009, 372.

40 Pit complex 1608-1781-1856. Pit 1856 was the single feature at Balatonőszöd which contained paired cattle burials: a 4- to 6-month-old calf and an adult mature cow: see Horváth 2014, Section 3.2.1, 122-123, Fig. 93.

tle skeletons in Burial 328/74 in a round pit suggested that individual A was more than 5 years old, and individual B more than 8 years. Both were castrated males (oxen). The pathological alterations indicated that they were two draught oxen working as a pair: the older animal was yoked to the left side, the younger one to the right.[41]

2. The relation between the published phenomena and the excavated settlement (the context of the animal deposit within the site)

The cattle remains uncovered at Balatonőszöd can be grouped according to various criteria. As we have seen, cattle could be deposited into a large communal sacrificial pit or an independent burial/grave/sacrifice/deposit (sacred or kitchen refuse), it could function as funerary good or food offering, or prestige good. In every case, we found complete and partial skeletons (e.g. without a head, head and front quarters, etc.).

Single burials can be grouped according to body position, sex, age and the associated finds. Some cattle bodies were laid on the side with the limbs extended or drawn up, some had the head bent back, some had the body rolled up, and in some cases the animal bodies were simply dumped into the pit.[42]

Some cattle burials in the Budapest area had the animal's body arranged in a frog position.[43] Owing to the many different body positions conforming to the diversity of how human bodies were deposited, I suggested that cattle burials might be seen as correlates of human/male burials and that they may have been substitutes for humans in blood sacrifices. This seems to be borne out by the proximity to one another of pits containing human and cattle burials (e.g. Pits B-1236 and 1237, and Pits 1831 and 1832). I quoted analogies from cattle-breeding African peoples among whom men identify themselves with, and symbolise themselves through, cattle; and their perception of their society and of the world around them is filtered through this construct.[44] There was only one paired cattle burial among the 47 deposits found at Balatonőszöd. Cattle dominate the number of deposits in individual features (47 in 30 features, with 36 complete individuals), while sheep represent the highest number of sacrificed animals (71 individuals in 11 features).

If the spatial distribution of animal skeletons and the ritually associated human burials and other ritual artefacts are mapped over a sufficiently large excavated settlement area, we can make a series of insightful observations. At Balatonőszöd, for example, we find that animals are concentrated in the settlement's eastern, Baden-occupied part and that there are very few in the Boleráz occupation area, where they always have a dual, Boleráz-Baden nature. Another striking phenomenon is that the single human burials often lie in the immediate vicinity of single animals, but in a separate pit. In almost every case, we found various ritual artefacts and vessels in pits located in the proximity of the animal burials, which had perhaps been used during a particular ceremony.[45] These finds and features could clearly be associated with one another, and they perhaps outline a ceremonial area – all the more so, considering that a ceremony was made up of several rituals performed at various times and in different locations. It is therefore of crucial importance to examine the broader area of a particular phenomenon, as is the excavation of a sufficiently large area of a site and its detailed publication in order to gain an overall picture and not merely a tantalising glimpse of the phenomenon studied.

3. The nature of the cattle remains/deposits (complete/partial skeleton, a few bones, etc.)

Any kind of evaluation should begin with the most detailed archaeological and zoological description, followed by a separate interpretation of each feature and, finally, an overall interpretation at the level of the whole site. At Balatonőszöd, focusing on the cattle deposits, certain patterns can be noted following the basic classification:[46]

– Complete cattle skeletons. In these cases, the pit was usually shallow, its fill was burnt and contained ashes, and it did not yield any finds beside the animals, aside from the occasional bone or chipped/ground stone tool. I interpreted them as settlement burials/graves which followed the human burials/sacrifices or were substitutes for them. If the pit was deep and contained other finds, I described it as a blood sacrifice in black magic (the whole animal is offered to the chthonic power). In general, it was part of a large communal sacrificial pit.

– Partial skeletons. I distinguished several modes of this manipulation: body without head, head without body, front end of the body, back end of the body, legs without body. Most of these features contained another complete body (human or animal), but some were solitary. I interpreted them as the remains of ritual activities (blood sacrifices in white magic, in which parts of the animal are consumed together with the celestial power, or grave goods; food for the otherworld).

Some pits contained many animal bones, but not in anatomical order and without associations. It remains uncertain whether these represent kitchen refuse or something else that can be connected with some kind of ritual activity.

4. The nature of the cattle burial/deposit (large communal sacrifices, single burial / single burial with other animal burial(s) / cattle burial with human burial(s) / cattle burial with human burial(s) and other finds, or lacking other finds)

After the detailed and joint archaeological and zoological descriptions, we can undertake the finer work of classification based on the condition of the feature and the skeleton, on visible special or unusual traits such as pathology, age, sex and mortality, and on other sacrificial features or finds near or in the

41 Fabiš 2005.

42 Horváth 2010, 42-46; 2014, Section 3.2.3, 160-168.

43 Endrődi 2004, 31, Fig. 49.

44 Douglas 2003, 91, 155, 327.

45 Horváth 2014, Section 3.2, Fig. 83.

46 Horváth 2006; 2010; 2012; 2014, Section 3.2.1, 113-129; Section 3.2.3, 160-169 in detail.

pit, etc. As a reflection of the community's beliefs and values, the Transcendent was manifested and expressed through bloody human and animal sacrifices, and the associated ritual weapons, implements, ceremonial vessels and artefacts, as well as the grave goods accompanying the deceased on their journey to the otherworld, found near the sacrifices.

Following a classification with a view to these aspects and anomalies, we can distinguish several special rituals: post-mortem manipulations, firstling sacrifices, burnt offerings connected with white celestial magic (burnt and smoked), deep-water offerings connected with black chthonic magic, oath offerings, a favourite pet as a companion to the otherworld, etc.[47]

5. Paired/unpaired burials within one feature/site (with paired burials perhaps indicating a wagon or yoking)

In Hungary, paired cattle are known from the settlements of Balatonőszöd–Temetői-dűlő (Pit 1856), Dunaszentgyörgy (Pit 78/105)[48] and Mezőkövesd–Nagy-Fertő (Pits S-38 and S-133)[49] and from the above-mentioned formal cemeteries of Alsónémedi (Grave 3) and Budakalász–Luppa-csárda (Grave 3 with humans).

