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Technological observations on a Late Copper Age ceramic assemblage from Hódmezővásárhely-Kopáncs-Olasz-tanya, Hungary

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Abstract: The observations of the present paper, following the footsteps of previous studies, provide researchers with a rich set of data that shed more light on the pottery manufacturing techniques of Late Copper Age potters. The investigated assemblage belongs to the Baden culture, excavated at Hódmezővásárhely-Kopáncs-Olasz-tanya I in 2009. So far, four studies have been published on other sites from the heritage of Baden culture, which have been examined in a similar way, focusing on pottery technology.[1] Therefore, the Baden culture is currently the most researched in this respect because the same macroscopic methods were used. In this state of research, we have an opportunity to compare these five assemblages, which allows us to identify similarities and differences in certain details of the technology of potting tradition of different regions in one extended cultural complex. In order to clarify the terminology and certain procedures of handbuilding techniques and possible tool usage in burnishing I make corrections on earlier statements. In addition to observations of potting technology also documenting the use-traces, the secondarily used sherds and any noticeable phenomena, such as grain imprints on ceramics. For the question of intentional or accidental occurrence of grain imprints on ceramics, I share the potter's viewpoint, to shed more light on this topic. The aim of this paper is to present and discuss a wide range of phenomena that can be used for the *chaîne opératoire* of pottery production and object-biographical studies.

Keywords: pottery technology, Late Copper Age, handbuilding techniques, comparison

Methods

Macroscopic observations were made during restoration, taking into account the criteria of ideal feasibility of these examinations.[2] The finds in this state are already cleaned but their joints are not glued together and the empty places are not yet filled with gypsum. Later, when the restoration is complete, it significantly reduces the observable number of phenomena. From the whole assemblage I collected many joining surfaces, which formed when building units were worked together. As the sole condition for documenting joining surfaces, I dealt only with cases that were clearly visible on the fracture surfaces or less commonly, in the ceramic fabric.[3] I generally ignored cases that are presumptive by the crease of ceramic's fabric but are not entirely clear.[4] In these cases the joining

1 Gucsi 2000; Gucsi 2009; Kreiter 2009; Horváth 2010.
2 T. Bíró 2012, 268.
3 Martineau 2000, Fig. 40, Fig. 44, Fig. 46, Fig. 48, Fig. 49, Fig. 53, Fig. 71.
4 Martineau 2000, Fig. 89 right lower, separately framed picture of Pottery 4135, Fig. 95; Pétrequin et al. 2009, Fig. 10,b.

 10.17204/dissarch.2021.41

surfaces were not revealed by breakages, only the pattern of the ceramic fabric is oriented curly, wavy, or organised into parallel lines, which is the result of the temper particles oriented by pressure and the rolling movement applied during the making of coils,[5] or during the act of pressing them together, or later caused by wall thinning procedures which apply pressure. Valentine Roux discussed the basic principles of pottery *chaîne opératoire* and published a picture showing *oblique fissure indicating oblique junction of coils.*[6] Here the fissure (joining surface) is the addressed, important evidence and has not been named the oriented structure of the ceramic fabric on the same picture. Probably because this small gap is the clearest visible trace. While the oriented lines too carry information, their examination is a different approach.[7] I did not document the countless cases when sherds had only one joining surface, so they did not occur in parallel pairs or near the bottom or rim, therefore they do not carry significant information other than the evidence of the handbuilding technique of assembled elements. The distances between the joint surfaces were measured at the centre line of the ceramic wall, according to the method previously defined.[8] In the descriptions, instead of the determinative phrases of "strips" I followed the neutral "building unit" phrase.[9] In total; 7081 pieces of sherds, vessels or ceramic objects were excavated from the site of Hódmezővásárhely-Kopáncs-Olasz-tanya[10] *(Fig. 1)*. From this amount I found 82 measurable building units, 28 base discs, 13 handle pegs and more additional traces.

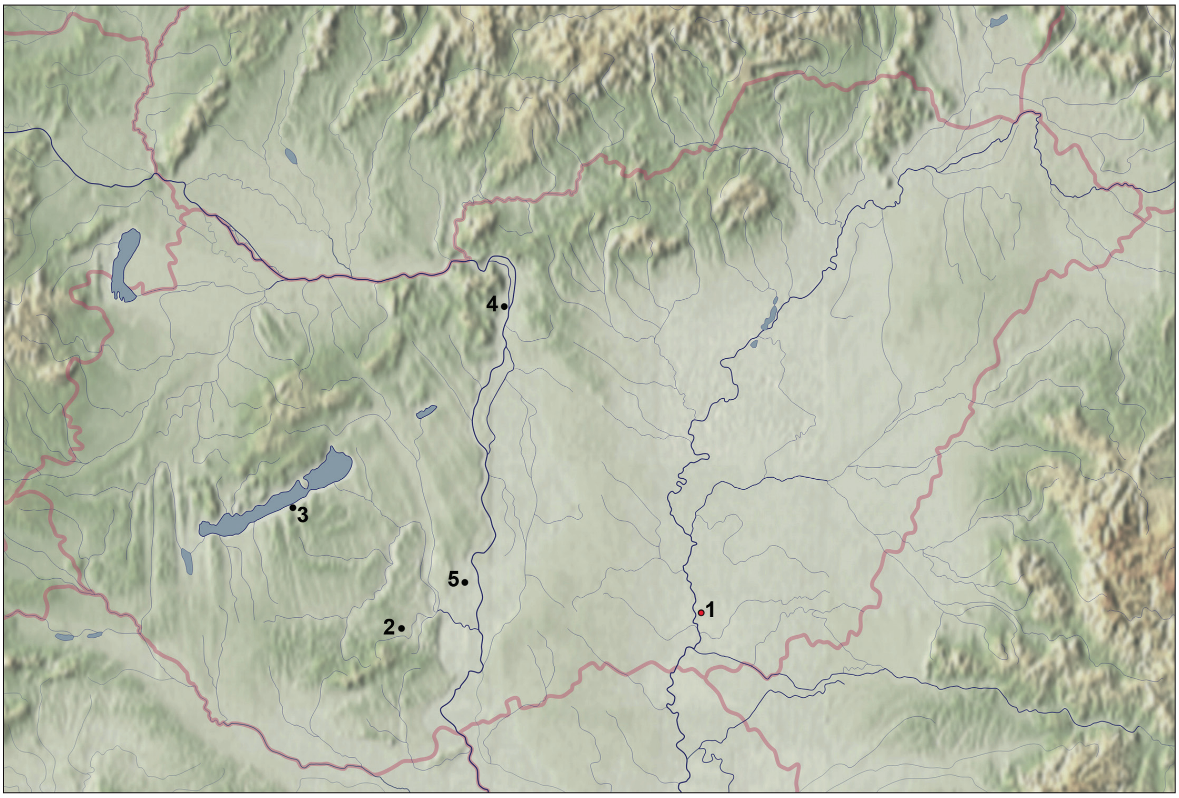


Fig. 1. The location of the sites from where the ceramic assemblages are technologically compared. 1 – Hódmezővásárhely-Kopáncs-Olasz-tanya I, 2 – Aparhant-Felső legelő, 3 – Balatonőszöd-Temetői-dűlő, 4 – Budakalász-Luppa csárda, 5 – Dunaszentgyörgy; Map: © Institute of Archaeology, Research Centre of Humanities.

5 Berg 2008, 1185, Fig. 5.
6 Roux 2017, Fig. 2,g.
7 Berg 2008; Gomart 2014.
8 Gucsi 2006, 3. kép 3.
9 Kreiter 2009.
10 Herendi 2010.

For the comparison between the five sites published, it is important to keep in mind that the different assemblages have been examined in the different states of restoration, and with slightly different approaches used by other researchers. Not all noticeable cases were collected and presented systematically from each assemblage. From Balatonőszöd, only prominent and selected examples were published, from the enormously huge assemblage of 48171 ceramic finds yielded from 1066 features (the Boleraz and the Baden features in sum).[11] At the site of Dunaszentgyörgy seven features were excavated and altogether 361 pottery fragments were found,[12] from which 23 pieces were selected for petrographic analysis and macroscopic observations.[13] Partly due to the small number of finds, there is no data about handle pegs and base discs from this site. However, the excavated five features at Aparhant can suggest roughly the same amount of finds; the exact number of all sherds is lacking in its publication.[14] What we can know for sure, is that 116 pieces of diagnostic ceramic finds were discussed from the five features and from the excavated 5×10 m block.[15] Among this amount of finds with the systematic observation were diagnosed; 16 measurable building units, 4 base disc, 1 handle peg, and 1 tunnel-like handle attached on a smooth surface. Here other examples were also documented from the surface collection material and from the private collection of Antal Csiszér. In the material of Budakalász, 6 measurable building units, 4 base discs, 5 rounded bases (profiled later), 6 handle pegs and more additional traces were found out of the 342 ceramic object. Because this is a cemetery assemblage, there are 157 intact or nearly intact, refitted pieces, 60 fragmented vessels (each represented with more sherds), and 124 single sherds. Based on these circumstances, a comparison between the five Baden sites with the same methods is not possible in terms of statistical analyses.

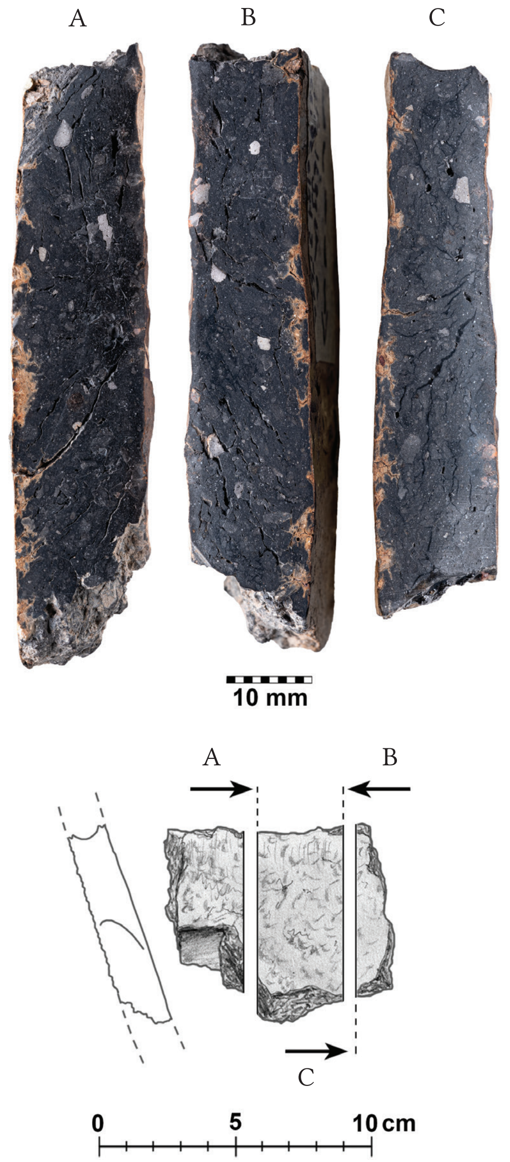


Fig. 2. Sections of find no. 52. A – Shows the joining surface in the cross section, B – Can not see any clear trace of the joining surface, C – The oblique crack in the middle is at the same position as the joining surface, but can not be clearly identified. Photos by Attila Kreiter.

The exact typo-chronology of particular finds is not clear either, since many sherds are not diagnostic. Even if they have recognisable characteristics, the whole assemblage is not processed and published from Hódmezővásárhely-Kopáncs, consequently it is not clear which features can be dated to which phase. However, in the section of this study discussing the divided bowls, the closest parallels of find no. 105 found in other sites dated to the Baden IV period. It is also

11 Horváth 2010, 5, Note 4.
12 György 2009, 23.
13 Kreiter 2009, 41.
14 Bondár, 2000.
15 Bondár 2000, 39.

worth mentioning, that in this assemblage of Hódmezővásárhely-Kopáncs there is a bowl with a typical decoration of the Kostolac style, arranged in a chessboard-like pattern with impressions, surely can be dated to the final phase, such as find, no. 92 has a Coțofeni style of decoration which represents the same later phase. Other ceramics presented in this study can be dated to the classical period. Furthermore, the fine typo-chronology of the Baden culture has many unsolved issues, especially in its classical phase, where seemingly the pottery style had little changes during three centuries.[16] Consequently the chronological focus of this study may be wider than it would be optimal for comparisons, but the recent state of research allows this. On the other hand, the technological choices are probably changing at a slower rate than the vessel shapes and decorations, so their comparison can be still useful.

To the reconstruction of certain steps of *chaîne opératoire* I used my experience in the handbuilding techniques. In the last 30 years I made nearly 1400 vessels with these techniques.

Drawings are preferred for the illustrations, because technological characteristics are better highlighted. Usually, it is very difficult to properly show the joining surfaces in photographs, although there are cases where their presentation can be superb that way as well.[17] The drawings have a uniform scale ratio of 1:3, with the exception of the largest vessels, which are presented in a 1:4 scale.

Observations on the pottery techniques

The order in which the observations were described follows the "life cycles" of ceramics,[18] with the exception of the mining of the clay and its preparation. This study does not deal with the identification of temper, as the possibility of macroscopic observation is limited, which calls into question its usefulness. Although it can be stated, that grog was definitely used as temper for many vessels in this assemblage, ceramic petrographic evaluation is a much more accurate method for determining the size range and the type of temper. This paper follows the order in which the vessels are made, from forming the bottom of the vessels, continuing with the construction of the wall, the formation of the rim, and the attachment of handles, knobs, and ribs. Firing is also out of the scope of this paper; however, usage traces are documented in the catalogue of the finds, repairs, and secondary use are also the topic of this study. Finally, a section is devoted to examining the imprints of grains. Drawings and photos made by the author.

Base-disks

As a first step in shaping mid-sized and larger pots, potters of the Baden culture have often made a clay disc that formed the bottom by flattening a single block or a ball. The bottom disc can be smooth-edged, flanged-edged, their cross section can be parallel-sided regular disc or lens with a curved surface at the top, tapering towards to the edge of the disc and flat at the bottom, and variations of these two pairs of categories.

Base-disk with parallel section
Basically a simple geometric shape of a disc. Clear examples are: finds no. 2, 4–9 *(Fig. 8)*, 15, 17 *(Fig. 9)*, 19–21, 23 *(Fig. 10)*. There is a variation in this type when the bottom side of the base is showing a concave curve and the upper side of the disk follows that with a convex, bulging curve: finds no. 1 *(Fig. 8)*, 16 *(Fig. 9)*, 22, 25 *(Fig. 10)*. In some cases this can be the result of a distortion of the base during vessel shaping, in other cases it is intentionally made.

16 György 2014, 167, 201–204.

17 Horváth 2010, Fig. 5,3,9, Fig. 6,8 top view, Fig. 6,9,10,12, Fig. 8; Gucsi 2000, 3. kép 1, 4. kép 1–3; Gibbson – Woods 1997, Fig. 11,13.

18 Kreiter 2007a, 161–162.

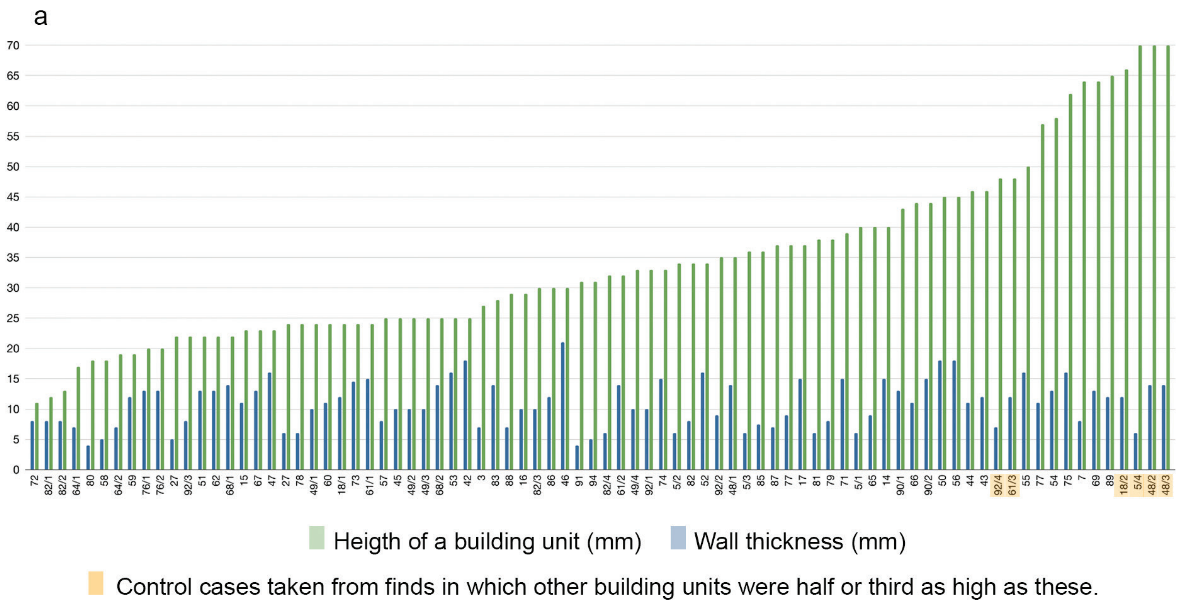
Base-disk with lens-like section

These disks are uniformly made with a flat bottom side and a convex, bulging upper side: finds no. 3, 10–12 *(Fig. 8)*, 13 *(Fig. 9)*, 27, 33 *(Fig. 11)*, 82 *(Fig. 16)*.

Base-disk with smooth edges

The clearest examples of this technical solution are the following: finds no. 1 *(Fig. 8, Fig. 23)*, 2 *(Fig. 8, Fig. 22)*, 7 *(Fig. 8)* among bowls. Finds no. 6 *(Fig. 8)*, 27 *(Fig. 11, Fig. 30)*, 29 *(Fig. 11)* among jars. Finds no. 13, 15, 17 *(Fig. 9)*, 20, 24, 25 *(Fig. 10)* among bigger vessels like amphoras and pots. The most clear example of all is find no. 1 *(Fig. 8, Fig. 23)*, which clearly shows the vertical cylinder side of the disc, to which the additional part forming the wall of the bowl was attached from the side. The joint surface on the edge of find no. 13 *(Fig. 9)* is also nice and distortion-free but this bottom disc has a lens shape in cross-section. An imprint of a disk with a regular 90 degree angled top edge remained in the case of find no. 29 *(Fig. 11)*, where the first building unit forming the vessel wall was pressed on the edge of the top of the bottom disk. In most cases, the first building unit was fitted to the bottom disc from this direction, i.e. from above. This action, accompanied by strong pressure which often distorted the top edge of the originally plain disc in various shapes, in the case of find no. 22 *(Fig. 10)* it is nearly 45 degrees, in which case the steep angle could have been made intentionally too. A flatter angle of distortion can be seen on finds no. 2, 7 *(Fig. 8)*, 15 *(Fig. 9)*. In other cases the pressure resulted in a "U" shaped joint surface on finds no. 6, 8, 9, 10 *(Fig. 8)*, 17, 22 *(Fig. 10)*. It should be noted here, that there are pieces that at first glance might be thought of as flanged. This is because the building unit is strongly pressed against the smooth-edged bottom disc from above, and the force of further smoothing movements from outside can cause the edge of the disc and the joint surface to deform, as if it were slightly flanged: finds no. 20, 24, 25 *(Fig. 11)*. Given the possible deformation of the joined surfaces, it would be erroneous to assume that they are in each case exactly the same shape as before the beginning of the building units were joined together. Therefore, only cases that are clearly and markedly formed were defined as flanged edges.

Fig. 3. The distribution of measured building units by their height and their associated wall thickness.



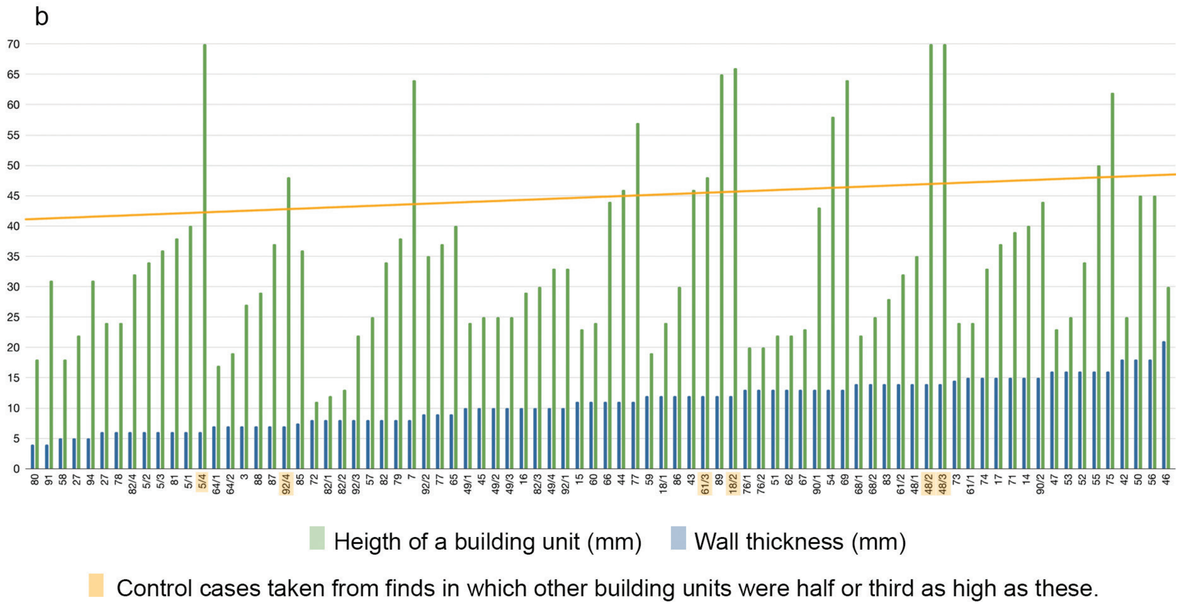


Fig. 4. a – Building units in ascending order by their height, b – building units in ascending order by their wall thickness. Based on the control samples, the cases above the orange line are considered as too big to identify as single coils.

Base-disk with flanged edges

The examples of this are the following: finds no. 3 *(Fig. 8)*, 5 *(Fig. 8, Fig. 24)*, 12 *(Fig. 8)* among bowls, finds no. 14, 19, 21, 26 *(Fig. 9)* among the biggest vessels such as amphoras or pots. Find no. 4 *(Fig. 8)* also belongs to this category, but the vessel type is uncertain, we can say only that this is a fine ware and not a coarse ware. They were made so that the edge of the disc was folded up, pressed up, or shaped with pitching. This upward-facing flange can be up to 2 cm high for larger pots: find no. 14 *(Fig. 9)*. In the next step, the first building unit forming the wall was attached on the inside of this flange, compressed strongly, and then smoothed to remove the lines of the joints. Inside, the smoothing movements only in the direction to the centre of the pot are practical. Outside, the smoothing was more practical in the upward direction, around the edge of the base with a series of intense movements with tools or fingertips: find no. 16 *(Fig. 9)*. This unifying action of joints made with pressure and at the same time smearing of the top layer of the clay. It can be seen on this find that the fingertips moved from the bottom upwards, and then the amount of clay smeared from the edge of the bottom disc and the intense force formed a wavy edge in the structure of the joint surface that was not necessarily formed before. On the outside, in a 1–2 cm wilde zone just above the edge of the bottom, it often forms a corrugated surface in the case of pots. The same pattern can be seen on a find from Dunaszentgyörgy[19] and from Balatonőszöd, but in this case the smoothing movements happened from up to downward.[20] Tünde Horváth also mentioned the trace of these, and presumably she also described the phenomenon of the flanged bottom disc, but this is not entirely clear from the description. According to her description, "the bottom line was reinforced with a separate strip of clay (usually a strip of thin triangular cross-section), which could be placed on the outside, inside or on both sides."[21] To illustrate the phenomenon, she presented two pictures, both clearly showing solutions of the flanged bottom disk on many base fragments.[22] The phenomenon on the outside, which she describes as a "small triangular cross-sectional band", is presumably the rim portion of the flange itself. On the inside, however, I have not encountered such in the materials examined so far. Therefore, it is so important to present these phenomena by drawings in order to show the joint surfaces in cross section, because such uncertainties could be avoided. However, it is conceivable that the internal reinforcement she mentioned is similar to those which are already observed at the joints of partition walls of internally divided bowls.[23] If small clay stripes are really used for reinforcement on other vessels outside of the walls of internally divided bowls, then this is a unique technical solution of the potters of Balatonőszöd.