At the Balatonőszöd site, there was only one pair of cattle (Pit 1856) among the many cattle deposits. The same can be noted across the entire European continent: there are only a few paired cattle among the cattle deposits.[50]

Pit 1856 was part of a large pit complex, consisting of Oven 207, Pits 1434, 1435, 1436 and 1782, and Pits 1608 and 1781 with other animal deposits.[51] Pit 1856 contained a 4- to 6-month-old calf (time of death: October-December) and an adult/mature cow, as well as a limb from another adult cow and a lumbar vertebra from a dog (Fig. 2). The sex and age of the paired cattle burials rule out the possibility that they had been a draught animal pair (calves being too young for traction: the Hungarian ethnographic record indicates that oxen could have been trained for this purpose once they reached 3-4 years of age after their castration in the first year).[52] They rather seem to represent a mother-and-child relation, which can be confirmed by future DNA analyses on the site's animal samples. The small, round, shallow pit filled with the animal bones also excludes the possibility of any kind of artefact connected with transportation (a travois/sledge with or without wheels, two-wheeled cart, or four-wheeled wagon).

Investigating the regular cemetery graves in the Alsónémedi and Budakalász cemeteries, I can say nothing certain regarding the original find circumstances and their documentation (Fig. 3).

The new, modern finds in Europe presented at a conference with their complete documentation of drawings and photos were wholly convincing to me:[53] there were visible signs of the two wheels in the form of rut marks in front of the cattle, some organic remains indicated traces of the wheels or the cart, while the paired cattle could have formed a draught animal pair anatomically.[54]

These features are absent from the above-mentioned Hungarian burials.[55] Regarding the date of their excavation – over half a century ago – and the more rudimentary field techniques, we could assume that the missing traces can be attributed to the circumstances. However, the fact still remains that no indication of wheels or a cart can be seen on Soproni and Korek's original photos, and that the cattle deposits were not complete skeletons, nor did they form pairs of draught animals.

6. Relation between the cattle burial/deposit and the other finds (related finds)

As with the human burials,[56] I distinguished sacrifices/deposits and settlement burials/graves based on body position and on the fill, the form, the depth and the contents of the pits containing one or more cattle skeletons or skeleton parts. In the case of sacrificial pits, the fill was often ashy and burnt, containing burnt daub fragments, suggesting some sort of link with fire (perhaps with burnt offerings).

In addition to the cattle remains, some pits contained the complete or partial skeletons of other animals, too.

Some pits also yielded various other finds in addition to the animal remains. Pit 1841 (Fig. 4), for example, contained fragments of a basalt axe, and a blow mark caused by a heavy implement could be seen on the cattle mandible.[57]

47 See Horváth 2006; 2010; 2014, Section 3.2. The animal deposits of ritual background may reflect the natural events of their deaths. Regarding the possible decimation of the livestock, mention must be made of a cause of death specific to this region, although its incidence could only be demonstrated with special genetic analyses. In consequence of the heavy rains of the past few years in Hungary, the country's livestock was decimated by an epidemic that was believed to have long disappeared, namely fasciolosis (Rózsa 2005, 318). This disease is spread by the dwarf pond snail (Galba truncatula), whose mass appearance can be demonstrated after major floods and in stagnant floodwater. As an intermediate host, it principally endangers sheep and, although to a lesser extent, cattle. It is possible that the wetter climate and the higher lake level in the southern Balaton region during the period in question led to the appearance of this pest on the pastures, endangering the livestock and causing serious damage.

48 György 2009, 31, Fig 2; Tugya 2009, 62. One lived for 2.5-2.75 years, the other for 2.75 years and was placed first in the pit - thus they were almost of the same age and could have formed a draught animal pair anatomically, but there was no trace of a wagon. Their deaths came about in winter.

49 György 2008, 43-44. In Pit S-38 one bovine was excavated, while the archaeozoological analysis described two individuals. This means that there were not two complete skeletons. In Pit S-133 there were two juvenile individuals: one was complete, and the other only some bones (Fig. 46/1). Their being draught cattle is excluded in both cases.

50 Jeunesse 2006.

51 Horváth 2014, Section 3.2.1, 122-123, Fig. 93.

52 Balassa, Ortutay 1982, 257.

53 Humans, Animals, Mobilities - exploring new socioeconomic constellations in the 3rd millennium BCE, 9th-11th April 2014, Foredragssalen, Moesgård, Denmark.

54 From Denmark, see Johannsen 2006; Johannsen, Laursen 2010. From Germany, see Müller, Schunke 2013, esp. 87, Abb. 3; Müller 2017, esp. 233-235, Abb. 7-10.