In this assemblage a unique solution can be observed on find no. 11 *(Fig. 8)*, where the edge blended up, but the first building unit was not attached to its inner nook, instead it was attached on the top of the flange.

Examining the finds excavated at Aparhant, I raised the possibility that the technical solution of the flanged bottom disk may be unique there.[24] However, it is clear now that this is a more widespread solution. As far as we know, the flanged edge on bottom disks appears in the Boleráz culture in the early period of Late Copper Age.[25] Similar technological solutions can be found in the Late Neolithic assemblages of France[26] and in the pre-scythian period of Ukraine too.[27] The use of the (mostly plain) bottom disks can also

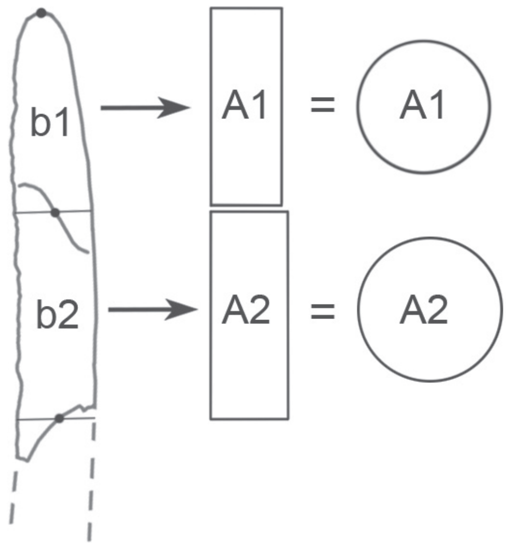


Fig. 5. Building units are simplified to rectangles to calculate their areas from which the diameter of coils can be calculated.

19 Kreiter 2009, Fig. 14.
20 Gherdán et al. 2010, 13.
21 Horváth 2010, 62.
22 Horváth 2010, Fig. 5,9 (Fig. 5,9 was accidentally numbered twice, the quoted actual images are in the middle of the page).
23 Gucsi 2000, 93.
24 Gucsi 2000, 92–93.
25 Gucsi 2006, 2. kép 9.
26 Martineau 2000, Figs 47–48.
27 Terenozhkin 1961, Pic. 25,1,2,7.

be observed in Neolithic,[28] Early and Middle Bronze Age,[29] Late Bronze Age[30] and Celtic ceramics in Hungary.[31] Simple base disks are also present in the Neolithic of France.[32] Therefore, now it seems that this technical solution is self-evident, so not entirely culturally specific, although it is not clear yet, which related prehistoric cultures apply this uniformly.

In this assemblage, the two types of bottom discs and the flanged and smooth-edged versions vary and no particular solution can be linked exclusively to vessel types. What is certain, is that the disk with parallel sides and smooth edges are the most common among all vessel types. The other clear tendency is that lens shaped discs were found in eight cases, and the majority of them are made for fine wares (jars and mosty bowls), while two of them were made for bigger vessels.

Sherd and twig imprints in the vessels base

Tünde Horváth mentions a special solution for the bottom of pots from the material of Balatonőszöd. "However, the rectangular imprints on the bottom were made during the making of the pots – perhaps created by an aid-device which was used during the forming. Our thought is a kind of moulding table or mount which has left a stamp-like impression on the plastic bottom."[33] Based on the two available photos we can agree with her conclusion, that there are imprints of sherds at the bottom of those pots.[34] However, it appears that both vessels were already relatively dry, they were less plastic at the time of the indentation since the imprints appear to be quite shallow, although the lack of drawings of cross section or other metric data does not help to establish this clearly. Based on my own experience, building up and shaping by stacking of vessels of the height, diameter and weight assigned to the reported finds is not feasible when placed on a sherd of the size which imprints are shown in the two examples given. Knowing the static properties of plastic clay, the possibility of rotating them during moulding on these small supports is completely ruled out. The ethnographic observation quoted by Horváth, probably means the use of a much larger piece of pottery sherd that extends at least to the edge of the bottom of the vessel being formed, although the referred paper did not contain any metric information about the exact size of the sherd, only that this is "a sherd of a larger vessel".[35] The two pictures in this study also show that these vessels have a globular shape, probably with a rounded base, which requires this kind of support while being built up and formed. In view of these, it is more likely that those finds were almost completely dried when placed on a ceramic fragment, ensuring that the drying base can shrink without stress. This may avoid the formation of cracks in the middle of the bottom due to shrinkage caused by drying. Placing raw vessels on twigs could have served the same purpose.[36] Along with the interpretations of some phenomena may be misleading at some point, Horváth's observations are very important, as she tried to present all the phenomena related to pottery manufacture in small details by processing a really huge assemblage, thus providing a good basis for comparisons with other sites. Based on the hitherto unparalleled imprints, it seems that Late Copper Age potters lived at Balatonőszöd may have a special, unique habit to which in the last stage of drying their vessels were placed on smaller objects, ceramic fragments or twigs.

28 Füzesi 2019, 15. ábra.
29 Kreiter et al. 2004, 87–88.
30 Ilon 1996, 137.
31 Kreiter 2008, 139.
32 Martineau 2000, Fig. 44, Fig. 46.
33 Horváth 2010, 64.
34 Horváth 2010, Fig. 5,8.
35 Sárkány 2008, 542.
36 Horváth 2010, Fig. 5,7.

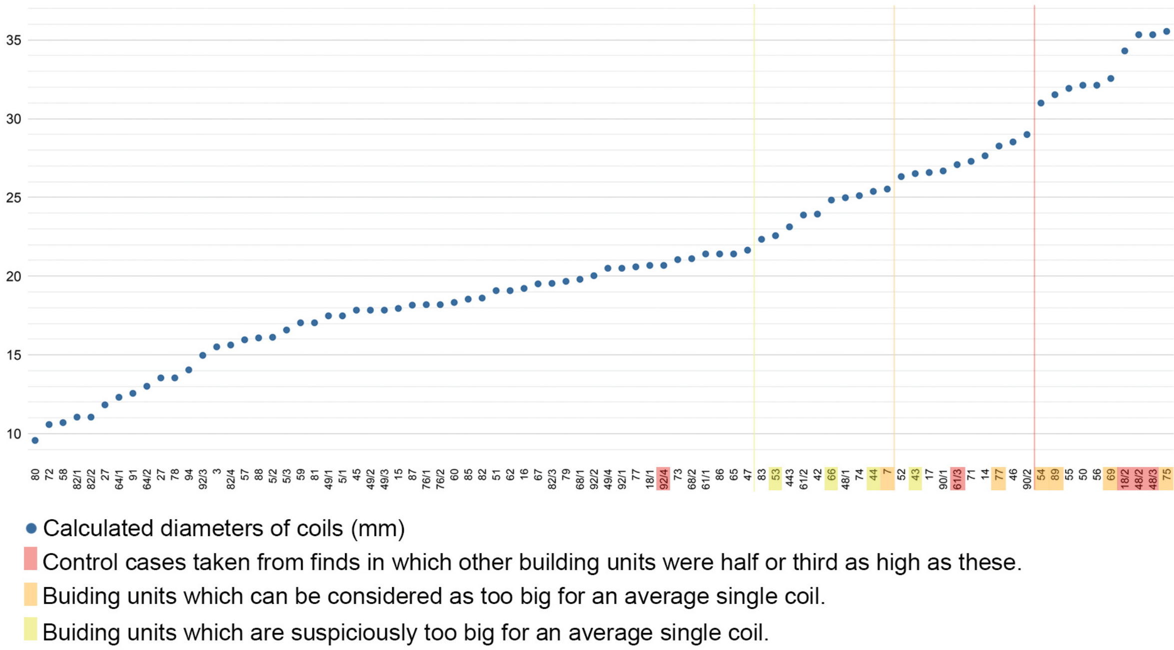


Fig. 6. The calculated diameter of coils in ascending order.

When observing the shaping of the bottoms, it is documented several times in the material of the Budakalász cemetery that the bottoms of the vessels, including bowls and surprisingly jugs too, were curved.[37] These were probably pressed into a mould with a hemispherical shape and in the final working phase of the fully built up vessel, the profiled bottoms were formed by working a small clay coil (a few millimetres in diameter) into a nearly triangular shape in cross section and annular way on the spherical base. With this, a profiling was created which ensured that the object could stand stably on a horizontal surface. Based on the four Baden sites currently available in this topic, the solution of shaping the rounded bottoms into a flat base has only occurred in the Budakalász assemblage, while the variations of the bottom discs described above are generally found in the material of four sites.

Fashioning the vessel body

The problem of the invisible joining surfaces

In some of the ceramic fragments, a special phenomenon can be observed when the profiles of separate sherds of the same vessel clearly fall in line, yet one fragment shows more joining surfaces than the other: find no. 49 *(Fig. 14)*.[38] There are also pieces where the joints are repeated at regular distances, but in one or two places the joints are only visible along two to three times the regular distances, (finds no. 5, 18, 82), or after the regular repetition no additional joint is visible at all (finds no. 27, *Fig. 11*, 76, *Fig. 15*). There are also sherds that show a small part of the horizontal joint surface on one of its sides, but the ceramic is intact on the other side at the same height (find no. 52, *Fig. 2, Fig. 14*). In the latter case, the find was specifically examined by Attila Kreiter to see if the joint surface is visible in the ceramic fabric. Three cross sections were polished from the fragment along a vertical plane perpendicular to the wall of the vessel. One shows the "S" shaped line of the joint *(Fig. 2.A)*, which is slightly different from what was visible just 1 cm away in the breakage surface, depicted on its graphics. The other cross section was made approximately 3 cm away,

37 Gucsi 2009, 450.
38 Gucsi 2006, 3. kép 1.

where the identification of the joining surfaces is uncertain among the other microcracks in the section *(Fig. 2.B,C)*. It is clear from this latter inspection that we are currently unable to determine all joining surfaces. It seems that if the ceramic does not break along the well-crafted, nicely unified building units, the structure of the raw material becomes so homogeneous that the former joints of the building units cannot be clearly identified even when analysed with higher magnification. According to Roux; "As a general rule, given the often polysemic character of the attributes, it is important to combine different scales of observation, that is to say from the naked eye down to the microscope. It is also important to combine different analytical tools" such as X-Ray.[39]

X-rays of ceramics were also taken to find invisible joints in sherds[40] and in whole vessels,[41] but both have negative results. Even an expert of this topic, who examined big series of samples made with an experimental approach emphasising that the successful identification of forming techniques fall somewhere between 60–80% with X-ray methods.[42] Especially when slab-building or coiling is suspected, to examine a large cross-section is advised, but this method is based on the orientation of particles in the section, and not to find the trace of joining surfaces, although some of them can be seen on X-ray pictures too.[43] Other studies have been performed with the endoscopic technique on intact vessels with narrow necks, but these have essentially shown phenomena that are in a relatively closed place, therefore difficult to observe with the naked eye.[44] However, when processing an entire ceramic assemblage of a site, intact, narrow-necked, closed-shaped vessels occur rarely.

On the basis of the above, basic conclusions can be drawn. Among the current methods the easiest way to determine the distance between joining surfaces at the macroscopic level is with the naked eye. These observations are suitable to ascertain the use of the coiling technique in prehistoric potting traditions, taking into account the proportion of the wall thickness and the distance of joints. However, the possibility of proof is only one-way, i.e. the coiling technique can be proved, while the slab building technique may not. The coiling technique can be determined on the basis of the smallest measurable parallel, horizontal joining surfaces with the size range of 1–6 cm. The occurrence of joining surfaces at a greater distance, even if these distances are the same within a vessel (find no. 26, *Fig. 10*), cannot be the sole evidence of the use of slab technique, due to the possible occurrence of invisible joining surfaces. It is easily possible that the larger distances defined as "slab or stripe" are given only by the height of several well unified building units. In this case, the longer repetitive distances are only due to some resting time, after 2–3 coils have been built up.

Variability in the implementation of coiling technique

Ethnographic research in Africa found more than 50 techniques of shaping the vessel body.[45] Those can be grouped into six main categories as pinching, moulding, drawing of a lump, coiling, pounding in a concave mould and drawing up several rings of clay. Among these the coiling also has many variations in how it is applied. While "macroscopic examination only allow a gross estimate of the procedures",[46] at least a few characteristics can be identified on archaeological materials. In the following paragraphs these differences are discussed.

39 Roux 2017, 5.
40 Cseplák 2005, 80–85.
41 Hungarian National Muzeum, Archeology Database. https://archeodatabase.hnm.hu/hu/node/1617 Természettudományos vizsgálatok/Kerámia vizgálat/63372_keramia_rontgen (last access: 09. 11. 2020).
42 Berg 2008, 1179.
43 Berg 2008, Fig. 3,a–b.
44 Dúzs et al. 2005.
45 Gosselain – Livingstone 1995, 150.
46 Gosselain – Livingstone 1995, 152.

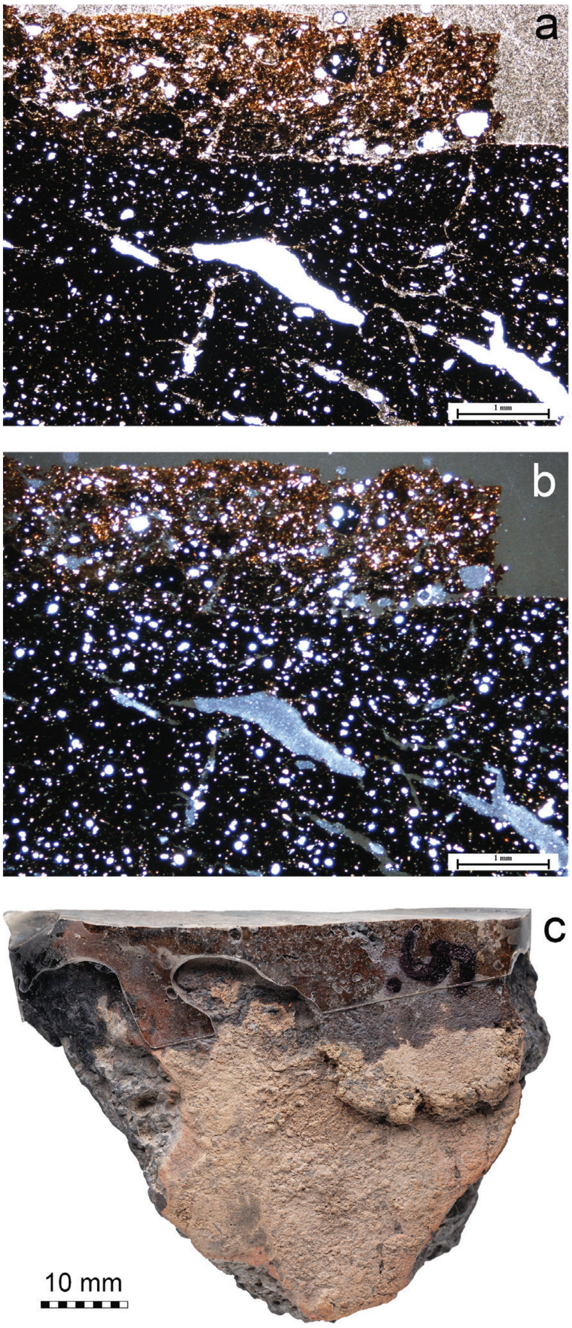


Fig. 7. Thin section of find no. 63 shows a separate, thick coating layer whose raw material is the same as the ceramic body. a – 20× 1N, b – 20× +N, c – the sherd with the line of the section. Photos by Attila Kreiter.

1. In the most basic way, clay coils can be stacked in rows vertically or in spiral ways on top of each other to form a vessel.[47] In this case, the diameters of the coils are roughly the same as the wall thickness of the vessel (thin coils).[48] When placed, they are not immediately compressed significantly together, just enough to stay on top of each other. After applying a few rows (3–5), it is advisable to smooth the surfaces to continue further construction, but it is not necessary when the shape of the vessel allows it. The smoothing of the outer and inner surface is mainly aimed at removing the traces of the joints between the loops and forming the surfaces. The operation in this case is not of such intensity that it can affect the plastic clay significantly inside the vessel wall, it only means the smearing of a thin top layer of clay near the surfaces. The shape of the vessel essentially did not change much by this smoothing. When a ceramic object made by this technique breaks later, its visible joining surfaces generally extend all the way to the edge of the ceramic surface in cross section, being slightly convex, concave, straight, or sloping. They slightly curve down or up at the two edges according to the directions used when smoothing the surfaces. Due to the relatively poor pressure used for their smoothing, the whole series of joint surfaces of the coils are often clearly visible in one object along the entire profile. The best examples of these are finds no. 18 *(Fig. 9)*, 42 *(Fig. 13)* and 92 *(Fig. 18)*. Looking at the characteristics of all the joining surfaces available so far, this method is more common in the Middle Copper Age (Balaton-Lasinja) and the early period of Late Copper Age (Boleráz)[49] finds than in the Late Copper Age (Baden).

2. In the next "level" of the application of the coiling technique, the diameters of the coils are usually two to three times the intended thickness of the vessel wall.[50] In the building phase, the current next coil is slightly overlapped by the actual edge of the vessel, squeezing the two parts to be joined together with pinching movements.[51]

47 Rice 1987, 127.
48 Gosselain – Livingstone 1995, Fig. 3.
49 Gucsi 2006, 1. kép 1–7, 2. kép 9.
50 Rice 1987, 127.
51 Rice 1987, 128.

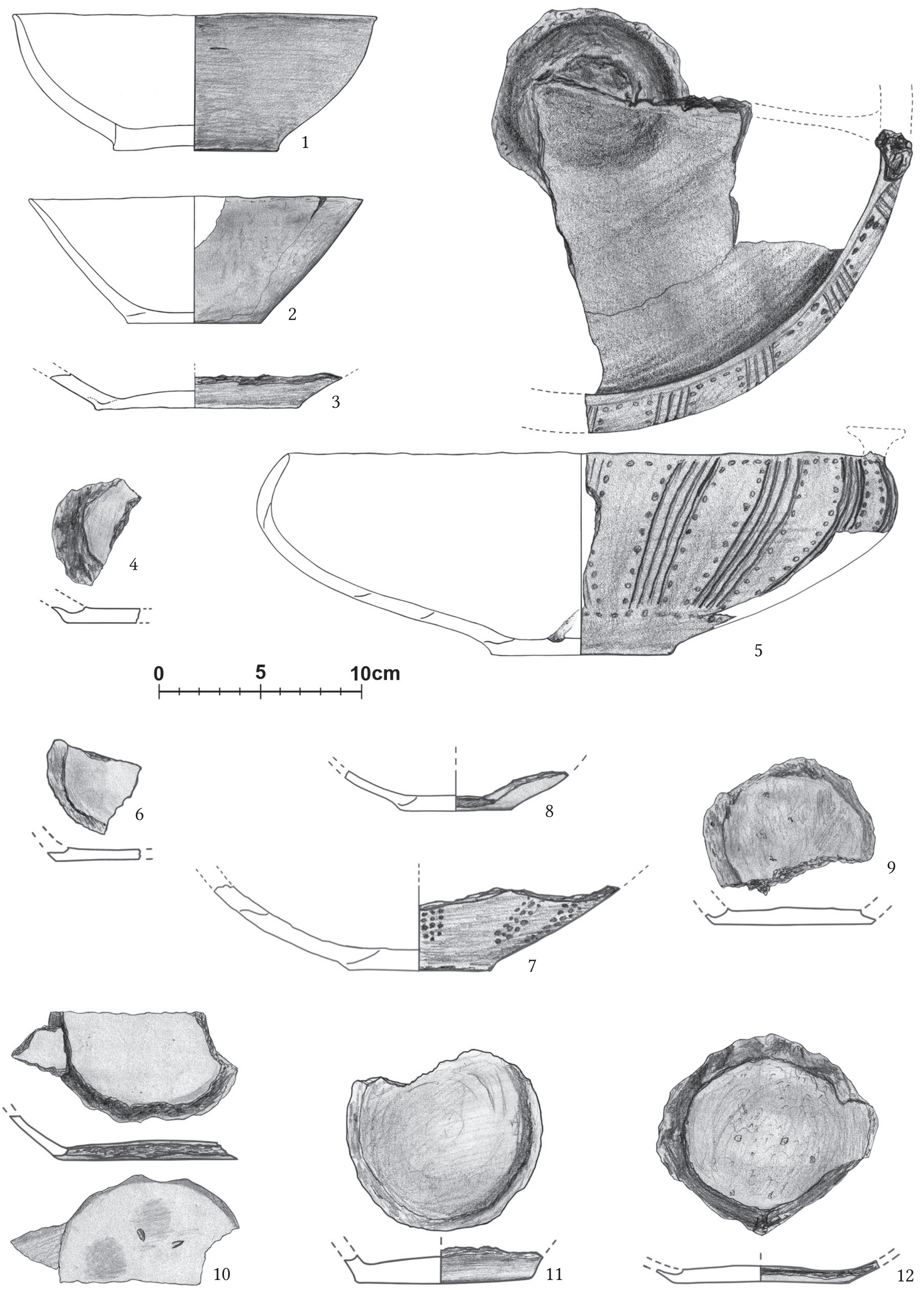


Fig. 8. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 1–12.

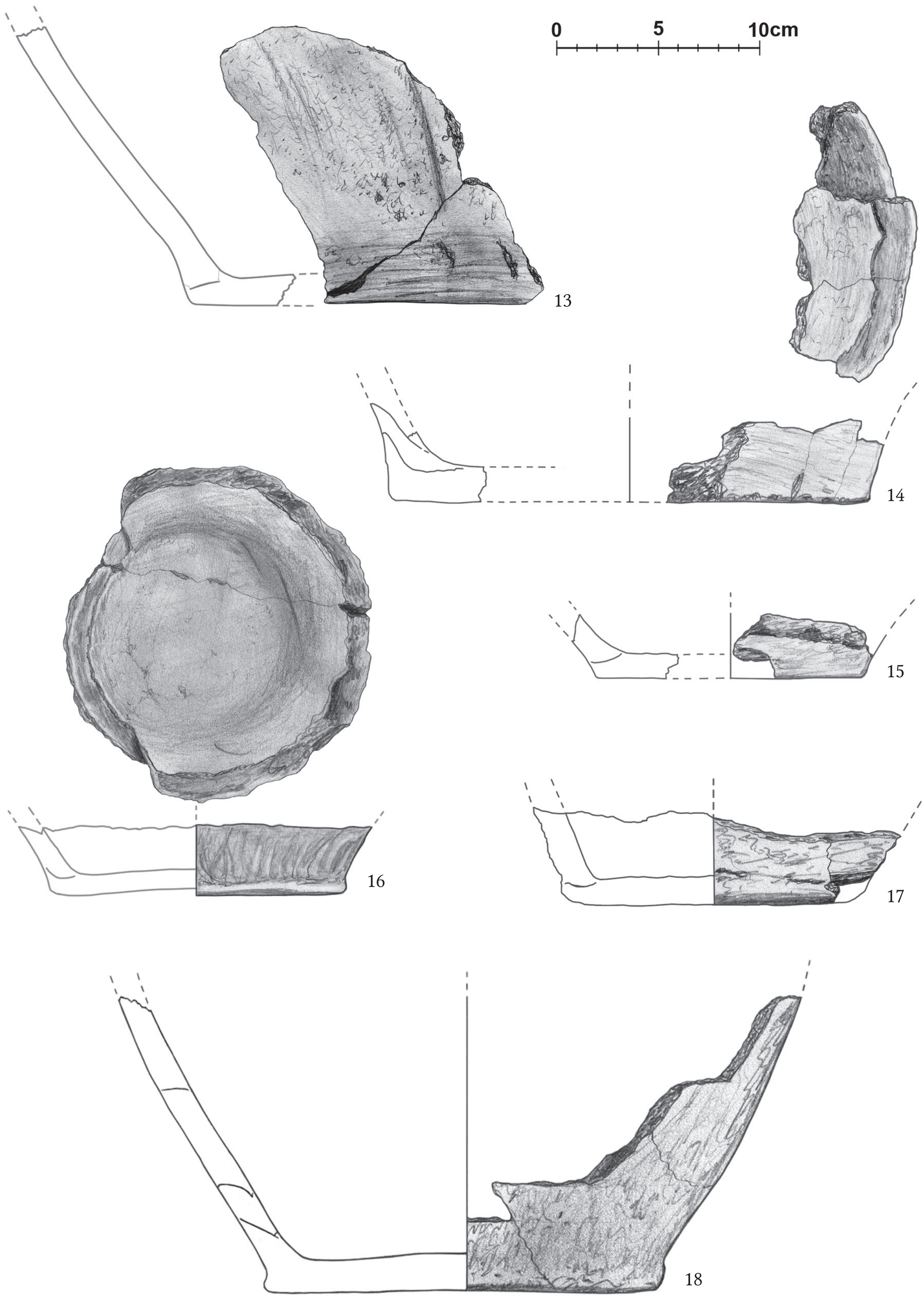


Fig. 9. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 13–18.

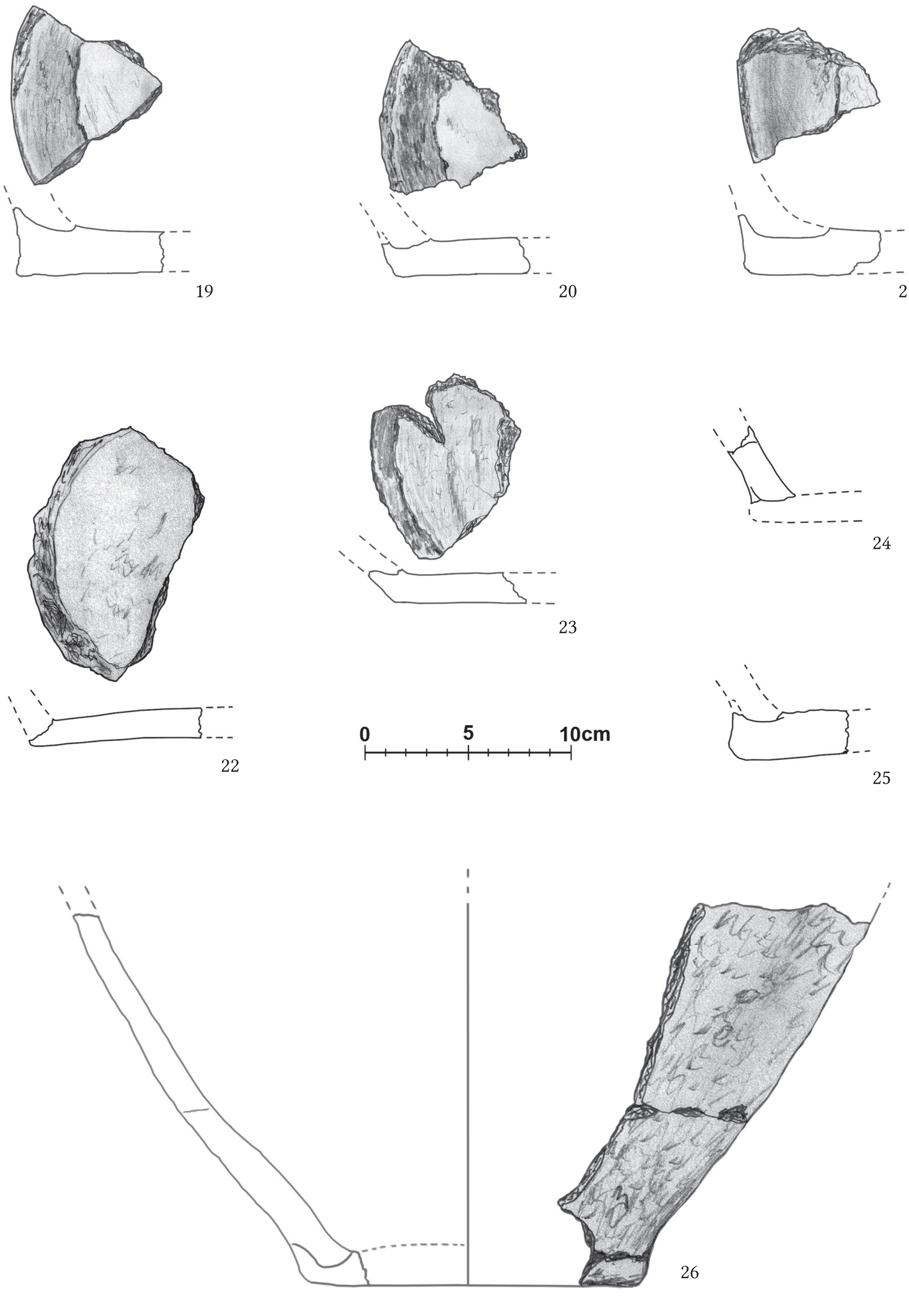


Fig. 10. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 19–26.

With that the coils of a round cross-section are flattened.[52] “The oblique juncture formed by an overlap allows a stronger bond between the coils because the area for bonding is greater and more direct pressure can be applied than with a vertically placed coil.”[53] During further wall thinning processes, by pressing or smoothing with bigger forces, can the shape of the vessel change, which further lengthen the applied coils. In archaeological materials, therefore, we could easily call such finds as “stripes or slabs”. As a result of the force exerted during compression, the joining surfaces will typically have a flattened “S” shape in cross section and are often undulating longitudinally.[54] The best examples of these are finds no. 48 *(Fig. 13)*, 49 *(Fig. 14)*, 62 *(Fig. 15)* and 90 *(Fig. 17)*.

3. When applying the third “level” of the coiling technique, it is done essentially as described above in its first step. But after thick coils are pressed together, in the next step when smoothing the surfaces, the material itself is also drawn up, so the wall of the vessel is stretched and thinned with much more intense force.[55] For this operation, potters often use large, oval, flat pebbles or shells from the inside and wooden or bone spatulas to smooth the outside. In this case, a compressive force is applied to the wall of the vessel to such an extent that it rearranges the internal structure of the plastic clay and eliminates unevenness in the wall thickness and surface. Instead of smoothing, this thinning and regulating operation can be done by percussion. In both cases, the requirement for the operation is to apply a support from the direction opposite to the side applying the force. Consequently, the coils in the wall of the vessel will elongate more than before as the wall thickness decreases, however, the joining surfaces will be very oblique or more likely to disappear completely. This can be seen on the belly of a bowl (find no. 96, *Fig. 18*) and on the belly of one of the bowls from feature no. 5 of Aparhant,[56] or in the case of the Early Bronze Age pieces published from the site of Tuzsér-Kálonga-tanya.[57] This method requires more practice than the previous two, its skillful application allows the shaping of vessels with a smoother surface, thinner wall, nicer curve, a more profiled, articulated form and also reduces the possibility of later fractures along the joining surfaces.

Therefore, it seems that based on the findings examined so far, in the period between the Early Copper Age and the Early Bronze Age, the coiling technique is not necessarily replaced by the stripe or slab technique.[58] Even if it is replaced, and the coils were flattened in a separate act before being attached to the vessel being built, it was not proven by the applied macroscopic methods which did not take in count the invisible joints. At the same time, a continuous trend in the applied intensity of finishing operations done with higher force can be outlined during shaping in this mentioned time range.

Other joining surfaces that can be categorised

Parabolic cross section

A typical shape of a joining surface is a section with a strongly convex but elongated, parabolic curve (find no. 69 most lower, *Fig. 15*; 71, *Fig. 15*; 82 most upper, *Fig. 16*).[59] In these cases it is often seen that the joining surface, which represents the actual edge of the object being built, has been nicely smoothed by the potter. These are the archaeological evidence of the ethnographic example, when Tua potters

52 Martineau 2000, Fig. 56.
53 Rice 1987, 127.
54 Horváth 2010, Fig. 5,3,4.
55 Rice 1987, Fig. 5,5.
56 Bondár 2000, 12. kép 1.
57 Gucsi 2006, 5. kép 2,4.
58 Gucsi 2006, 11.
59 Bondár 2000, Fig. 15,6; Gucsi 2006, Fig. 4,4, Fig. 5,4 upper joining surface, Fig. 6,2; Bondár – Raczky 2009, Pl. 76,82/1.

attach the neck and the rim to the vessel body then it is left to dry in the shade for a while, usually for a day.[60] When forming larger vessels, it is necessary to let them rest several times, because the significant weight of the wet clay causes certain limits on loading. The larger the vessel, the more depressed the belly, the more profiled its shape, the more statically sensitive it is to the pressure of the parts built over it. The orderly parabolic shape of the joining surface is explained by the fact that the actual edge of the resting vessel becomes drier but the next building unit is a softer and more plastic clay. When the potter works them together, the nicely smoothened edge is not distorted because the only practical way is to slush the softer clay to the drier. In this case, both the outer and inner surfaces can only be smoothed by movements directed towards the drier part, i.e. downwards.

Cross section with strong "S" shape
Vessels with thick walls sometimes have strongly "S" shaped joining surfaces. Here it must be emphasised that these occur only in vessels of larger size and larger wall thickness, typically at the line of the belly or shoulder.[61] So it is at those critical heights, where it is important to put the pot aside to rest and dry a little. These joining surfaces are characterised by a nicely smoothed, more regular "S" shape, not as wavy as described earlier, where internal distortions in the paste of clay automatically generated by shaping forces, result in a more flattened or oblique "S" surface. The phenomenon discussed here is essentially the same as described in the previous paragraph. The only difference is that the "S" shaped and not parabolic profile is created on the actual edge of the vessel being formed, to enlarge the joining surface to provide a stronger cohesion. This occurs only at that height when the potter knows it is time to put aside the vessel to drye. However, in the process of adding a more plastic clay building unit later, the opposite "S" shape does not have to be "similarly shaped" in a separate work step. The softer clay simply takes on the opposite of the previously formed shape of the drier "S" shaped edge due to the pressure exerted on it.

Strongly "S" shaped joining surface with finger impressions
In this assemblage, we found three cases in which the joining surface is characterised by distinct finger impressions (finds no. 70, *Fig. 15*; 89, 91, *Fig. 17*). Two of them are fragments of large vessels, and one of them is an extra-large vessel. In the two smaller fragments, the fingerprints preserved in quite good condition *(Fig. 28)*. Such a specifically made joining surface probably present in the assemblage of Balatonőszöd as well, but on the published picture it cannot be surely identified, only it's Hungarian caption mentioned fingerprints.[62] Therefore, this method could have been widely utilised, but the most reliable data shows that its occurrence is the highest in Hódmezővásárhely. Its aim is to increase the cohesion between the building units.

A critical review of interpretations on the findings regarding handbuild techniques

In related former studies, we can find different opinions about the technical solutions, which have been used by the potters of the Baden culture. Attila Kreiter mentions the "slab technique" as the hand-building technique of the Baden vessels, and specifically a variant of it, called Morsel technique,[63] while Tünde Horváth mentions additionally the "patch technique" [64] and I used the phrase

60 Sárkány 2008, 542.
61 Bondár – Raczky 2009, Pl. 110,273/1; Gucsi 2006, Fig. 6,2; Vicze 2011, Pl. 186,829/2.
62 Horváth 2010, Fig. 6,10.
63 Kreiter 2009, 46–47.
64 Horváth 2010, Fig. 5,6.

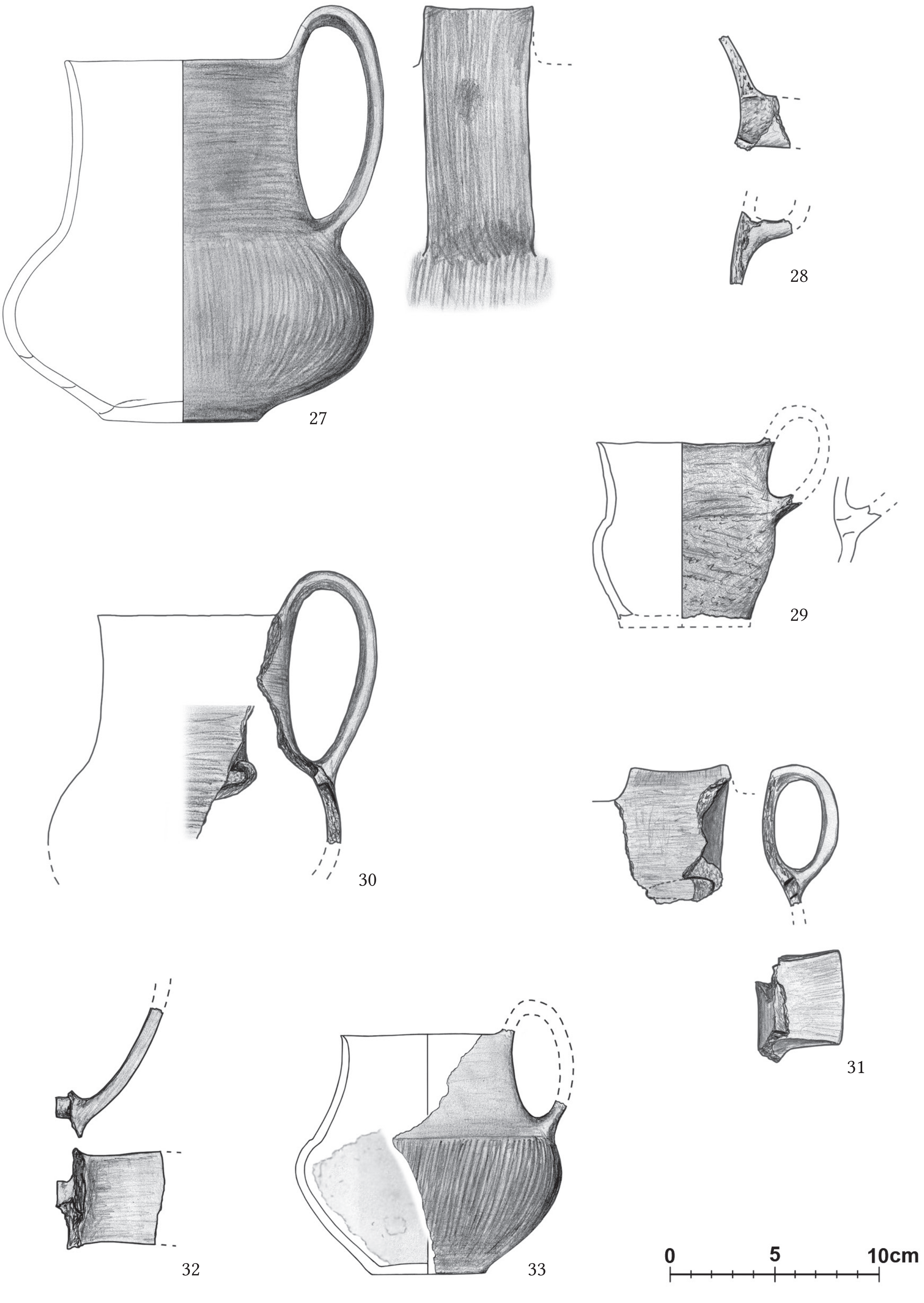


Fig. 11. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 27–33.

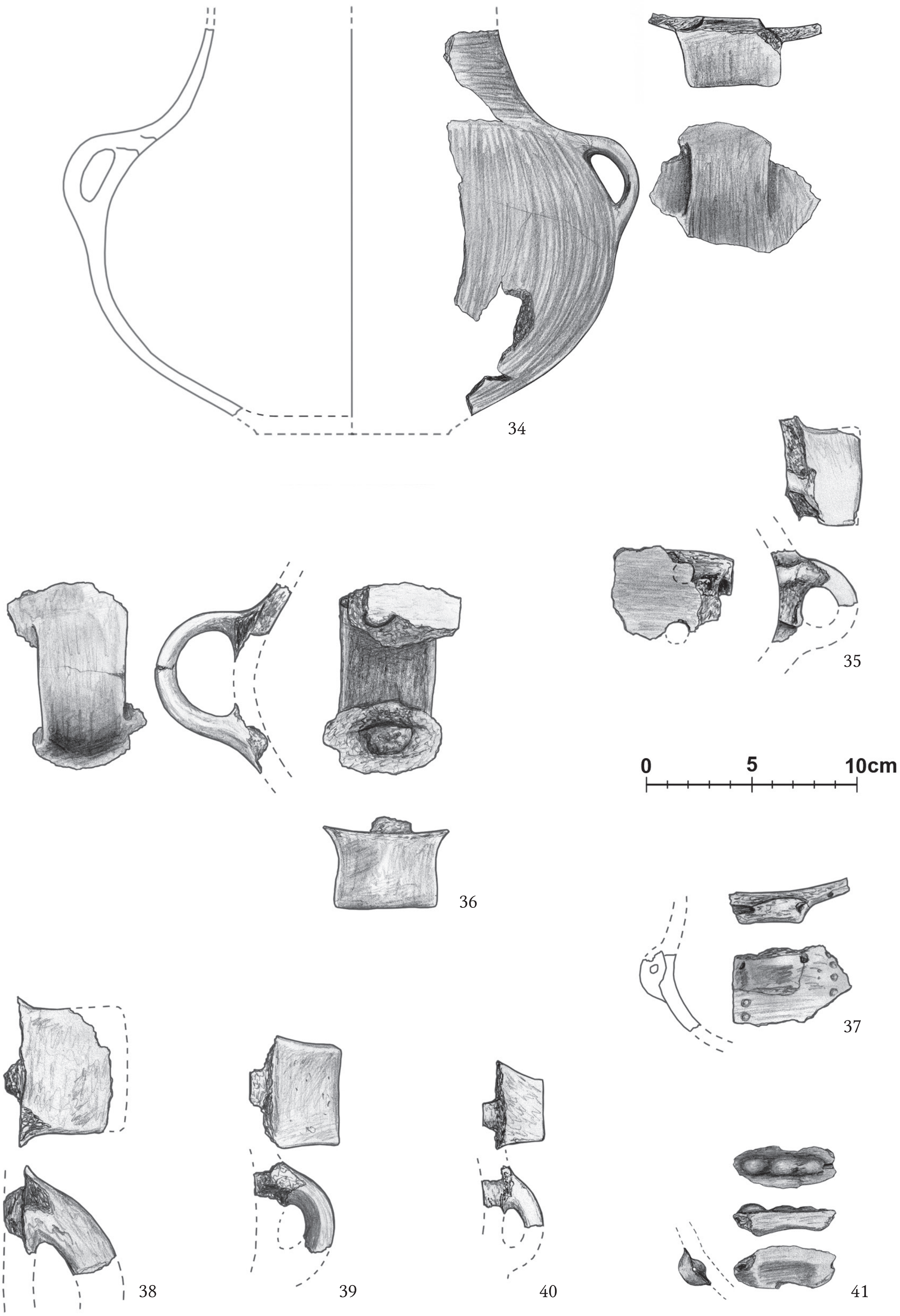


Fig. 12. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 34–41.

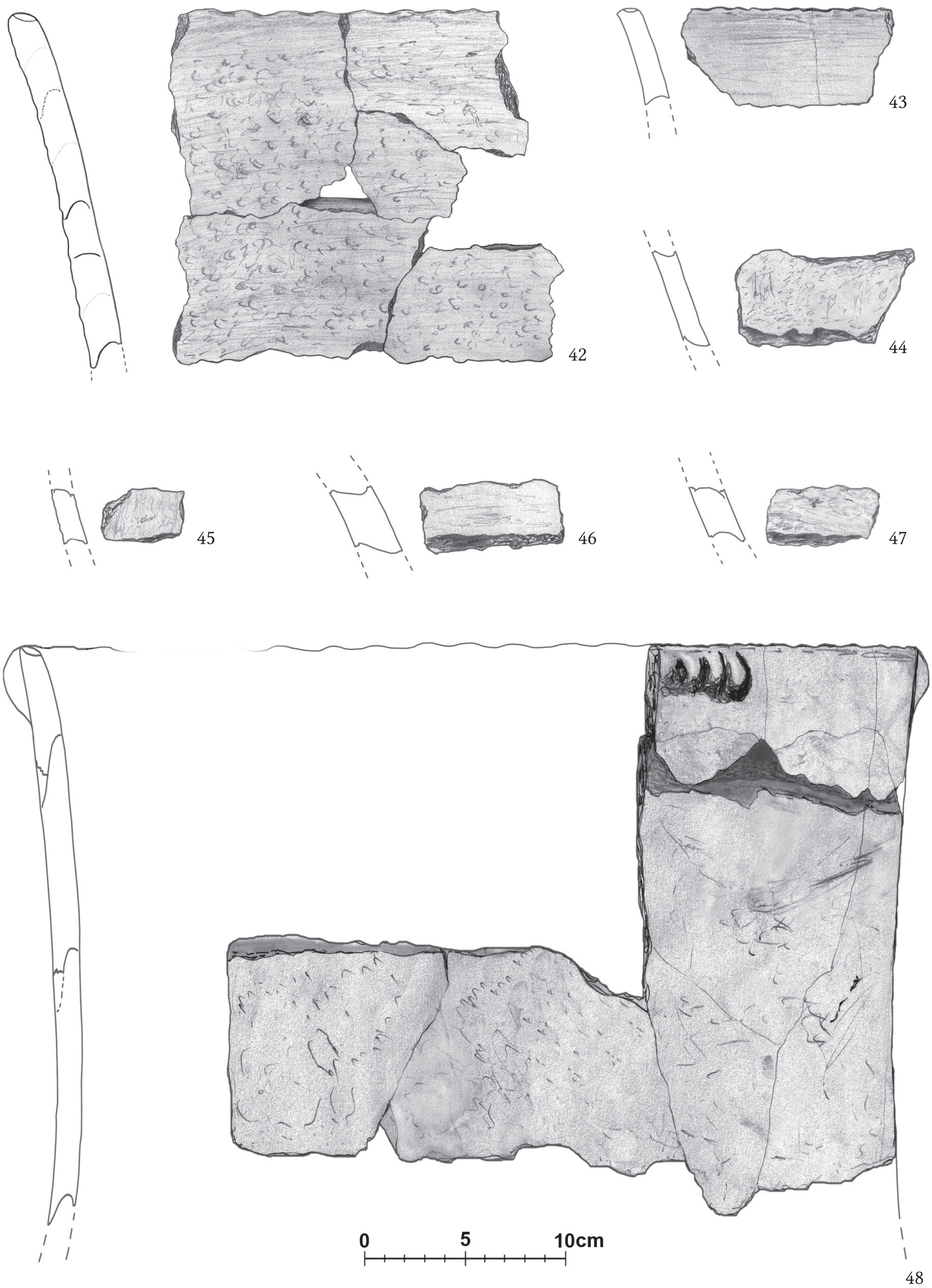


Fig. 13. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 42–48.