55 See Horváth 2015 for the cart, wagon and wheel models in Hungary.

56 Horváth 2014, Section 3.2.1 and 3.2.2; 2017.

57 Ibid., Section 3.2.3, 164-165, Fig. 144.

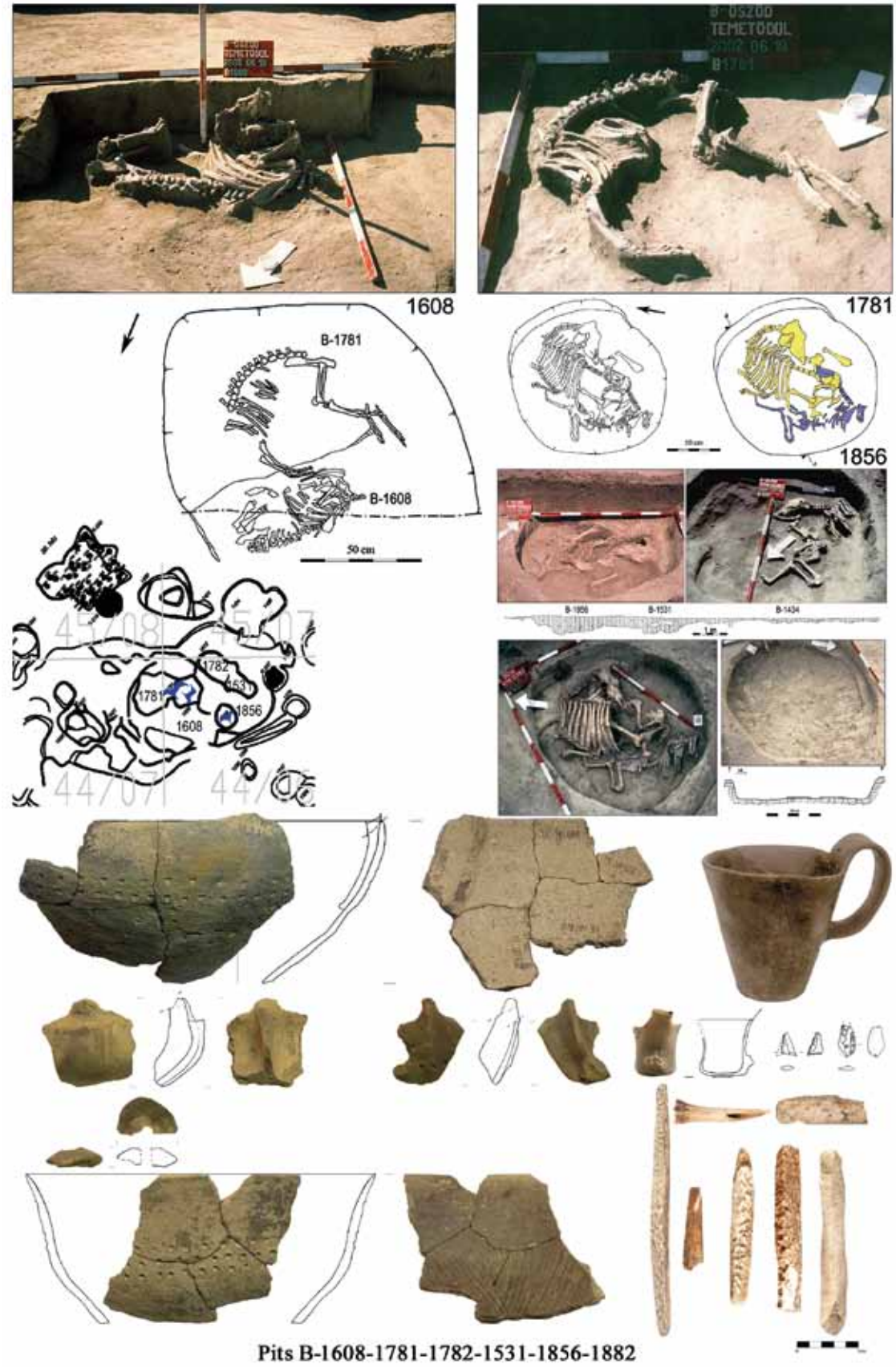


FIGURE 2. Balatonőszöd, Pit 1856: paired cattle deposits at Balatonőszöd, Pit complex 1608 (made by T. Horváth).

7. Cattle depictions on other animal figurine types and their possible relation to the burials/deposits

The cattle-related finds of the Baden complex include a large Boleráz amphora with cattle heads (Fig. 5.1),[58] a handful of larger clay animal figurines (Fig. 5.2),[59] among which calves are also depicted, and a few copper or clay/stone figurines/representations of the Boleráz horizon and the Middle/Late Copper Age (Fig. 5.3–4, Fig. 9),[60] as well as some stone carvings in Europe without more accurate dates (Fig. 6).[61] There are possible cattle depictions from pots dating from the classical Baden period (Fig. 7). Curiously enough, these always portray cattle with large, long horns, in marked contrast to the actual animal remains (see above, Section 2).

Some of these portray the animals with a rope around their neck, providing proof of their secondary exploitation (traction: e.g. Vác, Bytyń). The Bytyń hoard, made up of copper oxen figurines and axes, and the hoard of copper axes wrapped in linen found under the Moravian burial mounds and textile remains from this period reflect the associations among particularly prestigious,[62] valuable commodities, as well as the highly developed state of trade, the secondary exploitation of the animals and the period's new innovations, such as copper, linen and wool products connected with wheeled transport and continental trade routes.

It is noteworthy that these finds come from the early period – that is, from the close of the Middle Copper Age and the onset of the Late Copper Age – and that they can be assigned to Boleráz; none come from the later, independent classical Baden period. There are no comparable cattle representations from the classical Baden horizon: merely indirect finds without genuine cattle depictions (Fig. 7), such as the four-wheeled wagon models without cattle protomes and, of course, the cattle deposits themselves.

58 Vác, Kővári 2010.

59 Boleráz cemetery of Pilismarót-Basa-harc, Torma 1973.

60 Radošina/Radosna (Sl): Boleráz rectangular vessel/travois or two-wheeled cart model with double cattle protomes, Fig. 5.3; other cultures: Krężnica Jara (Pl): on vessel, Dieburg (D), Lisková Cave (Sl), Tsoungiza (Gr): single clay figurines; Bytyń (Pl): copper double cattle figurines with flat axes, Fig. 5.4; Lohne-Züschen (D), Val Camonica/Cemmo, Mont Bego/Val de Fontanalbe (I/S), Tarxien, Third Temple (M) (Fig. 6.2).

61 See Matuschik 2006.

62 Baldia et al. 2008; Harris 2003.

FIGURE 3. Idealised picture of Budakalász, Grave 3 (after Judit Torma in Trogmayer 2005, 40-41).

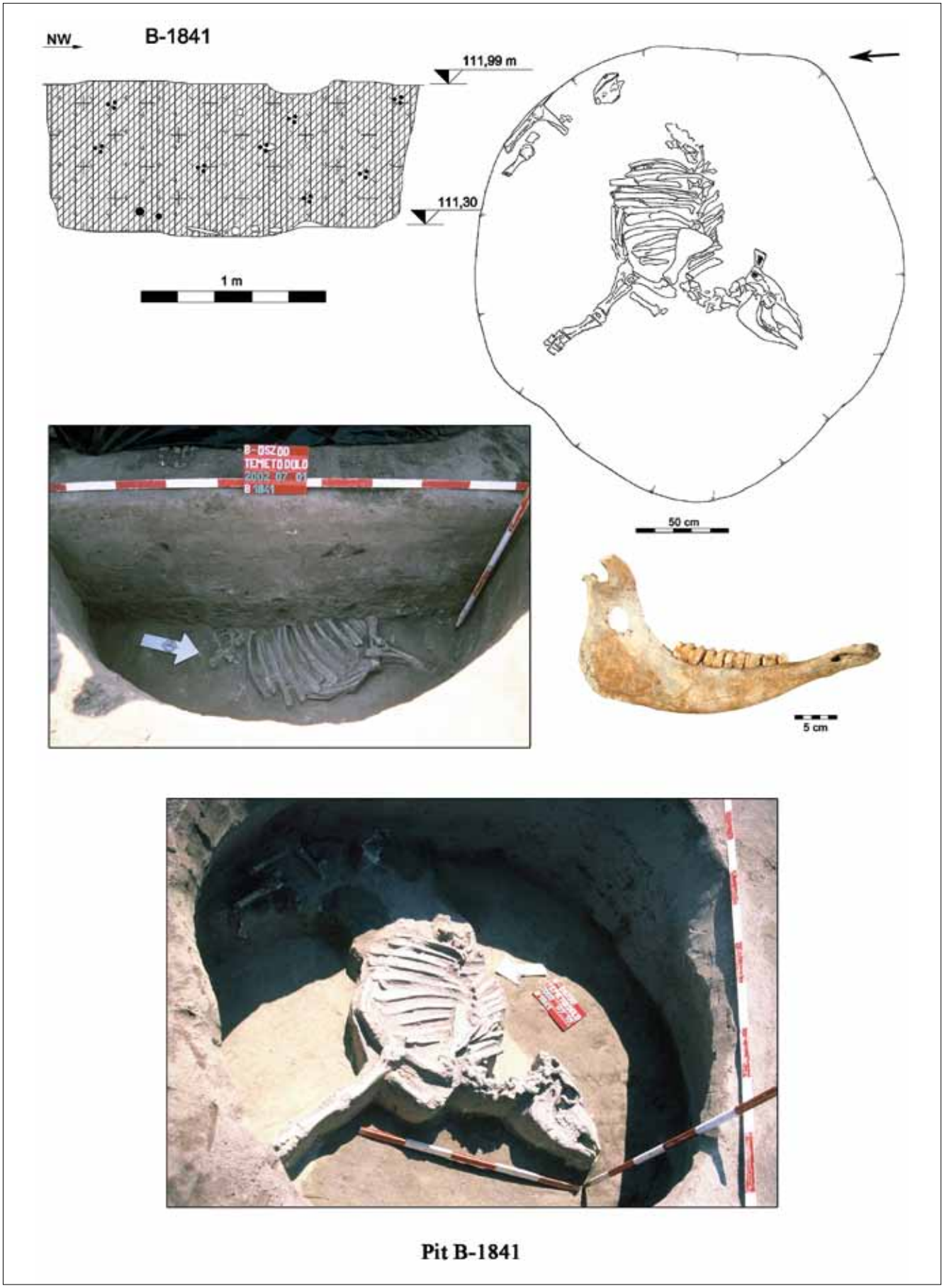
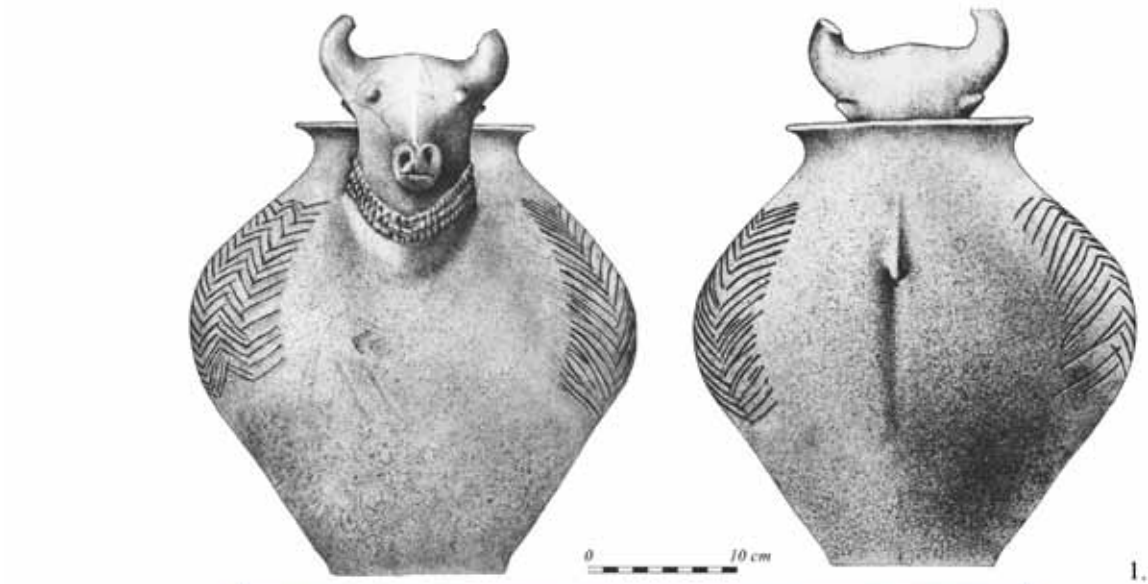


FIGURE 4. Balatonőszöd, Pit 1841: cattle burial with traces of an axe blow on the mandible (made by T. Horváth).



1.

2.

3.

4.

FIGURE 5. 1. Vác, Boleráz zoomorphic amphora (after Klára Kővári 2010, fig. 4); **2.** Pilismarót–Basa-harc, Boleráz cemetery: large clay figurines of young animals (after a postcard of the Hungarian National Museum); **3.** Radošina, rectangular vessel with cattle protome (after the title page of Bronislav Chropovský 1973); **4.** Bytyń hoard (after Wofram Schier 2010, 36).

FIGURE 6. Rock carvings from sacred places with cattle: **1.** Mont Bego peak sanctuary (after Dal diaspro al Bronzo, Fig. 2);

FIGURE 6. Rock carvings from sacred places with cattle: **2.** Tarxien (Malta, Third Temple, around 3100 BC (made by T. Horváth).

FIGURE 7. 1. Incised figures of cattle or horses and seated humans on the neck of a bowl with Ózd-type handle from Bükkábrány, unpublished (courtesy of L. Fekete); **2.** Ram or cattle protome with big horns on the rim of a Kostolác-like pot from Ikervár–Gyári-dűlő, unpublished (courtesy of M. Nagy).

8. Secondary exploitation (traction)

There is archaeological evidence for the secondary exploitation of animals during this period and in the Baden culture, too. István Vörös noted that the cattle bones from Balatonőszöd came from milk breeds.[63] The practice of yoking cattle and evidence for the attachment of a neck yoke with ropes was found on a cattle horn recovered from one of the largest sacrificial pits (Baden Pit 1612, Fig. 8). A cattle protome dating from the Boleráz horizon was also brought to light (Pit 1998, Fig. 9); the protome probably broke off an artefact resembling the sledge/travois or cart model from Radošina/Radosna.[64]

We did not discover any finds that could be associated with ploughing, and there were very few indications of arable farming at the site. Charred millet seeds were found in a vessel and on a grinding slab.[65] Even though sickle gloss could be noted on some of the chipped stone blades, the phytolith analyses suggested that this could have been caused by other activities too, not necessarily by cereal reaping.[66] The use of ploughs can be excluded during the Baden period in Hungary.

Wear traces caused by a rope for the attachment of a neck yoke were identified on the horn of an old bovine recovered from the lower level of Pit 1612, the settlement's largest sacrificial pit.[67] This feature also provides an excellent illustration of the stratification and of the long duration of the community's use of sacrificial pits.

Axel Pollex's proposal that cattle burials should rather be labelled *cattle deposits* was an excellent idea because it expresses the complexity of this archaeological phenomenon: on the one hand, these deposits are very often made up of the remains of several animals representing different species or the same one; on the other, the radiocarbon dates for the skeletal remains indicate that several years had elapsed between the depositions, i.e. they were not deposited on one occasion.[68] It therefore makes sense to call these ritual phenomena collective sacrificial pits, because such a large number of animals would hardly have been sacrificed during one season, and it seems likely that even a community could only raise this number over several years.