"band or stripe technique" to describe the difference between the coiling technique and interpret the regularity that the measured average distance between joint surfaces is around 5 cm.[65] It was hypothesised that clay coils presumably flattened on a smooth surface in a separate act before they were worked together.

As mentioned in the introduction, the phrase of the "building unit" in the object descriptions followed (see the catalogue of the finds), instead of naming different techniques. Based on the findings of the present study, it was in this subject that I had to re-evaluate my previous position the most. The difference between my previous opinion and the current conclusion can be due to a number of reasons:

- Earlier the quantity of data was not representative.
- I was affected by my own modern concept, which reflected the view of efficiency, speed and productivity. It is questionable whether these "values" for the people of prehistoric societies, were as important as for us nowadays, instead of following their traditions.[66]
- Although evidence of coils has already been found, there were only a few examples. Since they were just above the base as the first building units, or they were forming the rim, as the last building units of the vessel, and they were rarely found on the vessels' body. In my interpretation these were to balance the symmetry and were used as levelling building units.
- The phenomenon of invisible joining surfaces has been encountered, described and presented. I also used the calculation of invisible joining surfaces in cases where the distance between two joining surfaces was greater than what could be embraced by the thumb and the middle finger.[67] However, this phenomenon alone requires a more detailed analysis, as it is a key to determine the use of coils or bands, stripes.

According to the interpretation of Tünde Horváth, joints with more flattened "S" or may be "U" shaped cross sections were made by "forming the edges of the already constructed vessel wall with a slightly sloping ledge with a groove on it and joined with another similarly shaped piece of clay, then worked together."[68] While the first part of the quoted text, that "S" shaped joints can be intentionally formed in special cases can be accepted (see above in the strongly "S" shaped paragraph), the second part however is too difficult to execute as described by her. In practice, the similar shape is simply the result of joining a softer, wet clay to a drier, harder clay. Rémi Martineau also observed that the subsequently joined coil is taking the shape of the previously formed edge, but he reconstructed the first work step separately, as the actual edge of the vessel was formed intentionally into an oblique surface with a shallow groove before the next coil attached to it.[69] Here it must be emphasised again, that if the plasticity of the actual edge of the vessel and the next building unit are the same, the oblique, less strongly "S" shape of joining surfaces can be formed naturally, without any intention. Also utilising a separate work step to make the groove, can nearly double the time of the building process, however this may not be that important for a potter who follows the traditions and acts by learned behavioural patterns.

Among the findings of Dunaszentgyörgy, Attila Kreiter observed 10–15 cm wide slabs on sample no. 12. (amphora).[70] Also on sample no. 13. (amphora) 9–10 cm and 14–15 cm wide slabs were reported.

65 Gucsi 2006.
66 Kreiter 2007b.
67 Gucsi 2000, 2. kép 1.
68 Horváth 2010, 62.
69 Martineau 2000, 148–149, Fig. 52, Fig. 56, Fig. 75, Fig. 76.
70 Kreiter 2009, 49, Fig. 8.

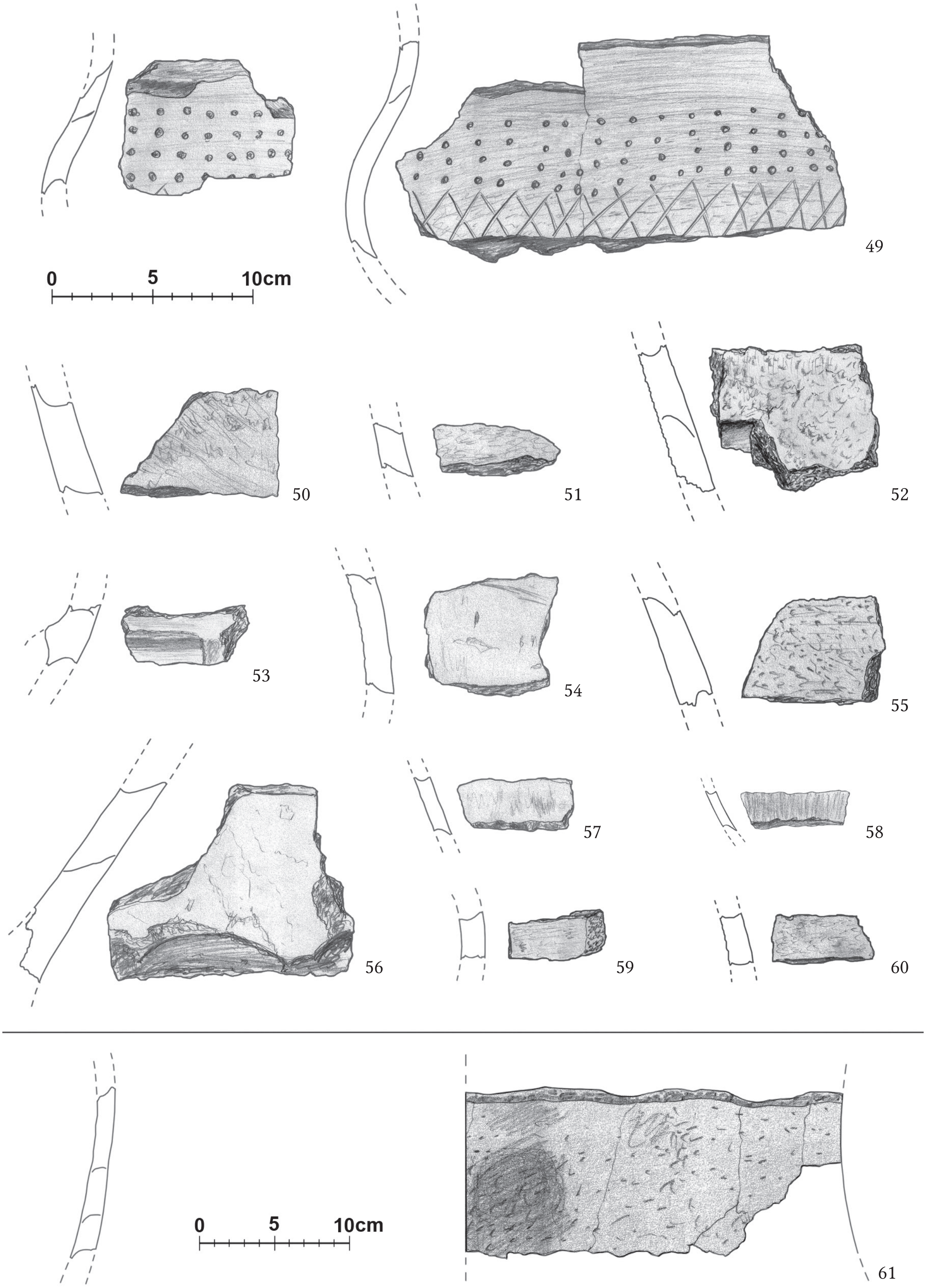


Fig. 14. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 49–61.

According to the detailed macroscopic description of these samples, "It could also be established that the building units are not rings running around the vessel, but smaller pieces, which are separated along almost vertical lines. The section of the separated units is much smoother and a shallow groove was formed on them which provided a 'nest' for the next slab."[71] Even if this description is clearly talking about joining surfaces, apart the "nest"-like shallow groove, which may not necessarily were formed intentionally as discussed above, it is uncertain that the identification of the Morsel technique is absolutely accurate here, since it was not mentioned specifically if the vertical breakage surfaces are also joining surfaces or not. Comparing the description and drawing of sample no. 16 (large bowl with inverted rim), it's figure clearly shows the breakage line on the horizontal top edge of the lowest 11.5 cm tall sherd mentioned in the text.[72] The height of the other two building units was determined on the basis of the crack on the inside and in this case no mention was made of vertical joints. Based on the published drawings, which are nicely executed anyway, they don't show any of the mentioned joints between building units, nor vertically, nor horizontally. According to the importance of the identification of such a specific technique on archaeological material, it would require detailed illustrations, photos and drawings of those vertical joining surfaces, for further analysis and discussion. The same issue appears in another study made on Celtic ceramics found in a kiln, where a drawing depicted the reconstruction of the slab building technique.[73]

From the Middle Bronze Age, Kostalena Michelaki also mentioned the use of "slab-building, especially for the large vessels."[74] Here also the same issue can be noted. Horizontal breakage lines can be seen on *Fig. 4,a*, which are made along joining surfaces, on *Fig. 4,b* the lower horizontal breakage line is so straight, probably made along by a joint as well. However, both pictures show roughly the same size of rectangular shaped sherds fitted together, there is no photo from the vertical breakage lines, which should show joining surfaces as nicely as *Fig. 4,d* shows one, and even if this latter's captions says "coil/slab break" there is no information if this was in a horizontal or vertical position.

In Horváth's paper the caption of the already quoted picture is: "Oblique joints of ribbons, pit 1036."[75] In the related main text it says: "In the vast majority, the wall of the vessel was built by laying horizontal strips from the bottom upwards (stripe technique), but sometimes there can be observed the vertical/oblique joining of bands (patch technique)."[76] In this published picture, unfortunately cannot be recognised any joining surface on any breakage. The large fractured surface of the bottom part of the vessel facing us, running from the bottom to the line of the belly and then rising slightly further to the left, appears to be relatively regular. However, the characteristic of the curved, long winding line of the fracture is most similar to the cracks that occur during firing or by a hard hit.

Observations made on Copper and Early Bronze Age ceramics, I concluded that the coiling technique was characteristic of the periods before the Baden culture, while the use of the significantly faster and more efficient stripe technique in the subsequent times.[77] A total of 70 fragments were suitable for examination and measurement from four periods and four sites; the heights of the building units were presented in a table.[78] I based the interpretation of the data set on the idea that the pieces breaking along the joints can statistically give the height of the commonly used building units.

71 Kreiter 2009, 49, Fig. 9.
72 Kreiter 2009, 50, Fig. 12.
73 Kreiter 2008, 135, (find nos 1, 2), 140, Fig. 7.
74 Michelaki 2008, 363, Fig. 4,a,b.
75 Horváth 2010, Fig. 5,6.
76 Horváth 2010, 62.
77 Gucsi 2006, 9–11.
78 Gucsi 2006, 11.

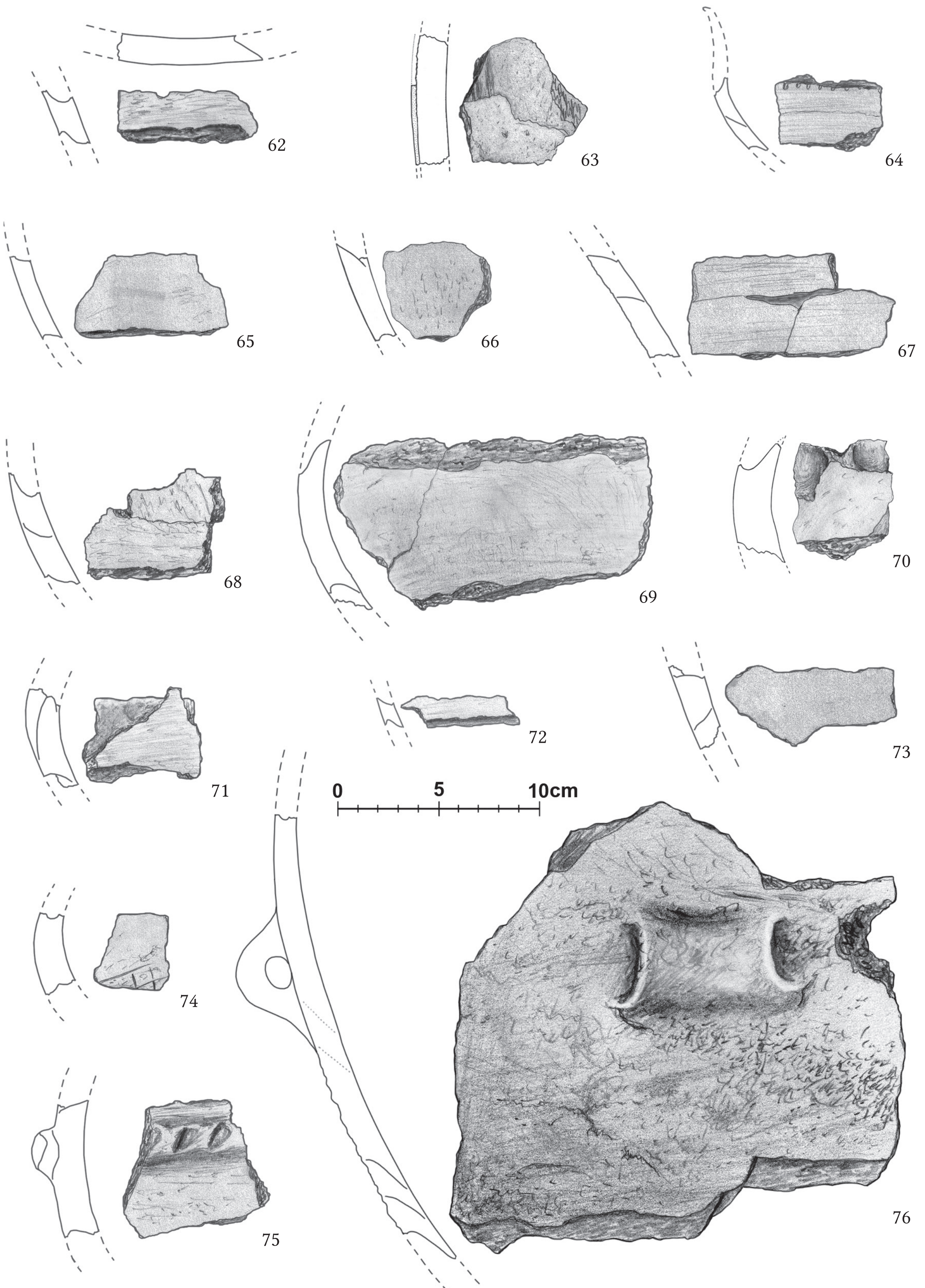


Fig. 15. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 62–76.

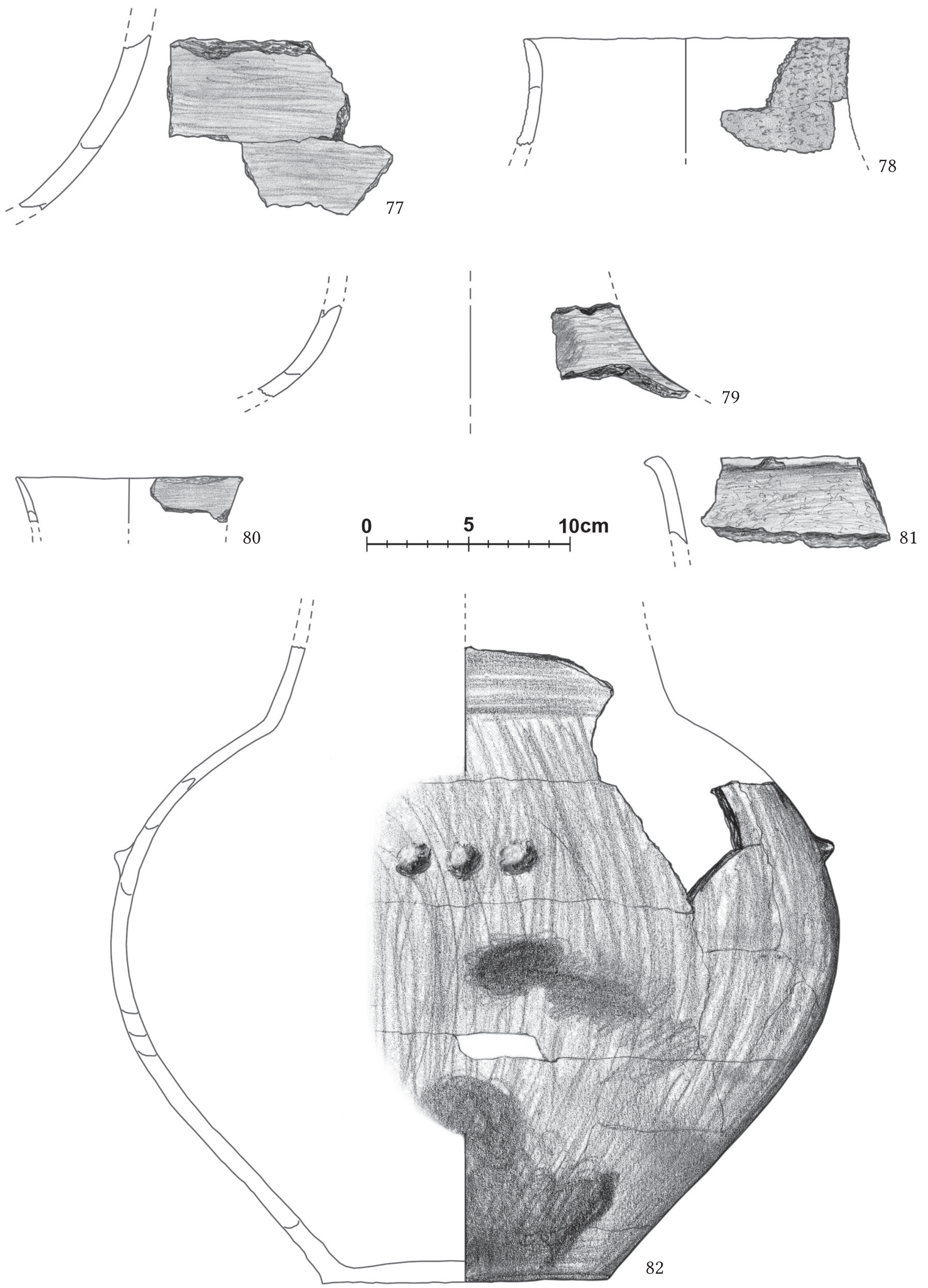


Fig. 16. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 77–82.

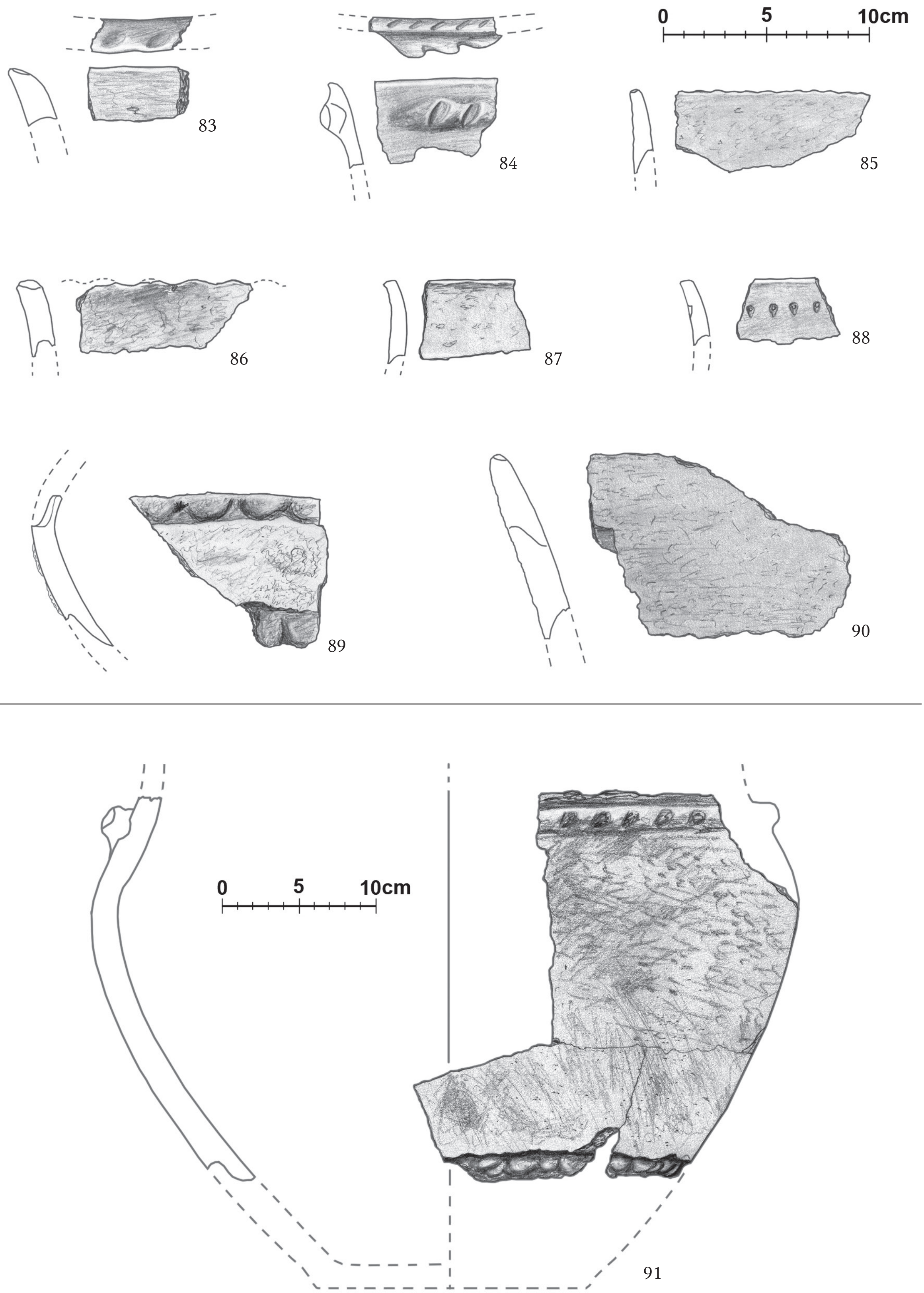


Fig. 17. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 83–91.

However, in the finds alone of Hódmezővásárhely-Kopáncs-Olasz-tanya there are 82 pieces of measurable and identifiable building units. This amount of data drew attention for the need to re-evaluate the issue of the utilisation of the stripe technique. Based on the height data of the building units, the minimum measurable distance in this assemblage is 1.1 cm, the largest is 7 cm, and the average height is 3.3 cm. Thus, this average was well below the average height of the previously measured Baden finds and it is rather closer to the Early and Middle Copper Age data examined earlier. Based on the large amount of data currently being evaluated, it can be concluded that potters at this site generally (or always?) used the coiling technique (see the detailed analysis two paragraphs later).

According to Rice's definition; "In slab building (…) a vessel is constructed from one or more slabs of clay that are rolled or patted flat and then joined into the desired shape. (…) Morsel building in which small lumps of clay are flattened and shaped then successively joined to build the vessel (…) is a variant of this method."[79] As can be seen from the critical re-evaluation of the handbuild technique, the identification of certain methods need to be done with more caution. Ceramic fragments in the form of a "slab" or a "patch" do not in themselves prove the presence of techniques with similar names. These can only be factually verified by drawings and macro-photographic representation of the joining surfaces if the macroscopic observation was used for identification.[80] To prove a slab technique, it is essential to find a vertical joining surface that runs longer than 7 cm. Two schematic drawings show this technique, on both, it can be seen that the vertical joints should be almost as numerous as the horizontal ones.[81] In spite of that, vertical joining surfaces can be found very rarely. An end of a building unit can be seen on find no. 62 *(Fig. 15)*, which identified as a coil. From Budakalász another example is known,[82] while this sherd did not break along its vertical joint, we do not know what is the height of this building unit. In the case of the patch technique, it is also necessary to find and present joints that are patch-shaped. In the absence of such illustrations and pictures, we can consider that only the coiling and pinching can be proven to be used in the technological repertoire of Baden potters. Based on the observations on Neolithic ceramics, András Füzesi also found the coiling technique to be the most common.[83]

Thoughts on fingerprints

Searching for fingerprints, examining thousands of prehistoric pottery and finding only a few little parts of fingerprints, György Cseplák put it this way: "However, (the prehistoric potters) cleared away their fingerprints! I wouldn't be surprised if there was a religious reason for that."[84] The logical approach of the idea is completely understandable, according to which working with a plastic material (the clay), it can preserve all kinds of imprints, so we should see the imprints of the potter's fingertips on the objects many more times. In contrast, interestingly, no special effort is required to remove fingerprints in practice. During the shaping, they simply do not arise on their own. This is because moulding operations require the application of compressive and smoothing forces simultaneously. A fingerprint is typically obtained only when the potter's hand is clean, when the surface of the clay is smooth and already dried a little at that stage when it is not sticky anymore, and when the movement uses only compressive force and no lateral movement is present at the moment when the fingertip is lifted away.

79 Rice 1987, 125.
80 Cámara et al. 2021, 6–7, Figs 7–8.
81 Rye 1981, Fig. 55,e; Kreiter 2008, Fig. 7.
82 Bondár – Raczky 2009, Pl. 76,182/1.
83 Füzesi 2019, 94.
84 Cseplák 2005, 31.

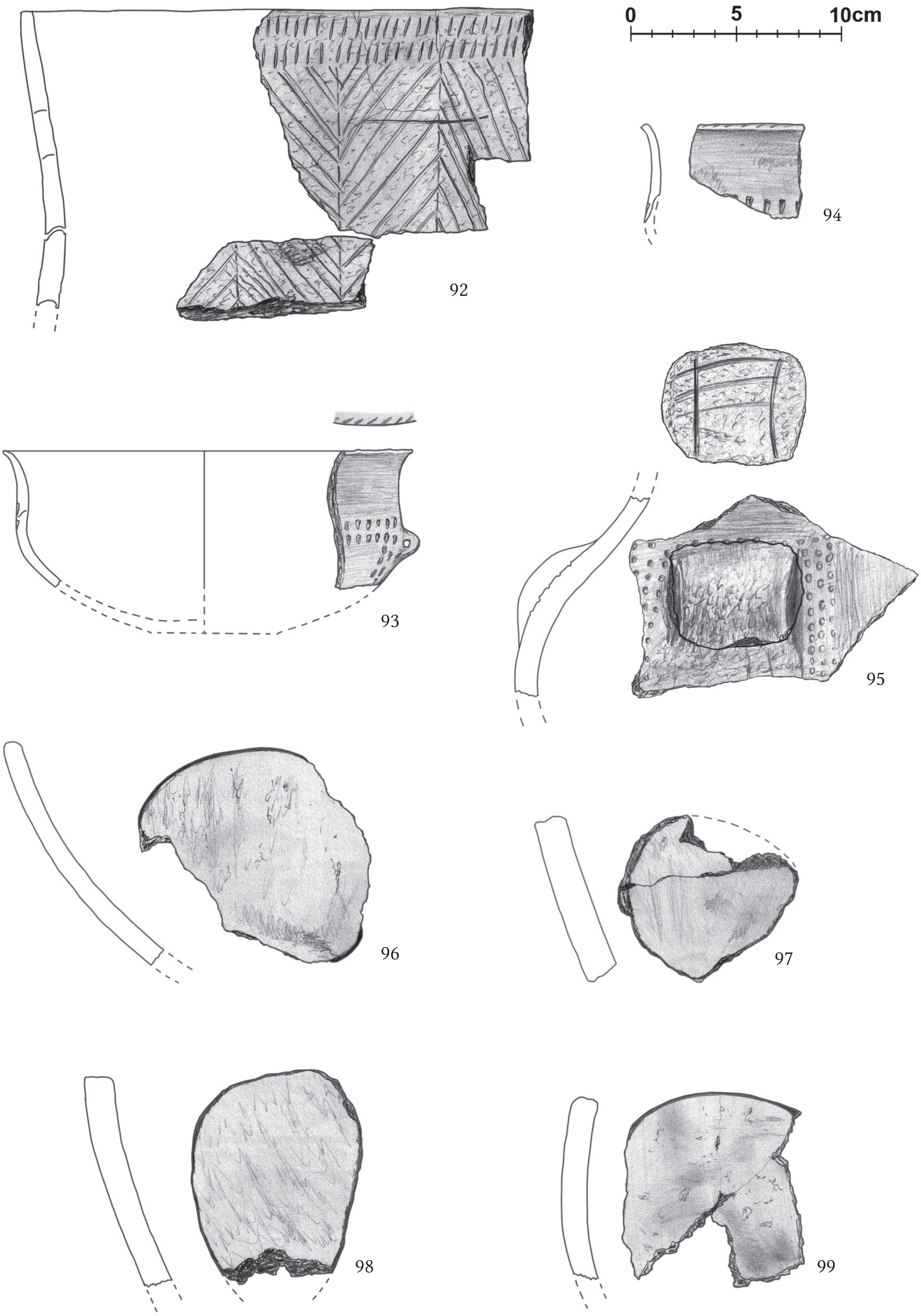


Fig. 18. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 92–99.

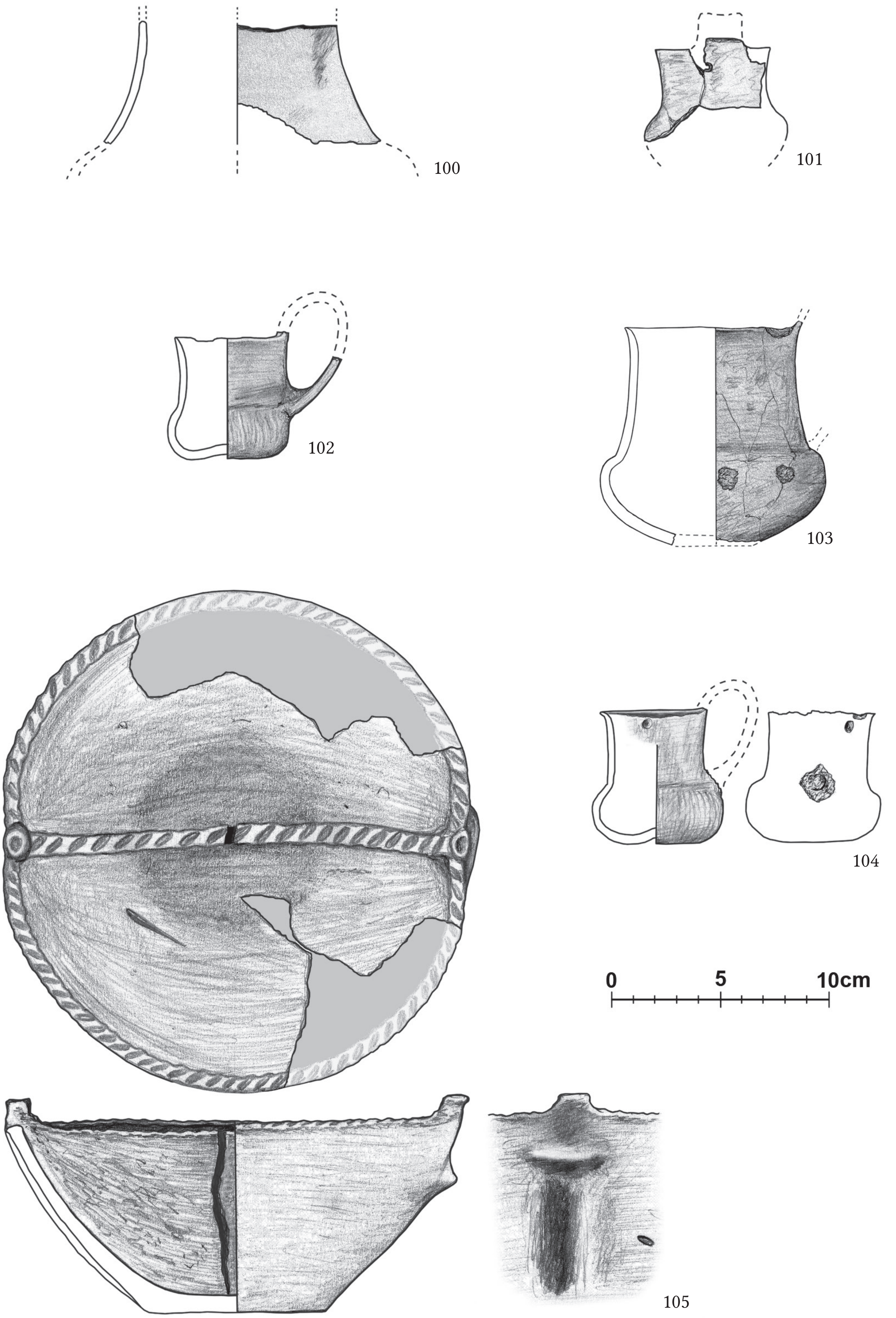


Fig. 19. Hódmezővásárhely-Kopáncs-Olasz-tanya I. Finds no. 100–105.

Graphs made using measured and calculated data

Fig. 3. shows a widely distributed cluster of data, instead of a straightly proportional one. This graph with the control cases also shows that above 45 millimetres height of the measured building units are likely all made with two or more coils (pink area). Based on these data, there is no direct relationship between the wall thickness (which usually correlates with the size of the vessel) and the measured distances between visible joints.[85] It would be expected and logical, that for bigger vessels larger coils were used. However, in several cases the fragments with larger wall thicknesses, have a smaller measurable distance between the joints while the thinner-walled vessels have bigger distances between the joints. This means that the utilised coils were in the same size range regardless of the size of the vessel. This can be explained by three types of procedures that are distinguished within the coiling technique (see above).

When plotting in ascending order the height of the 82 measured building units and the associated wall thickness data set *(Fig. 4,a)*, three main groups can be outlined. The first group is between 11–25 mm, in which a smaller group representing three cases is separated by a spacing of 11–13 mm. Then the curve of the graph is breaking and starting to rise in a more steep way until 50 mm. The last group is smaller and well separated from the previous. These cases are two to three times larger than the average, therefore their measurable height can be due to invisible joints. To check this possibility, separately marked data were taken from those finds in which other building units were half or third in size, to see where their occurence will be in this ordered plotting (5/4, 18/2, 48/2, 48/3, 61/3, 92/4, the first digit is the find no. and after the slash is the orderly described building unit, see in the catalogue). *Fig. 4,a* shows that these cases are at the end of the ascending order, as expected. If we take the same data and order them into an ascending array by wall thickness *(Fig. 4,b)*, the separately marked control cases (marked with yellow) spread in a wider distribution. Their pattern can help to clarify which other building units may be considered larger than a single coil. The yellow line on *Fig. 4,b* across the biggest values indicates that not only the control samples fall into the larger building unit category but also other samples (7, 77, 89, 54, 69, 75). Therefore, these samples are also most likely made from (at least) two coils, but the coils are well unified (they are marked with orange in the next graph, *Fig. 6*). There are further cases, when the value of the data is close to that line, but not bisected by it (43, 44, 53, 66 they are marked with yellow in the next graph, *Fig. 6*). These are suspiciously examples and may also be considered to have been built from two coils or at least from larger building units compared to the average.

Even though the height of building units may change when the wall of the vessel is formed (upward movements of hands expand the vertical length of vessel wall) the diameter of the coils used can be fairly well estimated as follows: First the height of the building unit is measured. Since the shapes of the building units in the majority of cases are irregular, the measurement should be taken in the centerline of the cross section to avoid skewing the data as much as possible. Then the shape of the building unit, since it is irregular in shape, is simplified to a rectangular shape *(Fig. 5)*. By multiplying the height and wall thickness of the building unit the area of the simplified rectangular is calculated. This area is equal to the area of the cross section of the coil (circle), which was applied and distorted as pressed. Having known the area of the circle (cross section of the coil) its diameter can be calculated: the area is divided by π, than extracting the root of the result to get the radius, which is multiplied by 2 to get its diameter.

85 Horváth 2010, 62.

Fig. 6 shows the calculated diameters of clay coils in ascending order. It must be mentioned, that the clay shrinkage by its drying, can be 5–10% depending on the type of clay. Consequently, these calculated diameters are smaller than that of the originally wet clay coils. Nevertheless, this diagram gives a similar curve as *Fig. 4,a*, but the order of the building units are different. To mark separately the control cases and those filtered cases which were mentioned in the analysis of *Fig. 4,b*, three lines can be drawn where the curve is suddenly changing. Until the yellow line, the building units surely were made from a single coil each, with the maximum diameter of 22 mm. Above the yellow, orange and pink lines, the probability is less and less for the same, but it cannot be ruled out if larger coils or even stripes were used. It is noticeable, that even when trying to narrow down the wild diversity of these data, with calculations and reasoning, there is still one case when the fourth building unit of find no. 92 is among the normal range of coils, while this was taken as a control, which seems double in size as other building units in the same vessel. Finally, a few statements can be made with certainty. The most preferred building units were coils with the diameter varied between 15–22 mm, representing about ¾ of which can be surely identified as coils. The rest ¼ are smaller coils, between 9.5–14 mm of diameters. Among them, for the shaping of find no. 72 and 82, interestingly small coils were used, compared to their wall thickness.

The large percentage of joining surfaces in Baden assemblages

Although only subjectively judged; the percentage of the visible joining surfaces are always much higher among the Baden ceramics compared to other prehistoric cultures and periods. There has to be a reason behind this phenomenon, which can probably be related to the place of their production or some small details in the *chaîne opératoire*. The appropriate unification of building units depends on the hydromety of the clay used and the pressure applied.[86] Breakages occur along joining surfaces if they are not completely unified. This can be the result of an inexperienced potter's work but the majority of the examined vessels do not fall in this category. It can be caused by the lack (or less than enough) of moistening the actual edge of the vessel before the next building unit was attached to it.[87] If the coils were rolled on leather or wood, then these can also take moisture from the clay. Moreover, a series of coils can be made as a first work step previously of the beginning of the building procedure.[88] This can make them a bit dry before they are attached to the vessel being built. Another possibility is when dry, crumbled clay or grog was mixed into the clay just shortly before it was used (in half an hour). What we know already from the petrographic examinations is that Baden ceramics are "overloaded" with temper. "It is, however, an interesting feature of the Copper Age samples that the quantity and size of the added grog and clay pieces (especially in the case of coarse grains) is so large that the fabric of the ceramics is heavily cracked. In some cases cracks can even be seen on the surface around such inclusions."[89] Of course, a petrographic examination cannot prove if the grog was dry or wet, although we can have an insight of the humidity of clay pieces based on their rounded or less rounded shapes. From the clay pieces added as temper, it can be stated surely that they must be harder, consequently drier than the clay paste itself, otherwise the whole fabric would be homogeneous. In this case the few millimetre sized small dry clay/ceramic pieces can absorb moisture from the clay paste, which works almost as the plaster settles, based on my own experience. To use this kind of clay, it can help in the building up procedure to have a stronger and more stable vessel body relatively quickly. The place of the production is also crucial.

86 Roux 2017, 4.
87 Rice 1987, 128.
88 Gosselain 1992, 567–570.
89 Kreiter 2009, 44, 45.

Fig. 20. a–b – Find no. 105 in refitted condition.

When it is happening out of a room in open air, even under a roof or three in shade, summertime a barely noticeable but hot and dry air flow can make the clay dry relatively quickly. Even the radiating heat from the environment can warm up the clay with a few degrees, which also accelerates its drying. If this latter is the main reason behind this outstandingly frequent phenomena, then consequently the pottery production was seasonal, and happened in an outdoor area. At the same time, this phenomenon can be the consequence of the listed six circumstances and their mixtures.

Additionals

Handles

Among the finds of Hódmezővásárhely-Kopáncs-Olasz-tanya, there is a large number of handle pegs. According to previous observations, handle pegs occur in the following variations:

- Round, half-peg. In this case, they did not pierce the wall of the vessel, only a roughly hemispherical hollow was made which can be done with a fingertip.
- Round peg. The wall of the vessel has been pierced in its full cross section. Typically, we have to assume some tool usage, because the diameter of the hole is usually smaller than a human finger. The hole is completely round, and for practical reasons the tool should be rotated during perforating the vessel's wall. On the end of the handle a conical tip was made which was pressed into the hole. When the potter could reach from inside due to the mouth diameter of the vessel, then it was pushed back and smoothed.
- Elongated or oval peg. In this case, they do not form a separate tip, but the end of the handle is slightly wedge-shaped making a hole corresponding to its width by completely breaking through the wall of the vessel and pushing the end into it. For this solution the use of tools when making the hole is also required.

Half peg
Finds no. 36 and 38 *(Fig. 12)* belong to this category. It is interesting that earlier such solutions were found only among the finds of the Early–Middle Copper Age.[90]

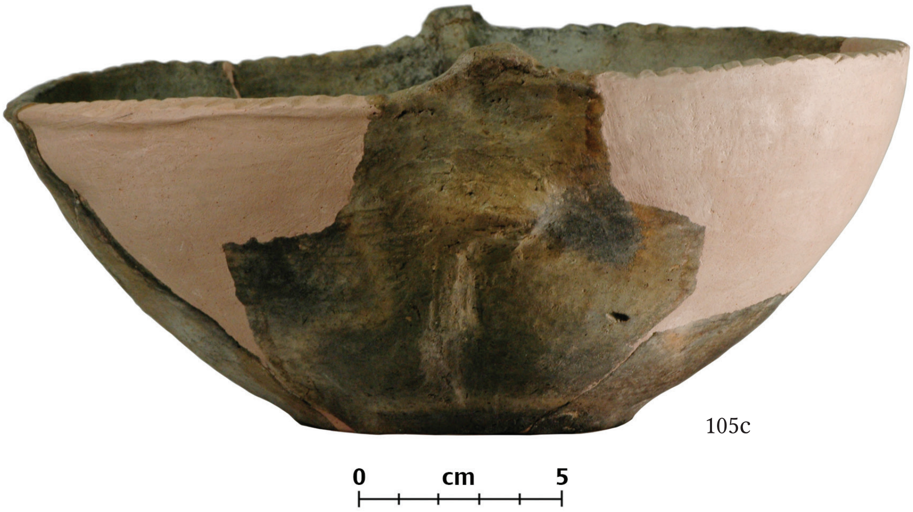
Round handle peg
Finds no. 32, 35, 38, 39, 40 *(Fig. 12)* and 104 *(Fig. 19)* show the application of this method. It is often used on small cups, here only find no. 104 is a cup.

Elongated, oval handle peg
Five pieces show this technical solution (finds no. 28, 29, 30, 31, *Fig. 11*; 34, *Fig. 12*). In the case of jugs with long, wide handles that rise above the rim, three pieces occurred here (finds no. 28, 30, 31, *Fig. 11*). With the find found in Aparhant[91] and the piece found in Balatonőszöd,[92] the handle pegs of six jugs can be compared, of which only one made with a round peg (find no. 32, *Fig. 11*). On the five others, an oval peg can be detected. Therefore, the use of oval handle pegs seems to be a more general trend on jars.

In the case of short handles in this assemblage out of the six, only one was fitted with an oval peg (find no. 34, *Fig. 12*), two were made with half peg (finds no. 36, 38, *Fig. 12*) and three with round peg (finds no. 35, 39, 40, *Fig. 12*). Oval pegs used for short handles twice in the material of the Budakalász cemetery[93] and three other cases published from Balatonőszöd.[94]

Tunnel-like handles
Two tunnel-like handles were broken off along joining surfaces from this site. In one case (find no. 41, *Fig. 12*), three finger-impressions were inserted in a row, into the bowl wall to provide a greater

90 Gucsi 2006, 1. kép 7–10, 3. kép 2.
91 Gucsi 2000, 1. kép 3.
92 Horváth 2010, Fig. 8,2 (middle).
93 Bondár – Raczky 2009, Pl. II,2/1, Pl. 136,353/2.
94 Horváth 2010, Fig. 8,2,4,5.



105c

105d

Fig. 21. a – Find no. 105 in supplemented condition, b – Detail picture of a grain imprint.

adhesion surface and then the material of the handle was worked into it. In the other case (find no. 37, *Fig. 12*), a small horizontal "ditch" was scooped out from the bowl wall with a tool or with fingertip where the handle was attached later. The same solution was documented on a fragment of a stray find from Aparhant[95] and reported from Balatonőszöd sporadically.[96] It seems that the solution to attach the clay (which forms later the handle) to the smooth surface of the vessel occurs more frequently on other sites.[97] However, no such example was found in this assemblage. At Balatonőszöd there is a tunnel-like handle, which was attached to a roughened surface, where nearly parallel lines were scratched to the vessel surface.[98]

95 Gucsi 2000, 4. kép 1; Bondár 2000, 18. kép 1.
96 Horváth 2010, 71.
97 Bondár 2000, 12. kép 1; Gucsi 2000, 1. kép 7, 4. kép 2, 3. kép 1; Bondár – Raczky 2009, Pl. 102,252/1; Horváth 2010, Fig. 8,7,8.
98 Horváth 2010, Fig. 6,11.

Ribs

On a large and an extra-large vessel joining surfaces can be observed between the rib and the vessel wall (finds no. 75, *Fig. 16*; 91, *Fig. 17, Figs 25–26*). In both cases, before attaching the rib, the potter had formed a regular horizontal, curved groove on the surface of the vessel, probably with the tip of a finger. Then a clay-coil was attached there and smoothed which formed the rib. In the technical evaluation of Balatonöszöd ceramics, Horváth mentions that the ribs often broke off in whole or in part along their joining surface.[99] It is not quite detailed in her description, whether the ribs were made with small trenches similar to the ones presented here, or just attached to the smooth vessel surfaces. Presumably the reason behind this, is that it was completely self-evident for her that ribs were worked onto the smooth vessel walls. As far as we know, this method with the ditches is completely unique, similar to the finger-impressed joining surfaces. Interestingly, both methods were used on the same object (find no. 91). However, it should be noted that the ditch under the rib was documented only on one fragment, while on the other fragments of the same vessel the clay coil was attached on the smooth surface without trenching.