9. Dating of the burials/deposits and the levels within one feature

The animals in Pit 1612 were probably slaughtered in late autumn/winter and in spring, implying a span of at least half a year for the deposit. ^{14}C data: Upper section: from a dog skeleton, 3140–2950 cal BC (1 σ), 4440 ±70 BP; lowest Level 6: from a sheep skeleton, 1960–1860 cal BC (1 σ), 3550 ±50 BP. The date, which is far too late, falls in Early Bronze Age 3. The TL/OSL date for the pedestalled goblet from this pit is 3390–2270 cal BC (1 σ). There is a contradiction between the radiocarbon dates, as the date for the lowermost level is later than the one for the overlying upper level. Another problem is that there is a difference of 890 years between the two final dates. If the radiocarbon dates are correct, this ritual pit was infilled for at least 900 years, corresponding to almost the entire duration of the occupation of the Baden settlement at Balatonőszöd.[69] In this case, it is obvious that the remains do not represent a massacre or a possible decimation of the livestock by an epidemic.

A similar 'inconsistency' could be noted in the case of the dates for Pit 426: the radiocarbon and TL dates suggest that the pit's use-life and infilling spanned several hundred years, and the date for the upper level is earlier than the one for the lower level.[70]

The first radiocarbon dates from Niederwünsch (D, Saal) suggested two periods and a kind of break or continuity between the early and later ritual cattle deposits.[71]

Discussion

In order to make new advances in this field, we need a joint international strategy that we should all adopt as a common protocol – in our case, by researchers who have excavated sites yielding cattle skeletons dating from a prehistoric culture distributed in Europe. We need to create a uniform set of criteria for examining and describing our finds from an archaeological, zoological and chronological/dating point of view. Our publications should contain all the relevant basic information accompanied by the necessary illustrations (and we should disregard any constraints imposed by limitations of space). Finally, we should also submit samples from the skeletal remains for absolute dating.

63 Horváth 2014, Sections 3.2.1-3; 3.3.1; 3.3.3.

64 Ibid., Section 3.2.4, 202-203, Fig. 168.

65 Ibid., Section 3.3.9, 380-384, Fig. 266.

66 Ibid., Section 3.3.8.

67 Ibid., Section 3.2.1, 123-124, Fig. 94.

68 E.g. Kuczkowo 1/A136: five dates between 4415 and 4370 BP; Kuczkowo 1/C2: five dates between 4970 and 4480 BP, after Szmyt 2006.

69 See the details in Horváth 2014, Section 3.3.15.

70 Horváth 2014, Section 3.2.1, 113-116, Fig. 85.

71 E. Müller dated Features 30122 and 30124 to 3600-3500 BC, falling into the early Salzmünde culture or the late Baalberg, while the later features (nos. 30110, 30111, 30116, 30117 and 30119) were dated to 3300-3000 BC, falling into the Walternienburg culture (its Salzmünde group): see Müller 2017, 237.

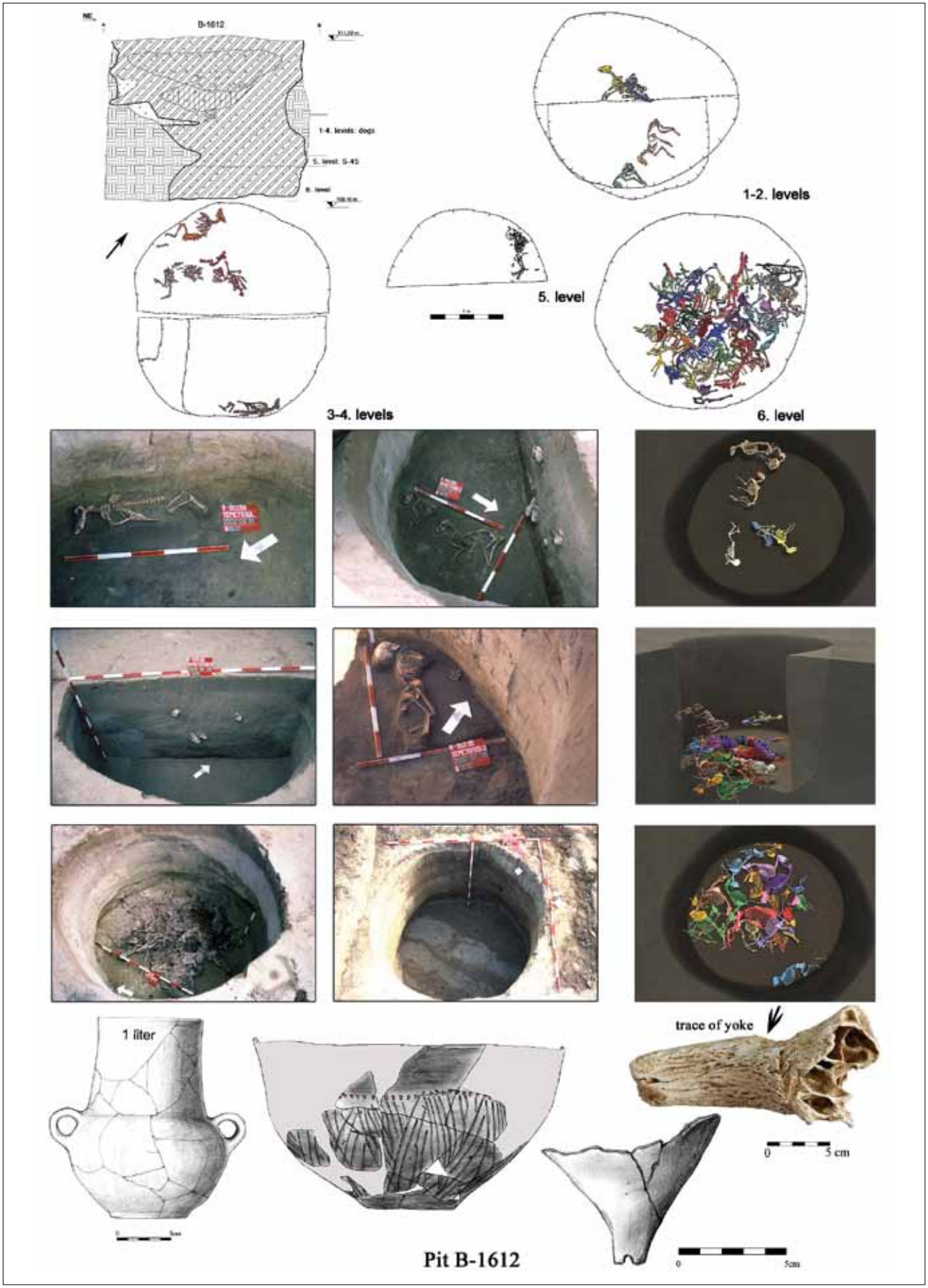


FIGURE 8.Balatonőszöd, Pit 1612, traces of yoking on the horn of the cow from the lower level (made by T. Horváth).