Knobs

Under the rim of a pot (find no. 84, *Fig. 17*) there is a knob which is divided by tool impressions. At the base of the knob a joining surface is revealed, which also shows a depression made probably with a fingertip, in which the knob was placed. Another knob with half-peg is only known from the Early Copper Age so far from Hungary.[100]

On the shoulder of a large decorated amphora (find no. 98, *Fig. 18*), there is a large, flat knob which broke off along the joining surface. Here it can be observed that the vessel wall was roughened by two vertical and three horizontal channels, made by dynamic, definite movements with a slightly rounded tip of a tool. At Hódmezővásárhely-Kopáncs-Olasz-tanya this is the only example like this, but can be considered as generally used for various attached additions at Balatonőszöd.[101] This solution is also documented on Neolithic ceramics.[102]

To make a knob, it is a more general solution to attach the clay piece to the smooth surface of a vessel. A good example of it can be seen in the assemblage of Balatonőszöd.[103] According to the publisher's interpretation, this object is a "scraper knife". Based on the high-quality photo made from multi directions and the sectional profiles drawn also from several views, we can have little doubt that it is a large, flat knob which broke off from the side of the vessel along a smooth joining surface. Therefore, this find is not a purposefully made object as a tool, rather just a simple sherd, although with a very specific shape, which can inform us on a technological detail of attaching knobs. Furthermore, this flake-like piece of a ceramic is so thin at its sharp edges, therefore it is very fragile and unsuitable to scrape any hard material.

Divided bowls

This vessel type is the most complex among the Late Copper Age vessels. Among the pieces unearthed at this site, on find no. 5 *(Fig. 8)*, there is a single-line trench at the bottom, where the size of the surface, to which a dividing wall was attached, was increased by further fingerprints *(Fig. 24)*.

99 Horváth 2010, 71.
100 Gucsi 2006, 1. kép 7.
101 Horváth 2010, 69, Fig. 6,9,11,12.
102 Füzesi 2019, 11. ábra.
103 Horváth 2010, 6,7 (right picture).

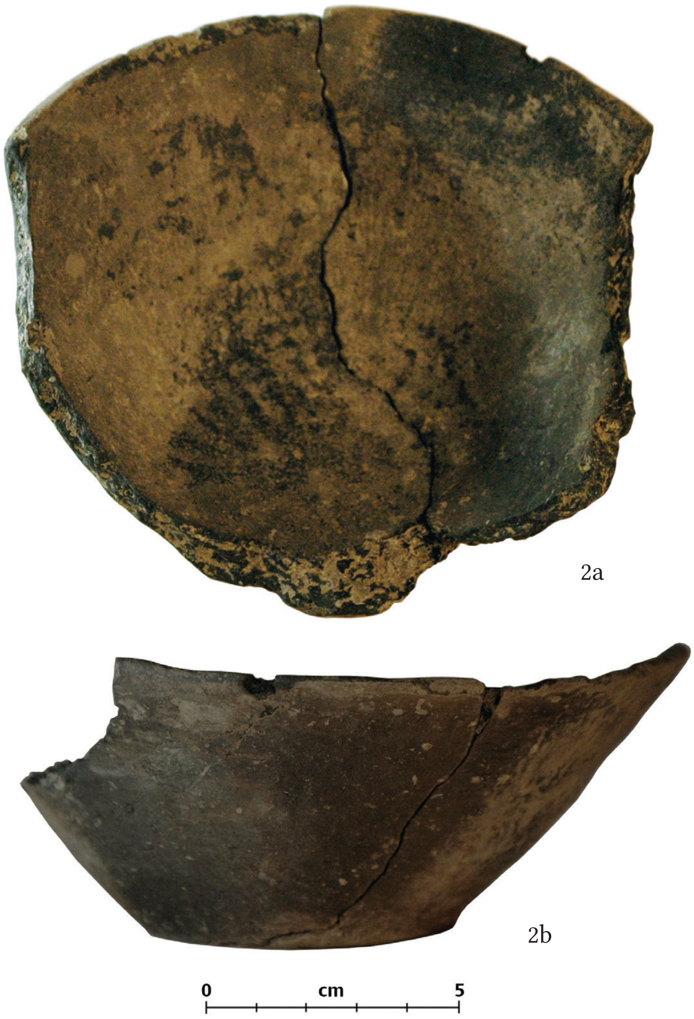


Fig. 22. a–b – Find no. 2.

There was no example of the use of small reinforcing clay coils embedded on one or both sides at the junction of the partition wall and the vessel wall, as opposed to the cases known from Aparhant.[104] There is no mention of such a technical solution in Balatonőszöd, but there is one piece with the trace of this solution from Budakalász.[105] However, in one case the inner surface of the bowl was roughened with scratches for better cohesion at Balatonőszöd.[106]

Based on my own experience, it should be pointed out that this is one of the most difficult types of prehistoric pottery to make. Due to its complex shape, drying and firing is particularly problematic, because when the clay shrinks, the partition wall inside the bowl dries differently and does not allow the diameter of the rim to decrease. The thermal expansion during firing also causes stresses in this form, which tend to crack in the middle of the partition wall (find no. 105, *Fig. 19, Fig. 20*) or at the junction of the partition wall and the bowl's wall. These possibilities of errors were avoided by their classical design, which has the following characteristics; the general proportion of division is ⅓ : ⅔, the partition wall is usually not attached to the interior bottom of the vessel, the partition wall is not straight but slightly curved to accommodate internal stress.[107] At Balatonőszöd the divided proportions visually are ¼ : ¾ on three, more or less intact bowls.[108] These pieces have more curved dividing walls which are not attached to the interior bottom of the vessel, but run much higher. In a few cases there are vertical ribs at the junction on the exterior, these are decorative elements partly but from a technological point of view, also serve to reinforce this critical point.[109] However, it can be observed on find no. 105, that outside this critical line, uniquely there are finger-wide ditches that may have been made during drying. When the potter noticed that the crack occurred, probably tried to save the object by pressing

104 Gucsi 2000, 93.
105 Bondár – Raczky 2009, Pl. 120,310/1.
106 Horváth 2010, Fig. 6,11.
107 Banner 1956, Pl. 4,14,15, Pl. 34,37; Bondár – Raczky 2009, Pl. 63,148/1; Němejcová-Pavúková 1974, Abb. 46,26.
108 Horváth 2011, 35 however, the visually estimated proportions strongly differ from the measured capacity of the two parts, 39. ábra.
109 Banner 1956, Pl. 62,2,4; Bondár – Raczky 2009, Pl. 63,148/1; Endrődi 1997, 10. kép 5; Němejcová-Pavúková 1974, Abb. 34,6, Abb. 37,7.

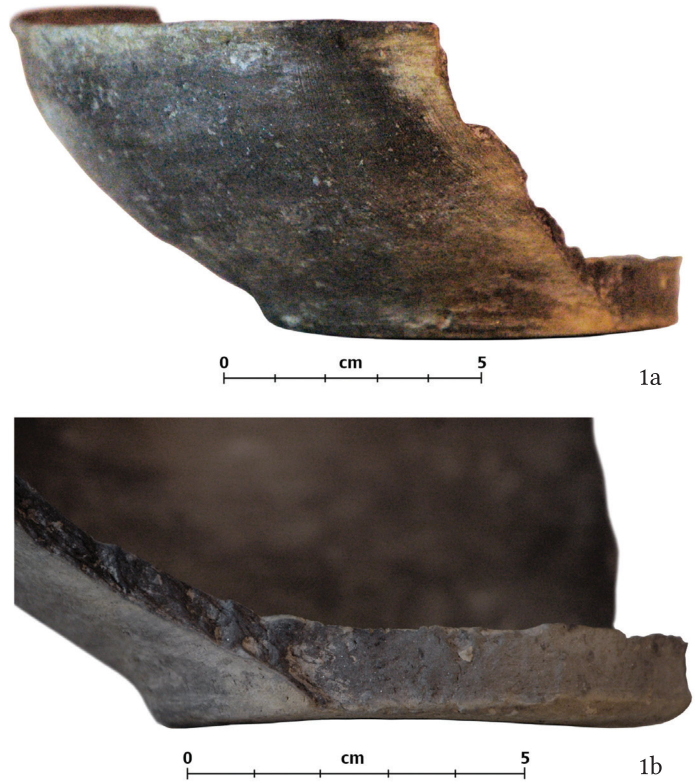


Fig. 23. a – Find no. 1, b – Detail of the joining surface of the base disk on find no. 1.

from the two sides. Because this bowl is divided into two equal parts, the dividing wall goes through the middle of the base, risking the formation of cracks. Therefore, the potter of this unique bowl did not seem to have full awareness of the important technological knowledge mentioned above or had either experimented with. This could happen when a new fashion spreaded, but the know-how was not yet embraced locally, or when these technological rules (and cultural as well) began to wear out from this community when this vessel was made. Interestingly, the dividing wall of find no. 5 goes through on its base too, but not exactly in the middle, so it is probably divided nearly for two half. Because the dividing wall is attached to the interior bottom in both cases, it is possible that this technically dangerous detail is rooted in the local tradition.

Find no. 105 has four other characteristics too, which make this piece unique. Its shape is conical, slightly semi spherical, instead of the usual (mostly pressed) bowl shape with inverted rim. It has no handle, but a vertically elongated knob *(Fig. 19, Fig. 20)*. The handle on this vessel type is always placed at the perpendicular axis of the division wall, while the knob on this item is at the junction of it. Its two buttons on the top of the junctions are very small, knob-like, instead of the typically large, slightly depressed disc shaped, usually decorated buttons. The top of its rim is decorated only with a relatively simple design; oblique impressions were made on it by some tool, while this vessel type is usually well decorated or undecorated.

The closest analogy to find no. 105 is known from Kiskunfélegyháza-Páka-puszta.[110] This is also a conical, slightly hemispherical bowl, and undecorated. It has a straight divider wall nearly in the middle of the bowl and at the junctions there are no buttons but rectangular parts protruding on the rim. One characteristic of it, although still fitting to the general vessel type, it has a handle, positioned on the side of the vessel perpendicularly to the divider wall. Another close analogy is published from Kamenín.[111] This bowl has ⅓ : ⅔ proportion divided by a curved wall; on its junction with the bowl's rim there are small rounded triangle shaped protrusions. It has a lug on its side instead of a handle (similarly to find 105), but its position is in the normal place. The rim of this piece is inverted, but the body of the vessel is more conical and robust, not as pressed as usual.

When looking for the unique characteristics of these three vessels, we can find the following (not mentioning all examples). A straight dividing wall occurs on a piece from Kunszentmárton-Puszta-

110 Banner 1956, PL. 47,16.
111 Nevizánsky, G. 1999, Obr. 8,10a–c.

Fig. 24. Find no. 5. a – Detail of the joining surface of the base disk and finger impressions at the middle of the base, b – Its exterior with the decorations.

istvánháza, which in all other characteristics fit into the classical design.[112] From Úny, there is a bowl, which has a straight dividing wall, bisecting the bowl nearly in two half, but the wall does not go through the base, just touching its edge.[113] The same proportion can be seen on a stray find from Budakalász, but the wall of this piece is slightly curved, not totally straight.[114] Another bowl from Kameník has a straight wall too, its proportion also close to the half-half division, at least clearly differs from the ⅓ : ⅔ rate and can be estimated as ⅖ : ⅗. These latter four are also richly decorated, their handles are in the normal position and their buttons are disc-like, their rims are strongly inverted. In contrast, small, knob-like buttons on the top of the junctions as find no. 105 has, can be seen on a sherd from Balatonőszöd[115] and on another from Budakalász.[116] Both have very slightly inverted rims, their shape therefore very close to these unique conical, hemispherical bowls. Similarly protruding parts above the junction, as the bowl from Kiskunfélegyháza has, known from Balatonőszöd, but only one has a rectangular shape, which seems to be a sherd of a conical bowl, or its rim just very slightly inverted.[117] There are three others in Balatonőszöd with triangular shaped protrusions.[118] To summarise, the most commonly shared features of these bowls is their slightly curved but not strongly inverted rims. In Horváth's opinion,[119] who agree with Nevizánsky,[120] the small, undecorated buttons represent the earlier periods, while the large, decorated ones represent the later phases. Němejcová-Pavúková proposed this first, but she mentioned that pieces with small buttons, together with characteristic decorations occur in the later periods too.[121] Also in that paper

112 Banner 1956, Pl. 61,2,5.
113 Banner 1956, Pl. 17,2,5.
114 Bondár – Raczky 2009, Pl. 167,10.
115 Horváth 2011, 41. ábra 1903.
116 Bondár – Raczky 2009, Pl. 175,49.
117 Horváth 2011, 41. ábra 1210.
118 Horváth 2011, 34, 40. ábra 1851, 41. ábra R-925,47/10, upper left drawing (unnumbered, but according to the main text it is R-925 49/11).
119 Horváth 2011, 34.
120 Nevizánsky 2001.
121 Němejcová-Pavúková 1974, 261.

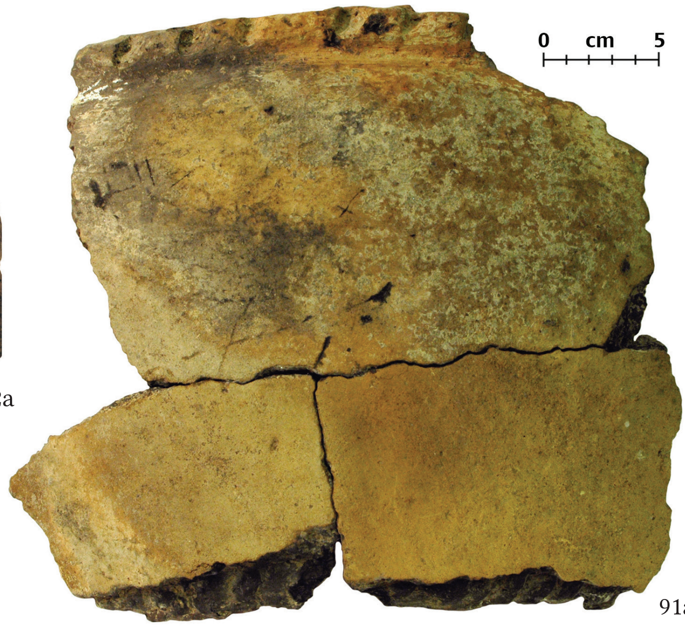


Fig. 25. 12a – The base disk of Find no. 12, 91a – Strongly "S" shaped joining surface with finger impressions at the lower horizontal breakage surface of find no. 91.

the published examples differ from these small, knob-like buttons. Only one resembling this type, but based on its photo it is not entirely clear if it just broke off or not.[122] The other pieces in that publication are small, but all have a disc-like upper part. Mária Bondár observed in the material of Pécs-Vasas, which represents the latest period of the Baden culture, that undecorated pieces in fact occur in the later periods, opposed to what was thought previously.[123] In that assemblage two pieces are also made with triangular shaped protrusion on their rims, their profiles are also slightly curved.[124] László György in his Phd thesis summarised the state of the research on this topic and did not refute Bondár's opinion, he also noted that the typo-chronology of this special vessel type is still far from certainty.[125] The case of find no. 105 seems to support these later opinions, as its closest connections dated to the later phase and other finds in this assemblage suggest the same possibility of dating, as mentioned above in the paragraph of the methods.

Use traces and repaired broken vessels

Among many kinds of use traces, here only the more prompt cases are discussed. Chipped rims are very common in any assemblage, here finds no. 81 *(Fig. 16)* and 103 *(Fig. 19)* presented as such. On cups, the damaged part sometimes included a wider area, which more often is on the left half or the upper quarter of the rim, when the handle is facing to us (finds nos 102, 104, *Fig. 19*). These traces can be related to a scooping movement, when a right-handed person scoops out something from a deeper vessel, and the rim of the cup is always rubbing to its inner surface. Such damage can be seen on a mug found in intact condition in feature no. 155 at Fonyód-Vasúti-dűlő 2.[126] Its chipped rim is also abraded or worn judging from its photograph. These finds are self-evident in settlements

122 Němejcová-Pavúková 1974, Abb. 34,6.
123 Bondár 1982, 35.
124 Bondár 1982, Taf. 3,10,12.
125 György 2014, 54.
126 Gallina – Somogyi 2007, 26, VI. tábla 6.

Fig. 26. 91b – Very thin white layer of coating (?) on the exterior of find no. 91, 91c – Strongly “S” shaped joining surface with finger impressions at the lower horizontal breakage surface and the very thin, white layer of coating (?) on the exterior of find no. 91.

but can be surprising in cemeteries, although there are some already published cases; two finds are also known from Budakalász-Luppa csárda with the same attribute.[127]

On two cups there are drilled holes just right under their rims. Find no. 101 *(Fig. 19)* has a fully perforated wall, next to the previously broken off handle, while find no. 104 *(Fig. 19)* has two unfinished holes. Its handle probably was also broken off at the time when the drillings were made. In the case of the perforated one, a string can be laced into the hole which replaces the function of the handle. Such drilled holes also occur at Balatonőszöd[128] and Budakalász.[129]

A small amphora’s rim was probably accidentally damaged, then along in a horizontal line the rest of the rim was broken around and the breakage surface was abraded and smoothed (find no. 100).

Find no. 33. *(Fig. 11, Fig. 29)* is a jug, which has a very thick, orangish coloured limescale layer in its lower part, until its neck. This is probably a result of storing water in it periodically for a long time.[130] It definitely differs from other limescale layers which can form on ceramics during their buried state in the soil. This particular case was not investigated by chemical analysis, as has been done on tree samples from Balatonőszöd.[131] There the result shows anhydrous lime, which was applied on the interior of the vessels in a thin layer, or these vessels were used to store this substance. This phenomenon is important from the restoration point of view since limescale is usually removed during cleaning, however, limescale may provide important information on the use of vessels.

The exterior surfaces of finds no. 63 *(Fig. 15)* and 89 *(Fig. 17)* have coatings applied in separate layers. It was hypothesised that some ceramics used for cooking were provided with such an extra, daub-like layer to protect them from heat shock. Find no. 63 was examined by Attila Kreiter in a thin section *(Fig. 7)*. The interface between the outer layer and the wall of the ceramic body is clearly visible. However, it turned out that the plus layer has the same raw material as the ceramic body

127 Bondár – Raczky 2009, Pl. 120,310/4, Pl. 167,7; Gucsi 2009, 454.
128 Horváth 2010, 73, Fig. 9,1,2.
129 Bondár – Raczky 2009, Pl. 167,9.
130 Horváth 2010, 67.
131 Gherdán et al. 2010, 99, Fig. 6,3.

in contrast to the macroscopic determination. To the naked eye, the additional layer may appear to be different in terms of material quality because its surface is rougher, while the surface of the ceramic is smoother, and the oxidising condition of firing of the outer side has affected the layer only.

From this site, an archaeometric analysis of a bowl and the animal bone found in it has been published, which investigated the marrow consumption by residue analysis.[132]

Fig. 27. Oblique joining surfaces in horizontal direction and voids in the ceramic fabric of find no. 76 suggesting coiling technique.

Secondarily used sherds

Among this assemblage there are four objects, which were made of large sherds of vessels (finds no. 96, 97, 98, 99, *Fig. 18*). What they have in common is that their intentionally abraded breakage surfaces are curved, but they have an irregular circular shape. The more abraded ones (finds no. 96, 99) have quite rounded fracture surfaces in their cross sectional view, their arches are shaped like a swan neck. On find no. 96, there are two abraded arches opposite to each other, one is longer while the other is shorter and has a stronger curve. The other two (finds no. 97, 98) have more irregular shape, their broken surfaces are not that nicely smoothed or abraded, probably they are unfinished. Three of them surely broke apart before being deposited, but on find no. 96 probably there is also an intentionally broken off part at its left side with concave breakage line.

The best analogy of this object type was found in the Middle Bronze Age site of Klárafalva-Hajdova.[133] It is a fragment of a medium-sized vessel, one of its side is abraded also in the form of a swan neck and has a rounded edge. Its publisher mentioned that it is probably a tool for burnishing.[134] The ceramic fragments with abraded edges from the material of Balatonőszöd are also associated with the possibility of ceramic burnishing. Since the lack of pebbles in the Balatonőszöd material, Tünde Horváth raised the possibility that "Some of the fine-grained sandstone fragments originally used as whetstone or grinding stone, broken into small, usually crescent-shaped pieces and showing grinding sides and edges, may have been suitable for this purpose (i.e. burnishing), although their hardness and strength not very durable".[135] In all three of the latter cases, it must be stated that these objects are completely unsuitable for burnishing due to the porosity of their material structure.[136]

132 Tugya et al. 2012.
133 Michelaki 2008, Fig. 6,b.
134 Michelaki 2008, 366.
135 Horváth 2010, 69.
136 Kreiter et al. 2014, 131; Forte 2019, 11.

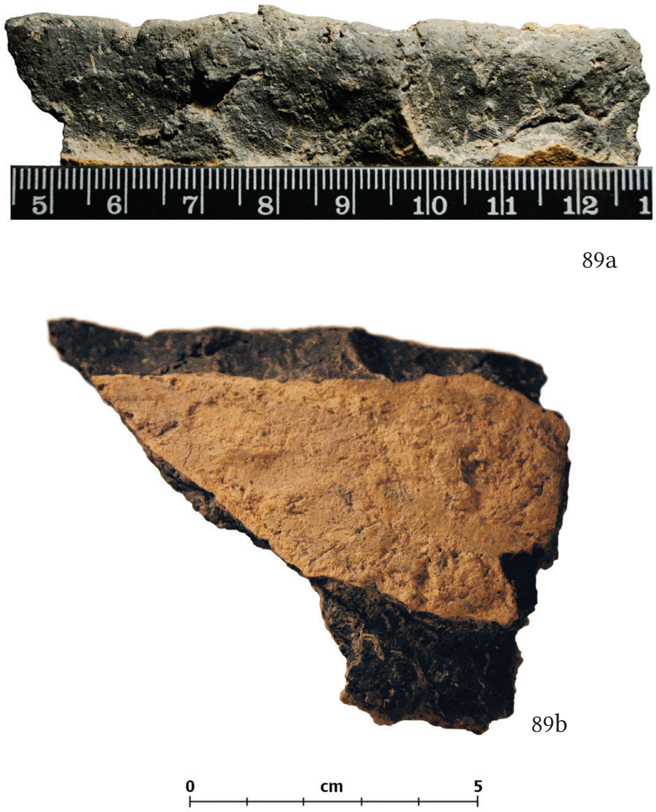


Fig. 28. Joining surface with finger impressions. 89a – Detail of fingerprints, 89b – the whole sherd.

They can only scratch the surface of a leather hard or drier clay, instead of smoothind the plate-like particles on the microscopic scale into an oriented pattern. Jasna Vuković already pointed out that this was an incorrect interpretation, even though her research primarily focused on the reuse of broken vessel handles as weights for nets during the Neolithic period in Serbia.[137]

These ceramic objects, if they can be associated with pottery, can only be used to smooth the interior wall of the vessels. In my experience, the swan-neck shape of the edges of the larger, flatter pebbles and shells are particularly suitable for shaping the forms of the vessels. Obviously, it is no coincidence that the edges of similar modern tools used in pottery production are of this shape. If these finds were indeed tools of potters, they could have been used if they were thoroughly soaked in water. The ceramic, due to its porosity, is known to have a very good absorbent capacity, so without soaking it would extract water from the clay when in contact with it and the clay would easily adhere, which inhibits the smoothing operation. For smoothing, both the vessel surface and the smoothing tool must be moistened even when the tool is not porous such as pebble, compact hardwood, bone or shell.