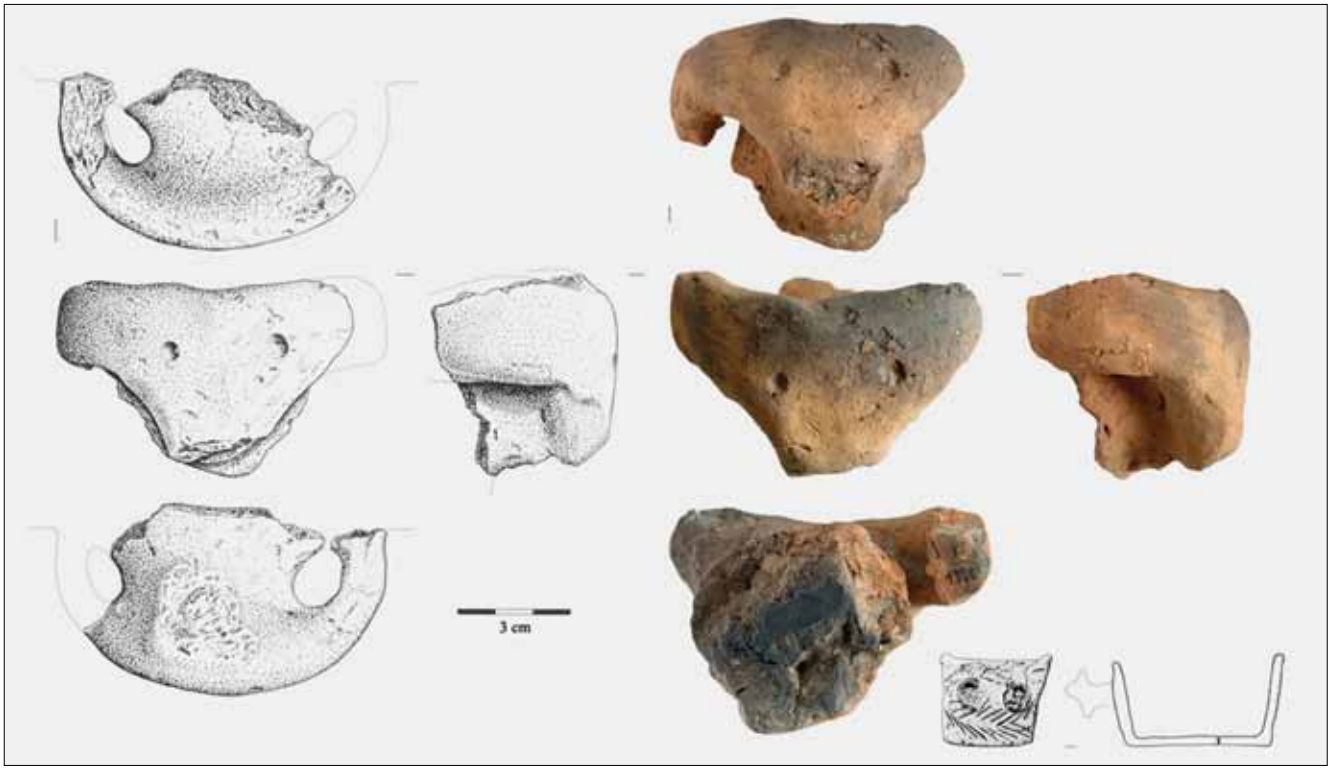


FIGURE 9. Balatonőszöd, Pit 1998, Boleráz: cattle protome, broken off from vessel (made by T. Horváth).

It is my hope that, once the necessary dates are available, we will find that the deposits form smaller chronological clusters within a longer, 1500-year time-span. These shorter, but associated, intervals will then be suitable for searching for the possible climatic and other external causes giving rise to the deposits.[72]

Comparing the ^{14}C data from Poland[73] and Balatonőszöd, we can note a common, shorter time interval, especially between 4480 and 4380 BP, roughly during 3300–3000/2900 cal BC. Collating the environmental record with the scanty archaeological evidence, this period shows a correlation with a rise in the water level of the Western and Central European lakes between 3700 and 3250 cal BC.[74] As Michael Magny has noted, many factors could underlie these climate fluctuations.

Many animal species have been vested with general traits by human communities: dog and horse, for example, often have funerary aspects as creatures accompanying humans to the otherworld. There may well be a similar body of beliefs associated with cattle. In many high civilisations, cattle were linked to the Sun cult.[75] It is possible that some of the European cattle sacrifices could be related to the strange and unusual celestial phenomena observed by communities living in the northern hemisphere: constantly cloudy skies, permanent rains, magnetic storms caused by solar winds, and an aurora borealis which can sometimes be seen from as far south as Paris. We could search for additional natural events, such as identifiable volcanic eruptions, behind these phenomena.[76] We should search for a quite large, at least VEI 4 or larger, eruption in the northern hemisphere. In

72 The end-date of cattle phenomena around 2200/2000 BC probably reflects the mysterious "4.2ka BP event", a global climatic deterioration at the end of the long rule of Pharaoh Pepi II (2246-2152 BC): see Risch et al. 2015. Unfortunately, the period before 3000 BC that can be synchronised with the Central European Late Copper Age is blurred because, even though the well-developed parts of the Old World from the south (Egypt: along the Nile, Old Kingdom, under the Third Dynasty, second king, Djoser, 2624-2575 BC; Mesopotamia: Sumer, Akkad, Proto-Elam, Mari and Ebla, Jemdet Nasr period between 3100 BC and 2900 BC, Early Dynastic Period from 2900 BC until 2350 BC, Early Dynastic I, 2900-2750 BC) emerged around 3100/3000 BC, their written records are later, dating from ca. 2600/2500 BC.

73 Szmyt 2006.

74 Magny 2004; Horváth 2014, Chapter 1.

75 Cf. some articles in Pétrequin et al. 2006, esp. by I. Matuschik, P. Butterlin and J. C. Margueron. It would be very helpful to find a link (e.g. coherent dates, written sources) between the royal cattle and human graves in the Near East and cattle sacrifices in Egypt and the climatic fluctuations in that region.

76 The period from 3500 BC until 3000 BC was an extremely turbulent time for volcanic activity around the world, particularly in Russia (White 2015).

view of the distribution of cattle deposits, the location of the eruption could lie closer to the northern active volcanic zone of Europe (e.g. Iceland or Russia/Siberia), rather than the southern one (southern Italy).[77] If we search the available databases, we can identify several potential volcanic eruptions with an eruption greater than magnitude 4 between 3600 and 2000 cal BC (Table 2, Diagram 1).