Grain impressions

The imprint of grains, other seeds or plant fragments in ceramics are studied worldwide in archaeology. Although this topic is still not in a focus of interest as much as it appears on the finds. In those areas where it was systematically studied, they found numerous examples from the Neolithic through the whole prehistory to the Early Middle Ages.[138] In Hungary, from the Copper Age, two such cases have been examined from Balatonőszöd.[139]

I have found impressions of grains on the surface of ceramics several times in Early, Middle and Late Bronze Age finds, of which one assemblage has been published.[140] Sometimes imprints of much larger seeds, such as sloe *(Prunus spinosa)* and cornelian cherry *(Cornus mas)* were in Middle Bronze Age vessels (the seeds are determined by the author). The grain imprints discussed here were not analysed by experts, it is out of the scope of this paper, instead I would like to share my opinion from the point of view as a potter.

137 Vuković 2015, 116.

138 Lempiäinen – Levkovskaya 1994, 191.

139 Gherdán et al. 2010, sample 15.1SZc, Fig. 5,5, sample 15.1SZd, Fig. 5,6.

140 Gucsi – Szabó 2018, Vessel 42. Fig. 18,1, Vessel 72. Fig. 38,1.

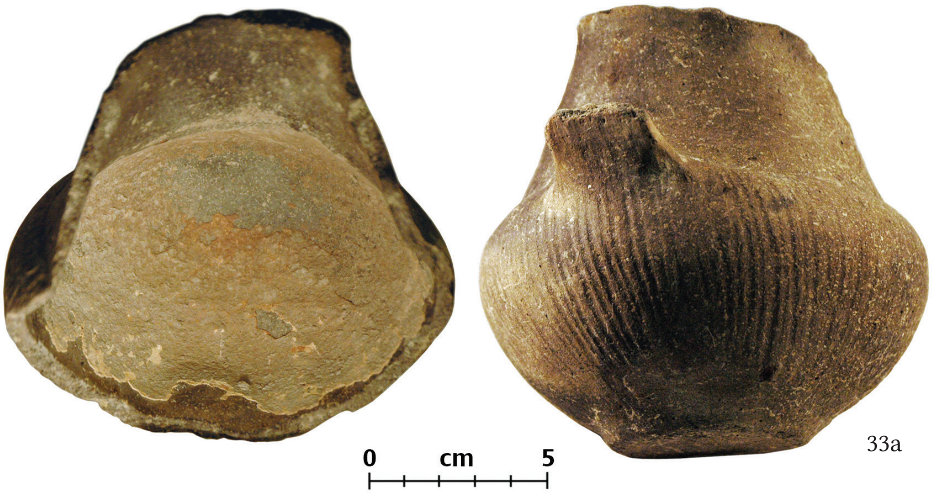
Grain imprints are found on two ceramics in this assemblage. Find no. 10 *(Fig. 8)* has two imprints on its base, one grain and one chaff leaf. Two imprints can be seen in an internally divided bowl (find no. 105, *Fig. 21*). One of them is a grain imprint in the exterior, and the other is a chaff leaf in the interior, probably a lemmae, as it continues into an imprint of an awn. Two imprints of chaff leafs can also be observed in the bottom of the pedestal of a goblet from grave no. 335 of Budakalász.[141] This type of object is associated with ritual practises due to their red ochre paints, similarly to divided bowls, which are also assumed to be associated with ritual practises based on their very special form.[142]

Interestingly, find no. 105 differs from the usual form as it is not divided in a ratio of ⅔ : ⅓ but in a ratio of ½ : ½. From a top view, therefore, it resembles the shape of cereal grains from the view of their ventral side. At the same time, the style of decorating the rim and partition wall, which is indented by a tool, is reminiscent of a row of grains. On the junction of the dividing wall and the body of the bowl, there are two small buttons and their slightly depressed recesses are suitable for inserting and holding objects only of approximately a size of a grain. The position of the imprints to the right and to the left relative to the knob and to the dividing wall, deserves further attention. Comparing the three examples, a symbolic representation of the terms "inner – fertile – reproductive – seed / outer – protective shell – chaff leaf" can be suggested. Taking into account the characteristics of this bowl; the embodied shape of a seed (?), the grain imprints and their positions, the grain-like form of the decoration give the impression of a multitude of symbols associated with this object.

Out of the two imprinted ceramic pieces found in Balatonőszöd, one was of a spikelet, probably belonging to an einkorn *(Triticum Monococcum)*, and the other probably the imprint of a seed of hawthorn *(Crataegus laevigata)*.[143] In the case of the spikelet imprint, it is unfortunately not clear from the publication that it was pressed into the surface of the bottom or the side of the vessel or became visible along the fractured surface and it was originally inside the ceramic fabric. Based on the silicone imprint, the surface can be both a roughened outer surface of a ceramic and a fractured surface. In the case of the hawthorn seed, the surface of the ceramic is identifiable and it was pressed into a rim where it is deeply impressed and is also mentioned in its description. The formation of both imprints was assumed to be accidental.

It is a very important question that the grain imprints are made intentionally or merely accidentally. When we consider the accidental scenario, this still carries some information on the production zones of different activities.[144] Lempiäinen and Levkovskaya collected the opinion of previous researchers, who concluded that the imprints on ceramics are accidental, based on their low number of occurence compared to their high proportion in daub and taking into account that imprints in ceramics represents much wider range of species, while daubs has a much narrow distribution of species.[145] Also on quantitative bases, on the quality of the remains and the thrashing waste property of the temper in their examined pottery (from 9^{th}–10^{th} century AD), they concluded that they were not mixed by accident into the clay.[146] The question of intentionality was recently discussed by Tanya Dzhanfezova and she pointed out the importance of consideration of the body clay and the surface, the location of the imprints and also the chance factors.[147] These factors related to

141 Bondár – Raczky 2009, Pl. 128. 335,2.
142 Bondár – Raczky 2009, 285.
143 Gherdán et al. 2010, 98, sample 15.1Szc, Fig. 5,5, sample 15.1Szd, Fig. 5,6.
144 Gosselain – Livingstone 2005, 41.
145 Lempiäinen – Levkovskaya 1994, 195.
146 Lempiäinen – Levkovskaya 1994, 195.
147 Dzhanfezova 2021, 1152.



33a

82a

Fig. 29. 33a – Thick layer of orange coloured lime scale in find no. 33, 82a – horizontal breakage lines formed along joining surfaces on find no. 82.

"procurement strategies, production locations, technological steps and technical approaches, additional surface treatments, usage, etc."[148] In this question of the research I would like to represent the potter's point of view taking into account the chance factors.

Imprints sometimes appear on the outer surface of the base of the ceramics (find no. 10, *Fig. 8*), in which case it could be argued that the freshly formed object placed on the plant remains randomly scattered on the ground. Although, if the pottery production is more organised, in the meaning of drying procedure, when a shelf or wooden board were used, then it is much less likely to have any grains or plant remains randomly on it. The randomly scattered plant remains are also very unlikely in the case of the

148 Dzhanfezova 2021, 1153.

mentioned goblet from Budakalász, because the surface of the foot is very small. Consequently, to accept randomness would be to mean that the surface on which it was placed was richly sprinkled with chaff. In this case, the fact that the imprints are only in the middle of the base, also opposes randomness. Another argument in favour of randomness is when seeds are mixed into the paste of clay, into the core of the vessel wall. Here there is a significant difference between chaff or organic material tempered ceramics and exclusively grog, sand or other mineral tempered ceramics. In the Carpathian Basin the use of chaff temper is common only in the Neolithic. From the Copper Age to the Bronze Age grog and mineral based temper were used generally. During the restoration and drawing process I paid attention to this phenomenon in the last 10 years. In the case of ceramics made only with grog and mineral based tempers, I found that imprints occur in the core very rarely, much more often on the surface of the vessels, inside and outside, from the rim to the base. The depth of the imprints represent generally 50–80% of the seed's original dimensions. So, it is not that grains were in the clay and they just got close to the vessel surface during moulding. Grain or seed pieces sticking out of the surface partially also provide a time frame when those were formed. It likely happened when the vessel achieved its final form by the hands of the potter. Otherwise, the grain pieces would have been smoothed into the surface of the still wet clay during shaping, when various smoothing movements were still carried out on it. It can be safely stated that only burnishing treatments were carried out in the areas surrounding the grain impressions, which could only be done when the clay is in at least leather hard, partially dried state. The same can be said about impressions found at the base, otherwise those grain pieces would have also been smoothed into the wall of the still malleable clay during more intensive shaping. If the base of the bottom was not smoothed in the later phase of forming, and we suppose that the seed randomly get there during the building up procedure of a vessel, when it is rotated on a horizontal surface, even a piece of dried clay, a small stone or anything in the size of a grain can make a curved or spiral like trace as it is scrolling.

From a potter's point of view, it is also safe to say that grains and other larger seeds are generally avoidable in the clay. The cleaning process of the raw clay is well documented worldwide, showing its general importance in pottery manufacturing. Just to mention only one recent study; the Manyika potters of South Africa, in the Watsomba area removing impurities from the clay such as roots, grass and grit by pounding the clay on a stone slab with a wooden pestle.[149] This is because when the vessels are fired, those plant fragments are more likely to burst up the wall of the vessel if they are embedded in it completely. It is also difficult to imagine that seeds can stick to the hand of the potter or to a smoothing tool accidentally. If it happens with any foreign material, then it cannot be unnoticed by the potter during moulding. Any accidentally stacked foreign material piece can be noticed immediately by touch or their scratched lines on the smoothed vessel surface.

Summarising the above, the partially deepened imprints observed on the surface of the ceramics were most likely intentionally imprinted into the surface of the finished vessels upon completion of moulding. For further studies on this topic, it would be necessary to systematically collect the information of the location of the imprints on the vessels, their percentage of the embedded part, and the vessel type must be considered in a larger scale to identify if there are higher occurrences on special objects that may be connected to ritual practises. But this latter is not so easy, because what we consider simply as a storage vessel or cooking pot, it could have been used for example brewing beer, which can put their function into a ritual context even if they do not seem so special in terms of shape or decoration.[150] With the words of Neil Wilkin: "As there was no clear-cut dichotomy between ritual and domestic life during prehistory, typological similarity and variability can also be related to the 'everyday'/'domestic' assemblage, which Food Vessels may have alluded to or have been selected from."[151]

149 Nyamushosho et al. 2021, 4.
150 Nyamushosho et al. 2021, 5, Tab. 1.
151 Wilkin 2013, 27.

Fig. 30. 27a – Horizontal breakage lines formed along joining surfaces and the line of the base disc on find no. 27, 27b – Side view of the same jar.

In the case of the intentional impressions there may be one case to be considered; when these imprints are the result of a childish curiosity. This could explain why it is relatively rare to find imprints on ceramics, so the habit of making them is not a strict rule of what should be done in any case as a necessary rite. The other interpretation can be in a ritual framework. Well known from ethnographic research that there are usually more "thoughts" behind the activity of tempering ceramics than simply the functional, technical solution.[152] Other ethnographic data collected by Márta Galántha

152 Kreiter 2007b.

also remarkably showcase in the life of a millet cultivating community, how richly the life cycles and symbolism of their most important plant intertwine their entire culture.[153] In prehistoric thinking, respect for ancestors, the eternal cycle of birth and death, can often be demonstrated behind simple seemingly ordinary actions. This is not surprising, since people's religious existence before our modern desacralized world, not even the simplest act was on a purely physical level.[154] It is also clear from ethnographic data on grog tempering that it is important for people to provide soul or the power of ancestors to newly made pottery.[155] To do this, the potter, as the person who helps the birth of the object, assists and ensures that things happen in small ways according to the order of the cosmos. In this system of interpretation, the act of contact between the life-giving seed and the freshly formed vessel ensures that the man-made object is full of life, fertility and soul, like all existing things are alive in the animist worldview.

Conclusion

To identify the exact method of handbuilding technique used in the Late Copper Age I presented 82 building units, which can be measured and statistically analysed. By pointing to the phenomena of invisible joints between the well unified building units, presented the limits and the necessary criteria of the macroscopic identification of slab building technique. Based on the available data, I argued that with the present methods used, only coiling technique can be proven (next to pinching) in the repertoire of the Baden potters, opposite to the previously published opinions of stripe, slab, and patch techniques. The comparison of the available papers in this topic revealed that base disc and its flanged version can be found in the studied Baden assemblages widely spreaded. The oval handle pegs were preferred generally on all sites when a handle was attached to a jar's body. At the same time, other certain methods can be preferred locally in higher proportions. In the assemblage of Budakalász the solution when vessels made with a rounded base, then later formed into a flat base with an added thin coil ring is unique. At Balatonőszöd there was a habit to put the freshly formed vessels on sherds or twigs, to help them dry, which is also unique. Base disks with lens shaped cross section was preferably used for fine wares in the Hódmezővásárhely assemblage. At Balatonőszöd when the potters want to increase the adhesion by enlarging the surface between building units, the preferred method is to roughen the surface with sharp cuts made by a tool, while at Hódmezővásárhely there are more examples when fingertips were impressed into the vessel wall before attaching the next building unit to it. Since the technologically interesting, comparable number of finds are still small, the other circumstances which are determinative to drawn statistical conclusions are also affecting the possibilities present now (see the last paragraph of the methods), here just a sight of trends can be outlined but the similarities and different distribution of certain methods in the pottery tradition on each site is promising for further study.

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153 Galántha 2020.
154 Mircea 1959, 11–14.
155 Kreiter 2007a, 154–162.

Catalogue – Description of ceramics

Abbreviations: dB.: diameter of base; dR.: diameter of rim; H: height, Inv.no.: Inventory number; S.no.: stratigraphic number; Wt.: thickness of wall.

1. Semi spherical small bowl *(Fig. 8, Fig. 23).*
   Its base strongly profiled and its rim slightly everted. At the bottom, it is broken 7 cm along a joint surface that is almost regularly vertical and shows that the wall of the bowl was later added to the base disk. Dark brown, grey, yellow.
   Feature no. 56; S.no. 59; H.: 6.8 cm; dB.: 8 cm; dR.: 18 cm; Wt.: 4–10mm.
2. Conical small bowl *(Fig. 8, Fig. 22).*
   In its fracture surfaces, there was visible a joining surface in the ceramic fabric. This shows that the wall of the bowl was added to the disk of the base, joining the upper part of it. The edge of the rim is slightly worn. Its inner surface is strongly worn.
   Feature no. 41; S.no. 41; H.: 6.3 cm; dB.: 6.6 cm; dR.: 16.5 cm; Wt.: 3–7 mm; Inv. no. 2010.8.41.25.
3. Base of a bowl *(Fig. 8).*
   Along the fracture close to the base, a joining surface is visible in the ceramic fabric. The base disc has a lens-like intersection. The edges of the base disk were slightly bent up, during moulding, to form a flange that supported the first building unit which formed the wall. At the existing height of the fragment, the object is broken around, along a slightly convex joining surface. The distance between the two joining surfaces: 2.7 cm. Black.
   Feature no. 32; S.no. 32; dB.: 10 cm; Wt.: 5–8 mm.
4. Base *(Fig. 8).*
   The entire fragment is broken along a joining surface at the edge of the base-disk.
   Feature no. 55; S.no. 197; dB.: 8 cm; Wt.: 7 mm.
5. Divided bowl *(Fig. 8, Fig. 24).*
   The main part of the body of the vessel has been broken off from the base-disk, whose edges are bent up. Fractures along joining surfaces occurred at three more locations on the bowl. The first building unit which connected to the base disc is 4 cm wide, the second 3.4 cm wide. The third is 3.6 cm below the rim. The distance between the second and the third joining surfaces is 7 cm, which is twice the size of the units mentioned above. So, this section was probably made up of two more building units, but their joining surface was properly worked together and the ceramic did not break here. This double sized building unit was taken to the data analysis with a unique mark, to see as a control sample, where it is among the other data *(Fig. 3, Fig. 4, Fig. 6).* The object's fractures also revealed that the potter made a small curved ditch in the inside surface, in which the partition wall was processed in.
   Feature no. 44; S.no. 46; H.: 10 cm; dB.: 9 cm; dR.: 29 cm; Wt.: 5–8 mm.
6. Base (Jug or pitcher?) *(Fig. 8).*
   The entire fragment is broken along a joining surface at the edge of the base-disk. Black.
   Feature no. 9; S.no. 9; dB.: 7 cm; Wt.: 5–6 mm.
7. Bowl *(Fig. 8).*
   Base and lower part. Decorated with impressed dots arranged in stripes. Each stripe made three vertical lines of dots. Two joining surfaces were observable on the fragments. One is on the edge of the base-disk, and the other 6.4 cm higher. Black and yellowish grey.
   Feature no. 77; S.no. 179. + Feature no. 78. S.no. 82; dB.: 7 cm; Wt.: 8–10 mm.
8. Jar *(Fig. 8).*
   Base and lower part. There is a joining surface on the edge of the base-disk. Its surface is worn. Greyish black.
   Feature no. 5; S.no. 5; dB.: 5.5 cm; Wt.: 5–7 mm.
9. Base *(Fig. 8).*
   All around on the base-disk fragment a joining surface is observable. Slightly secondarily burned on its fracture surfaces as well. Yellow, black, stainy.
   Feature no. 50; S.no. 52; dB.: 7.7 cm; Wt.: 5–8 mm.

10. Base *(Fig. 8)*.
A joining surface can be seen on the edge of the base-disk. On the outer surface of the base there is an imprint of a grain, and a chaff.
Feature no. 9; S.no. 141; dB.: 10 cm; Wt.: 4–10 mm.

11. Base (Pot?) *(Fig. 8)*.
All around the whole fragment, the base broke off along a joining surface. Its characteristic is different from the other base-disks. Its edges strongly bend up, not just for supporting the next building unit, but already made a same thick “rib” as the wall, and the next building unit was placed on the top of this rib.
Feature no. 13; S.no. 13; dB.: 8.7 cm; Wt.: 7–13 mm.

12. Base (Bowl?) *(Fig. 8, Fig. 25)*.
Almost all around the whole fragment, the base broke off along a joining surface where edges were blended up. The outer surface of the base is worn.
Feature no. 32; S.no. 32; dB.: 9 cm; Wt.: 5–9 mm.

13. Big vessel (amphora?) *(Fig. 9)*.
Base and lower part. Before the restoration, the joining surfaces were clearly visible between the base-disk and the first building unit. The exterior surface of the base is strongly worn. Inside ash-grey, the exterior is butter-yellow.
Feature no. 41; S.no. 41; dB.: 17 cm; Wt.: 15–16 mm.

14. Big vessel *(Fig. 9)*.
Base fragment. The edge of the base-disk is strongly bent up. The first building unit was adjusted to its inner side. Other breakages occurred between the second and the first building units along a joining surface. The interior is brown, the exterior is yellow, and the fabric of the breakage surface is black.
Feature no. 60; S.no. 224; dB.: 24 cm; Wt.: 14–17 mm.

15. Big vessel *(Fig. 9)*.
Base fragment. Breakages occurred along two joining surfaces, which define the base disk and the first building unit. The distance between the two joining surfaces is 1.1 cm.
Feature no. 60; S.no. 261; dB.: 13.2 cm; Wt.: 11–13 mm.

16. Cooking pot? *(Fig. 9)*.
Whole fragment of a base. Two joining surfaces are visible. One is at the edge of the base-disk, which is slightly bent up. The other is on the top of the first building unit. The distance between the two joining surfaces is 2.9 cm. Black, light brown.
Feature no. 28; S.no. 28; dB.: 14.5 cm; Wt.: 10–11 mm.

17. Cooking pot? *(Fig. 9)*.
Base fragment. Breakages occurred along two joining surfaces, which define the base disk and the first building unit. The upper joining surface of the first building unit is extremely irregular, wavy. The building unit is 4 cm wide on one side and 2.5 cm wide on the other. (The calculated average of the two data was taken) The find can be evaluated as a beginner’s work.
Feature no. 54; S.no.57; dB.: 15.4 cm; Wt.: 12–15 mm.

18. Cooking pot *(Fig. 9)*.
Fragments of the base and the lower part. Along the fractures of the ceramic, three joining surfaces became visible. The lower two were formed along the edges of a building unit with a distance of 2.4 cm. The upper two has a distance of 6.6 cm, which are probably made of two or three well unified building units. This double or triple sized distance was taken to the data analysis with a unique mark, to see as a control sample, where it is among the other data *(Fig. 3, Fig. 4, Fig. 6)* Slightly secondarily burnt. Yellow, black, patchy.
Feature no. 36; S.no. 168; dB.: 19.4 cm; Wt.: 14 mm.

19. Big vessel *(Fig. 10)*.
Base fragment. A joining surface shows that the edge of the base-disk was bent up.
Feature no. 60; S.no. 63; Wt.: 20 mm.

20. Big vessel *(Fig. 10)*.
Base fragment. A joining surface shows that the edge of the base-disk was slightly bent up, but probably just after, then the first building unit was placed on the edge of the base-disk. Inside yellowish brown, outside light brown, the breakage surface of the fabric is grey. The edge of the base is worn.
Feature no. 60; S.no. 63; Wt.: 16–17 mm.

21. Big vessel *(Fig. 10)*.
Base fragment. A joining surface shows that the edge of the base-disk was bent up, before the first building unit was placed on the edge of the base-disk.
Feature no. 23; S.no. 165; Wt.: 22 mm.

22. Base fragment *(Fig. 10)*.
The edge of the base-disk is broken around by a joining surface, which forms an angle of approximately 45 degrees. Black, grey, yellow.
Feature no. 9; S.no. 142; Wt.: 12–15 mm.

23. Base fragment *(Fig. 10)*.
Its unique characteristic is that the edge of the base-disk was formed in the angle, which defined the angle of the base and the wall. The first building unit was placed on its upper, flat surface. Inside brown, outside light brown, the breakage surface of the fabric is black.
Feature no. 42; S.no. 46; dB.: 11 cm; Wt.: 13–15 mm.

24. Big vessel *(Fig. 10)*.
Fragment of a first building unit which was placed on the top of the base disk. Its upper and lower breakages occur along joining surfaces. Their distance is 3.2 cm. The fragment is 10 cm long. The surface inside is yellow, outside orange.
Feature no. 98; S.no. 103; dB.: approx. 30 cm; Wt.: 14–15 mm.

25. Big vessel *(Fig. 10)*.
Base fragment. A joining surface shows that the edge of the base-disk was slightly bent up. The exterior surface of the base is worn.
Feature no. 60; S.no. 63; Wt.: 20–22 mm.

26. Big vessel. Amphora? *(Fig. 10)*.
Its bottom disc has a strongly pronounced 1.8 cm high flange on its edge, to which the first building unit is attached. The find is broken along two other joining surfaces, which are horizontal joints of building units. These were not taken to the data analysis since their height is too big, probably each part was made from several building units. Black.
Feature no. 62; S.no. 65; dB.: 17 cm; Wt.: 11–19 mm.

27. Jar *(Fig. 11, Fig. 30)*.
It has a slightly pressed, globular body, cylindrical neck, one handle, which is emerging above the rim. Its belly is decorated with shallow flutings. Three joining surfaces were visible during restoration. One is on the edge of the base-disk, one is 2.2 cm above and the next is 2.4 cm above this last. The joining of the base-disk and the first building unit was not worked together properly, so the joining line is visible on the interior surface. Greyish brown with yellow stains.
Feature no. 58; S.no. 61; H.: 20 cm; dB.: 7.5 cm; dR.: 11.5 cm; Wt.: 4–10 mm.