We would certainly be in a much better position if we knew the exact date of the archaeological phenomena – without accurate dates, we are searching for the proverbial needle in the haystack.

Summary

Cattle deposits are one of the most interesting and spectacular ritual phenomena of prehistoric Europe during the Late Neolithic (or Late Copper Age in Hungary). We need more exact archaeological and zoological information to classify them, because they did not follow the same ritual pattern. We know that this period clearly marked the rise to prominence of cattle among the domestic species. However, animal husbandry is only one of the elements of a prehistoric culture. Ritual life, social activities, and environmental and climatic conditions also determined and moulded how a human community was built. In human society, everything counts, and everything is related to everything else. The most revealing sign of the colourful diversity of cattle deposits is that they are attested to in many prehistoric cultures. Perhaps these cultures lived at the same social level, or in similar environments, but this is insufficient information to answer why cattle were used in similar rites. This is the most important reason why we have to keep searching for an answer in the background – among the environmental and climatic factors, or in dating – to narrow the gap between 3600 and 2200/2000 BC.

77 There were smaller eruptions with local destructions, for example in the Campanian Plain: see Orsi, Cioni, Di Renzo 2013.

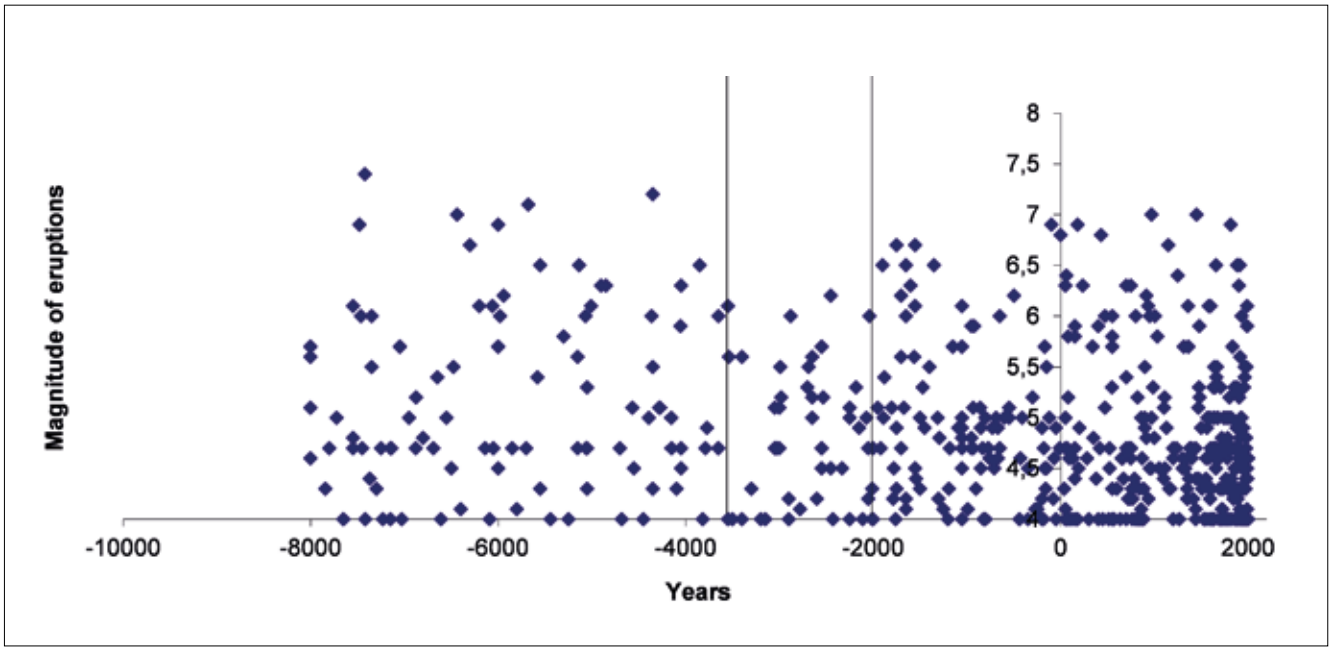


DIAGRAM 1. Volcanic eruptions (after Deligne et al.), database of large Holocene eruptions: http://www.volcano.si.edu/search_eruption.cfm. Magnitude of eruptions of VEI 4 or more, capable of causing serious climatic changes.

VOLCANO NAME	ERUPTION TYPE	AREA OF ACTIVITY	VEI	START YEAR	EVIDENCE METHOD (DATING)
Katla	Confirmed Eruption			-2000	Tephrochronology
Campi Flegrei	Confirmed Eruption	Averno	4	-2000	Tephrochronology
Snaefellsjökull	Confirmed Eruption			-2010	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-2020	Tephrochronology
Campi Flegrei	Confirmed Eruption	Solfatara	3	-2040	Tephrochronology
Katla	Confirmed Eruption			-2050	Tephrochronology
Ljósufjöll	Confirmed Eruption	Krothraunskula, Raudakúla, Graakula	3	-2050	Tephrochronology
Askja	Confirmed Eruption	Flatadyngja, other areas NE of Dyngjufjöll	0	-2050	Tephrochronology
Hveravellir	Confirmed Eruption	Lambahraun	0	-2050	Radiocarbon (corrected)
Campi Flegrei	Confirmed Eruption	Monte Olibano-Accademia	2	-2080	Tephrochronology
Katla	Confirmed Eruption			-2110	Tephrochronology
Campi Flegrei	Confirmed Eruption	Agnano Monte Spina	5	-2150	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-2160	Tephrochronology
Katla	Confirmed Eruption			-2190	Tephrochronology
Campi Flegrei	Confirmed Eruption	Eastern NYT caldera		-2220	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-2220	Tephrochronology
Katla	Confirmed Eruption			-2250	Tephrochronology
Snaefellsjökull	Confirmed Eruption	South flank (Thufuhraun)	0	-2270	Radiocarbon (uncorrected)
Fremrinamur	Confirmed Eruption	Ketildyngja	0	-2300	Tephrochronology
Hekla	Confirmed Eruption		5	-2310	Radiocarbon (corrected)
Campi Flegrei	Confirmed Eruption		3	-2330	Tephrochronology
Etna	Confirmed Eruption			-2330	Radiocarbon (uncorrected)
Ischia	Confirmed Eruption	Costa Sparaina		-2350	Potassium-Argon
Snaefellsjökull	Confirmed Eruption	NE flank (800 m)	2	-2400	Radiocarbon (uncorrected)
Vesuvius	Confirmed Eruption		5	-2420	Radiocarbon (corrected)
Katla	Confirmed Eruption			-2420	Tephrochronology
Campi Flegrei	Confirmed Eruption	Agnano-Monte Sant'Angelo		-2440	Radiocarbon (uncorrected)
Hekla	Confirmed Eruption	Vatnafjöll (Reynnisfellshraun)		-2450	Tephrochronology
Katla	Confirmed Eruption			-2480	Tephrochronology
Campi Flegrei	Confirmed Eruption	Cigliano	4	-2500	Tephrochronology
Katla	Confirmed Eruption			-2540	Tephrochronology
Hveravellir	Confirmed Eruption	Krákshraun	0	-2550	Tephrochronology
Campi Flegrei	Confirmed Eruption			-2580	Radiocarbon (uncorrected)
Vulcano	Confirmed Eruption	Fossa	3	-2650	Potassium-Argon
Brennisteinsfjöll	Confirmed Eruption	Leitin	0	-2660	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-2680	Tephrochronology
Ischia	Confirmed Eruption	Punta della Cannuccia		-2700	Tephrochronology
Hekla	Confirmed Eruption	Vatnafjöll		-2750	Tephrochronology
Katla	Confirmed Eruption			-2850	Tephrochronology

VOLCANO NAME	ERUPTION TYPE	AREA OF ACTIVITY	VEI	START YEAR	EVIDENCE METHOD (DATING)
Campi Flegrei	Confirmed Eruption	East part of NYT caldera		-2890	Radiocarbon (uncorrected)
Katla	Confirmed Eruption		3	-2920	Tephrochronology
Hekla	Confirmed Eruption	Vatnafjöll (Tröllaskógahraun)		-2950	Tephrochronology
Snaefellsjökull	Confirmed Eruption	SE flank (Dagverdarahraun)	0	-2970	Radiocarbon (uncorrected)
Krafla	Confirmed Eruption	Hvannstód	0	-3050	Radiocarbon (uncorrected)
Ischia	Confirmed Eruption	Cantariello		-3050	Potassium-Argon
Etna	Confirmed Eruption			-3050	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-3180	Tephrochronology
Hengill	Confirmed Eruption	Leitahraun, Ellidaárhraun	0	-3250	Radiocarbon (corrected)
Katla	Confirmed Eruption			-3280	Tephrochronology
Prestahnukur	Confirmed Eruption	Sköflungur	0	-3350	Tephrochronology
Hekla	Confirmed Eruption	Raudkollar, Vatnafjöll (Grafellshraun)		-3350	Tephrochronology
Katla	Confirmed Eruption			-3370	Tephrochronology
Katla	Confirmed Eruption			-3390	Tephrochronology
Etna	Confirmed Eruption			-3390	Radiocarbon (uncorrected)
Hekla	Confirmed Eruption	Vatnafjöll		-3450	Tephrochronology
Katla	Confirmed Eruption			-3480	Tephrochronology
Grímsnes	Confirmed Eruption	Kalfsholar	2	-3500	Tephrochronology
Katla	Confirmed Eruption			-3510	Tephrochronology
Etna	Confirmed Eruption			-3510	Radiocarbon (uncorrected)
Hveravellir	Confirmed Eruption	Strytuhraun	0	-3550	Tephrochronology
Grímsvötn	Confirmed Eruption	S of Thordarhyrna (Bergvatnsarhraun)	0	-3550	Tephrochronology
Vulcano	Confirmed Eruption	Fossa	0	-3550	Potassium-Argon
Ischia	Confirmed Eruption	Submarine SE flank (Secca d'Ischia)		-3580	Radiocarbon (corrected)
Katla	Confirmed Eruption			-3640	Tephrochronology
Grímsnes	Confirmed Eruption	Borgarholar	0	-3650	Tephrochronology
Katla	Confirmed Eruption			-3670	Tephrochronology
Katla	Confirmed Eruption			-3720	Tephrochronology
Grímsnes	Confirmed Eruption	Raudholar	0	-3750	Tephrochronology
Hekla	Confirmed Eruption	Vatnafjöll		-3750	Tephrochronology
Hengill	Confirmed Eruption	Hagavikurhraun	2	-3750	Radiocarbon (corrected)
Katla	Confirmed Eruption			-3790	Tephrochronology
Reykjanes	Confirmed Eruption	Reykjaneshryggur		-3800	Tephrochronology
Katla	Confirmed Eruption			-3810	Tephrochronology
Ischia	Confirmed Eruption	Zaro, Marecocco, Spiaggia degli Inglesi		-3880	Magnetism
Grímsnes	Confirmed Eruption	Kolgrafarholl	0	-3900	Tephrochronology
Katla	Confirmed Eruption			-3930	Tephrochronology

VOLCANO NAME	ERUPTION TYPE	AREA OF ACTIVITY	VEI	START YEAR	EVIDENCE METHOD (DATING)
Vestmannaeyjar	Confirmed Eruption	Heimaey (Helgafell)		-3950	Uranium-series
Hekla	Confirmed Eruption	Axarhraun, Vatnafjöll		-3950	Tephrochronology
Fremrinamur	Confirmed Eruption	Kerlingardyngja	0	-4000	Tephrochronology
Grímsnes	Confirmed Eruption	Alftarholl	2	-4000	Tephrochronology
Reykjanes	Confirmed Eruption	Sandfellshaed	0	-4000	Tephrochronology
Chaîne des Puys	Confirmed Eruption	Montcineyre, Estivadoux, Pavin		-4040	Radiocarbon (uncorrected)
Krafla	Confirmed Eruption	Ludent crater rows	0	-4050	Tephrochronology
Fremrinamur	Confirmed Eruption	Sveinar (Rauduborgir) fissure		-4050	Tephrochronology
Hekla	Confirmed Eruption	Baejarhraun		-4050	Tephrochronology
Grímsnes	Confirmed Eruption	Borgaholl	0	-4050	Tephrochronology
Snaefellsjökull	Confirmed Eruption	West flank (Ondverdarnesholar)	0	-4050	Tephrochronology
Stromboli	Confirmed Eruption		3	-4050	Radiocarbon (uncorrected)
Katla	Confirmed Eruption			-4060	Tephrochronology
Hekla	Confirmed Eruption		5	-4110	Radiocarbon (corrected)
Hekla	Confirmed Eruption	Vatnafjöll (Grasleysisfjallahraun)		-4150	Tephrochronology
Etna	Confirmed Eruption			-4150	Radiocarbon (uncorrected)
Bárdarbunga	Confirmed Eruption	Veidvötn (Sigolduhraun THf)		-4200	Tephrochronology

TABLE 2. Volcanic eruptions between 2000 – 4200 BC (made by T. Horváth, 2019).

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