28. Jar? *(Fig. 11)*.
Fragment of a handle with peg. The hole for the handle on the vessel body is equal with the size of the handle, but inside narrowing. Brown, yellow.
Feature no. 68; S.no. 193.

29. One-handled small pot *(Fig. 11)*.
At the missing base a joining surface was visible. The handle was attached to the vessel body with a peg. The hole on the vessel was the same wild as the base of the handle. The rim is chipped in a 1.6 cm wild place. Yellowish brown, patchy.
Feature no. 95; S.no. 100; H.: 8.5 cm; dB.: 6.2 cm; dR.: 8.5 cm; Wt.: 4–5 mm; Inv. no. 2010.8.100.19.

30. Jar *(Fig. 11)*.
Belly-neck-rim and handle fragment. The handle is rising above the rim, and sits on the shoulder, where attached with a peg. The handle peg is partly visible as a consequence of a breakage, but identifiable by its oval shape, its size is equal to the handle. The hole for the peg on the vessel body is narrowing.
Feature no. 32; S.no. 32; Wt.: 5–7 mm.

31. Jar *(Fig. 11)*.
Shoulder-neck-rim and handle fragment. The handle is slightly rising above the rim, and sits on the shoulder, where attached with a peg. The handle peg is oval, its size is equal to the handle. The hole for the peg is narrowing.
Feature no. 68; S.no. 72; Wt.: 5–7 mm.

32. Handle of a jar *(Fig. 11)*.
The handle was attached to the vessel body with a peg, which is roundly shaped. Dark brown.
Feature no. 60; S.no. 210.

33. Jar *(Fig. 11, Fig. 29)*.
Its shoulder and belly are decorated with vertical flutings. Above them a horizontal smoothed line emphasizes the carination of the shoulder and the neck. It's all surface worn. On the interior surface there is a thick layer of lime, which is not the consequence of the taphonomy, but this sediment most probably occurred during the use of the vessel. Brown with yellowish stains.
Feature no. 23; S.no. 165; H.: 11.5 cm; dB.: 5.5 cm; dR.: 8.5 cm; Wt.: 3–5 mm.

34. Amphora *(Fig. 12)*.
Globular body with curved neck. Its body is decorated with shallow flutings. A handle is on its shoulder, which was attached to the vessel body with an oval handle-peg. Dark brown, black, grey.
Feature no. 18; S.no. 18; Wt.: 5–7 mm.

35. Handle *(Fig. 12)*.
Both ends of the handle were attached to the vessel with a round shaped peg. Light grey.
Feature no. 60; S.no. 63.

36. Handle *(Fig. 12)*.
Both ends of the handle were attached to the vessel with handle pegs. The unique characteristic of this fragment is that the holes for the pegs did not perforated the vessel body. Yellow, but the inner surface and the breakage surface is black.
Feature no. 28; S.no. 28.

37. Bowl *(Fig. 12)*.
Fragment of a decorated bowl, with a handle. For this tunnel-like handle, the potter first made a "bed" by scraping out some material of the vessel body, then attached the material of the handle to the vessel. The "bed" is 2.5 cm long, 1.3 cm wild, 3 mm deep.
Feature no. 60; S.no. 227; Wt.: 8–9 mm.

38. Handle *(Fig. 12)*.
Fragment of a handle, which was attached to the vessel with a round shaped peg. Yellowish grey.
Feature no. 60; S.no. 63; 6 cm wild.

39. Handle *(Fig. 12)*.
Fragment of a handle, which was attached to the vessel with a round shaped peg. Greyish yellow surface, with black core.
Feature no. 68; S.no. 193; 4.5 cm wild.

40. Handle *(Fig. 12)*.
Fragment of a handle, which was attached to the vessel with a round shaped peg. Brown, grey.
Feature no. 68; S.no. 72; 3 cm wild.

41. Tunnel-like handle *(Fig. 12)*.
Typical handle on bowls. The whole handle broke off from the vessel along a joining surface. This revealed that the potter first made a "bed" by pressing his/her fingers three times into the vessel body, then attached the material of the handle to the vessel, finally made a horizontal hole with some tool.
Feature no. 48; S.no. 51.

42. Large pot *(Fig. 13)*.
Fragment of a finger-impressed rim. Along its fractures, three joining surfaces became available for inspection. The distance between the joining surfaces are 4.8 cm and 2.6 cm. Based on the visible joints and the surely measurable building unit (this latter mentioned 2.6 cm), we can count on four additional joining surfaces (dashed lines in the section), so that the existing fragment has been constructed with seven building units, which were on average 2.5 cm high. Yellowish light brown. Shoving signs of light secondary burning. The interior surface is burnished and worn.
Feature no. 60; S.no. 205; dR.: approx. 50 cm; Wt.: 17–18 mm.

43. Large pot *(Fig. 13)*.
Fragment of a rim with finger-impressed decoration. The lower, horizontal breakage which is in 4.5 cm distance and parallel with the rim, made along a joining surface. The interior surface is orange-brown and worn. The exterior surface is yellowish-whitish-gray, its core is black.
Feature no. 60; S.no. 217; dR.: approx. 45 cm; Wt.: 10–12 mm.

44. Sherd *(Fig. 13)*.
Its upper and lower, horizontal breakages occurred along joining surfaces with a distance of 4.6 cm. Inside yellow, the exterior surface is light brown-orange, its core is black.
Feature no. 77; S.no. 179; Wt.: 11 mm.

45. Sherd *(Fig. 13)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.5 cm. Both surfaces are light brown but its core is black.
Feature no. 60; S.no. 210; Wt.: 10 mm.

46. Sherd of a large vessel *(Fig. 13)*.
Both horizontal fractures were formed along joining surfaces with a distance of 3 cm. Gray.
Feature no. 58; S.no. 61; Wt.: 21 mm.

47. Sherd *(Fig. 13)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.3 cm. The exterior surface is light orange, inside and its core is black.
Feature no. 60; S.no. 206; Wt.: 16 mm.

48. Extra-large storage vessel or pot *(Fig. 13)*.
Neck and rim fragments. The rim is decorated with finger-impressions. Right under the rim, there are horizontally elongated knobs, which are decorated with impressions. Along its fractures, three joining surfaces became visible. The first located 3.5 cm from the edge of the rim. The other two have distances of 7–7 cm. The latter two have double size as the first, so probably both made out of two-two well unified building units each. This double sized distance was taken to the data analysis with a unique mark, to see as a control sample, where it is among the other data *(Fig. 3, Fig. 4, Fig. 6)*. Secondarily burnt. Orange.
Feature no. 60; S.no. 60; dR.: approx. 48 cm; Wt.: 14 mm.

49. Large pot *(Fig. 14)*.
Fragments of a large S-profiled vessel, decorated with four rows of points on the shoulders and net-like pattern on the belly. The larger fragment (which is glued from two big shards) shows three joining surfaces along the horizontal fractures. The first one, slightly below the belly-line on the entire length of the fragment. The second, shortly above the line of the dots. The third is over the entire length of the upper horizontal fracture surface (on the biggest sherd). The distance between the upper two is 2.5 cm. The smaller fragment also has three joining surfaces. One is at the height of the lower line of the dots, where the belly of the pot is the wildest. To put the two sherds cross sections together, three other building units can be defined. The next two below the first is 2.5 cm, the lower is 3.3 cm wild.
Feature no. 141; S.no. 162; Diameter at the belly approximately 45 cm; Wt.: 10 mm.

50. Sherd of an extra-large vessel *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 4.5 cm. The exterior surface is light yellow, inside yellowish grey, the core is black. Worn inside.
Feature no. 13; S.no. 13; Wt.: 18 mm.

51. Sherd *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.2 cm. The exterior surface is orange, inside yellow and its core is black.
Feature no. 60; S.no. 63; Wt.: 13 mm.

51. Sherd *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.2 cm. The exterior surface is orange, inside yellow and its core black.
Feature no. 60; S.no. 63; Wt.: 13 mm.

52. Sherd of an extra-large vessel *(Fig. 2, Fig. 14)*.
Its upper horizontal fracture was formed along a joining surface. On the left side of the sherd another joining surface is visible. The distance between the two joints is 3.4 cm. This sherd was given to Attila Kreiter to take a thick section because the joining surface visible on one side of the fragment is likely to continue in the ceramic fabric where it is intact, so it seemed to be very suitable for targeted inspection to detect any specific pattern in the ceramic fabric. Both surfaces are yellow, the core is grey.
Feature no. 60; S.no. 199; Wt.: 16 mm.

53. Amphora *(Fig. 14)*.
Small sherd of a big amphora. Its neck has a horizontal rib, to its lower side something (big, flat knob or handle?) was attached but broke off along its joining surface. Both horizontal fractures of the sherd were formed along joining surfaces with a distance of 2.5 cm. Lightly secondarily burnt.
Feature no. 68; S.no. 72; Wt.: 16 mm.

54. Sherd *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 5.8 cm. The exterior surface is yellow, inside black.
Feature no. 6; S.no. 6; Wt.: 16 mm.

55. Sherd *(Fig. 14)*.
Both horizontal breakages were formed along joining surfaces with a distance of 5 cm. The exterior surface is yellow, grey and its core black.
Feature no. 28; S.no. 28; Wt.: 16 mm.

56. Sherd of an extra-large vessel *(Fig. 14)*.
On the upper part of the sherd there are two horizontal breakages which were formed along joining surfaces with a distance of 4.5 cm. The exterior surface is yellow, inside black, brownish grey, yellow. Secondarily burnt.
Feature no. 18; S.no. 18; Wt.: 18–20 mm.

57. Sherd *(Fig. 14)*.
Both horizontal breakages were formed along joining surfaces with a distance of 2.5 cm. The exterior surface is light brown, inside black, grey.
Feature no. 10; S.no. 10; Wt.: 8 mm.

58. Sherd of a jar? *(Fig. 14)*.
Both horizontal breakages were formed along joining surfaces with a distance of 1.8 cm. The exterior surface is yellow, brown, inside black.
Feature no. 26; S.no. 26; Wt.: 5 mm.

59. Sherd *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 1.9 cm. The exterior surface is yellow, inside light yellowish grey.
Feature no. 77; S.no. 179; Wt.: 12 mm.

60. Sherd *(Fig. 14)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.4 cm. The exterior surface is yellow, inside black.
Feature no. 77; S.no. 179; Wt.: 11 mm.

61. Neck of an extra-large vessel *(Fig. 14)*.
The fragment has four fractures along its horizontal joining surfaces. Out of the lower three distances, two of them allow to identify the height of the units to be worked on one another. The distance between the lower two joints is 2.4 cm. The distance between the second and third is 3.2 cm. Based on the heights of the lower two building units, it is very likely that there should be one further between the third and fourth (top) joining surfaces, which however did not become visible along the fractures. The distance of them is 4,8 cm, which is double as the first. This double sized distance was taken to the data analysis with a unique mark, to see as a control sample, where it is among the other data *(Fig. 3, Fig. 4, Fig. 6)*.
Feature no. 136; S.no. 155; diameter at the top is 49.5 cm. Wt.: 12–14 mm.

62. Sherd *(Fig. 15)*.
Both horizontal fractures were formed along joining surfaces with a distance of 2.2 cm. The vertical fracture on the right-hand was also formed along a joining surface, which provides very rarely observed data about the end of a building unit (so far there was only one case in Budakalász previously). The exterior surface is yellow, light brown, inside black.
Feature no. 77; S.no. 179; Wt.: 13 mm.

63. Sherd *(Fig. 7, Fig. 15)*.
The interesting thing about this find is that almost half of the outer surface of the fragment has a 2–3 mm thick added layer of daub-like material that has been applied to the surface after the pot has been fired. The exterior surface is yellow, inside black.
Feature no. 13; S.no. 13; Wt.: 15 mm.

64. Bowl *(Fig. 15)*.
A decorated belly fragment of a bowl. Glued from two sherds. All four horizontal fractures were formed along joining surfaces, the distance between the lower two is 1.7 cm. between the upper two is 1.9 cm. Greyish brown.
Feature no. 60; S.no. 206; Wt.: 7 mm.

65. Sherd *(Fig. 15)*.
Both horizontal fractures were formed along joining surfaces with a distance of 4 cm. The exterior surface is red, grey, inside black, grey.
Feature no. 8; S.no. 8; Wt.: 9 mm.

66. Sherd *(Fig. 15)*.
Both horizontal fractures were formed along joining surfaces with a distance of 4.4 cm. The fragment is shaped approximately into a circle with hit marks around its edges. The exterior surface is yellow, inside black.
Feature no. 13; S.no. 13; Wt.: 11–13 mm.

67. Sherd *(Fig. 15)*.
The upper two horizontal fractures were formed along joining surfaces with a distance of 2.3 cm. The exterior surface is yellow, inside black, grey.
Feature no. 9; S.no. 141; Wt.: 13 mm.

68. Sherd *(Fig. 15)*.
All horizontal fractures were formed along joining surfaces. The lower two with a distance of 2.2 cm, the upper two with a distance of 2.5 cm. The exterior surface is light brown, inside black.
Feature no. 68; S.no. 72; Wt.: 14 mm.

69. Sherd *(Fig. 15)*.
Belly of a big vessel. Two horizontal fractures were formed along joining surfaces. The distance between them is 6.4 cm. The exterior surface is light yellow, inside dark grey, its core is black.
Feature no. 44; S.no .46; Wt.: 13 mm.

70. Sherd *(Fig. 15)*.
Belly of a big vessel. The upper fracture were formed along a joining surface. The surface has two finger impressions. Both made probably by a thumb. Both has partially preserved fingerprints. The exterior surface is light yellow, inside yellowish grey, its core is black.
Feature no. 52; S.no. 55; Wt.: 19–20 mm.

71. Sherd *(Fig. 15)*.
Belly of a big vessel. Both horizontal fractures were formed along joining surfaces. The distance between them is 3.9 cm. The exterior surface is black, inside yellowish grey.
Feature 60; S.no. 63; Wt.: 15–17mm

72. Sherd *(Fig. 15)*.
Both horizontal fractures were formed along joining surfaces with a distance of 1.1 cm. Black, but the interior surface is yellowish grey.
Feature no. 10; S.no. 10; Wt.: 8 mm.

73. Sherd *(Fig. 15)*.
Two horizontal fractures were formed along joining surfaces. The distance between them is 2.4 cm. The exterior surface is yellow, inside black.
Feature no. 5; S.no. 5; Wt.: 13–16 mm.

74. Sherd *(Fig. 15)*.
Belly fragment of a pot with net-like decoration. Two horizontal fractures were formed along joining surfaces. The distance between them is 3.3 cm. Other two can be presumed in the ceramic fabric at the same distances at the height of the handle.
Feature no. 60; S.no. 63; Wt.: 13–16 mm.

75. Sherd *(Fig. 15)*.
Belly fragment of a big vessel with a finger-impressed rib. Its both horizontal fractures were formed along joining surfaces with a distance of 6.2 cm. This fragment has another joining surface too, which is a small channel under the rib. The exterior surface is yellow (in an extremely thin section only), inside and the core is black.
Feature no. 6; S.no. 6; Wt.: 15–17 mm.

76. Sherd *(Fig. 15, Fig. 27)*.
Fragment of a big vessel with a large, tunnel-like handle. On its lower part, three horizontal fractures were formed along joining surfaces. These joining surfaces are defining two building units, which are both 2 cm high. On the level of the handle probably two other joining surfaces can be observed in the fabric of the ceramic (dashed lines). The exterior surface is yellow, orange, greyish brown, inside grey, its core is black.
Feature no. 32; S.no. 32; Diameter of the belly, approximately 45 cm; Wt.: 8–14 mm.

77. Amphora *(Fig. 16)*.
Neck fragment glued from two pieces. All horizontal fractures were formed along joining surfaces. The lower two with a distance of 3.7 cm, the upper two with a distance of 5.7 cm. The exterior surface is orange, red, inside yellowish grey. Secondarily burnt.
Feature no. 41; S.no. 41; Wt.: 9–11 mm.

78. Pot *(Fig. 16)*.
Neck and rim fragment glued from its pieces. One horizontal fracture was formed along a joining surface which is located 2.4 cm under the edge of the rim. The exterior greyish brown, inside light brown. Secondarily burnt.
Feature no. 60; S.no. 206; dR.: 16.2 cm; Wt.: 6 mm.

79. Amphora *(Fig. 16)*.
Neck fragment. Two horizontal fractures were formed along joining surfaces. The distance between them is 3.8 cm. Yellow.
Feature no. 56; S.no. 59; Wt.: 8 mm.

80. Jar (?) *(Fig. 16)*.
Rim fragment, with a joining surface, which is located 1.8 cm below from the edge of the rim. Black with yellow patch.
Feature no. 5; S.no. 5; dR.: 11.2 cm; Wt.: 4 mm.

81. Rim *(Fig. 16)*.
Profiled rim fragment with a joining surface, which is located 3.8 cm below the edge of the rim, in the whole length of the sherd. The rim is chipped in one place.
Feature no. 32; S.no. 32; Wt.: 7 mm.

82. Amphora *(Fig. 16, Fig. 29)*.
On each quarter of its shoulder are decorated with 3–3 round, pointy knobs, which are arranged horizontally in a row. Seven joining surfaces became visible along the fractures of the ceramic. The lowest is 3 cm above the edge of the base. The next three are located below the belly. Their distances are 1.2 and 1.3 cm. The three above them were visible at the height of the shoulder. Their distances are 3.4 and 3.2 cm. Beige, yellow, grey, black, patchy.
Feature no. 10; S.no. 10; dB.: 14.4 cm; Wt.: 6–8 mm.

83. Rim *(Fig. 17)*.
Finger-impression decorated rim fragment, with a joining surface, which is located 2.8 cm below the edge of the rim, in the whole length of the sherd. The exterior is yellow, inside and its core is black.
Feature no. 77; S.no. 179; Wt.: 14 mm.

84. Cooking pot *(Fig. 17)*.
Rim with tool impression decorated edge. Right below the rim there is a horizontally elongated knob, which is decorated with tool impressions as well. The right hand side vertical breakage revealed that there is a joining surface under the knob. The potter made a “bed” for the knob by scraping out some of the vessel body, then adjusted the material of the knob there. The exterior is yellow, inside and its core is black.
Feature no. 13; S.no. 13; Wt.: 7 mm.

85. Rim *(Fig. 17)*.
Finger-impression decorated rim fragment, with a joining surface, which is located 3.6 cm below the edge of the rim. Brown, black.
Feature no. 93; S.no. 98; dR.: 24c m; Wt.: 6–9 mm.

86. Rim *(Fig. 17)*.
Finger-impression decorated rim fragment, with a joining surface, which is located 3 cm below the edge of the rim. The exterior is yellowish brown, inside and its core is black.
Feature no. 60; S.no. 63; Wt.: 12 mm.

87. Rim *(Fig. 17)*.
Its horizontal breakage occurred along a joining surface, which is located 3.7 cm below the edge of the rim. Brownish grey.
Feature no. 9; S.no. 9; Wt.: 6–8 mm.

88. Rim of a bowl? *(Fig. 17)*.
Decorated under the rim’s edge with a series of tool impressions arranged in a horizontal line. Its breakage parallel with the rim is formed along a joining surface which is in 2.9 cm distance from the edge of the rim. Beige ash-grey.
Feature no. 82; S.no. 87; Wt.: 6–8 mm.

89. Sherd *(Fig. 17, Fig. 28)*.
Belly of a big vessel. Both horizontal fractures were formed along joining surfaces. Their distance is 6.5 cm. Both surfaces has finger impressions. All made most likely by thumb. The upper series are the actual negatives of finger imprints, the lower two are imprints of the imprints. On the exterior surface there is a thin layer of added coating. Both surfaces are yellow, its core is black.
Feature no. 32; S.no. 32; Wt.: 12 mm.

90. Rim *(Fig. 17)*.
The edge of the rim is decorated with finger impressions. Two breakages occurred along horizontal joining surfaces. One is located 4.3 cm below the edge of the rim. The other is 4.4 cm below the previous. The exterior surface seems has a white coating. Inside light yellow.
Feature no. 60; S.no. 225; Wt.: 11–15 mm.

91. Large vessel *(Fig. 17)*.
There is a rib with finger-impressed decoration on the shoulder. Under the rib there is a joining surface, which shows that the potter made a small channel as a “bed” to attach the rib on the illustrated fragment but the other has no such a dich. The lower horizontal breakage line of the find formed along a joining surface. On its whole length, there are imprints of finger impressions. All made most likely by the thumb

of the potter. Orange, light brown, gray, black patches in a flame like pattern. The surface is white at some part in an extremely thin section.
Feature no. 55; S.no. 197; Wt.: 18–20 mm; Inv. no. 2010.8.197.97.

92. Large pot *(Fig. 18, Figs 25–26).*
Decorated neck and rim fragments of a big pot. Right under the rim, two rows of short vertical lines running around. Under this decoration, there are vertical lines, about 5 cm in distance from each other. Between these lines oblique, parallel scratched lines nearly in 45 degree are filling these "panels" alternately slope in opposite directions. Based on its shape and decoration, it can be connected to the Coțofeni culture. One sherd has two long, horizontal fractures formed along joining surfaces which are in 3.3 cm distance. On the bigger fragment, (glued from four sherds), three joining surfaces are observable. The distance between the lower two is 3.5 cm, between the middle two is 2.2 cm, and the upper is located 4.8 cm below the edge of the rim. This last one is double ads the second, so it was taken to the data analysis with a unique mark, to see as a control sample, where it is among the other data *(Fig. 3, Fig. 4, Fig. 6).* The exterior surface is light brown, inside black.
Feature no. 68; S.no. 72 ; dB. approximately 50 cm, Wt.: 6–8 mm.

93. Bowl *(Fig. 18).*
Rim and belly fragment with tunnel-like handle. Decorated with tool imprints which are arranged in two horizontal rows on the belly. These two rows of impressions are turning down into vertical direction on both sides of the handle. Also there are oblique tool imprints on the edge of the rim. One joining surface was observable on this find, which is located 3.1 cm below the edge of the rim. Grey, black, yellow, patchy.
Feature no. 68; S.no. 72; dB.: 19.5 cm; Wt.: 4–6 mm.

94. Bowl *(Fig. 18).*
Rim and belly fragment. Decorated with tool imprints which are arranged in a horizontal row on the belly. On the edge of the rim there are oblique tool imprints. One joining surface was observable on this find, which is located 4 cm below the edge of the rim. Greyish yellow.
Feature no. 60; S.no. 204; Wt.: 4–5 mm.

95. Amphora *(Fig. 18).*
Shoulder fragment with a big, flat knob, decorated with horizontal and vertical rows of impressed dots. The knob broke off along a joining surface. Here on the shoulder was observable two vertical and three horizontal lines scratched in the surface before the knob was attached. Black with reddish-brown patches.
Feature no. 84; S.no. 89; Wt.: 8–11 mm.

96. Secondarily used sherd, tool? *(Fig. 18).*
Sherd of a big vessel. Its edges are strongly abraded, at two opposite parts. On one side a 9 cm long, nicely curved line was formed, the edges here are nicely rounded. On the opposite side the same can be observed on a 2.5 cm long area. Brown.
Feature no. 23; S.no. 165; Wt.: 10 mm.

97. Secondarily used sherd, tool? *(Fig. 18).*
Sherd of a big vessel, which formed with hits about a round shape. Its edges all around lightly abraded. The exterior surface is white, yellow, inside black.
Feature no. 9; S.no. 141; Wt.: 15–16 mm.

98. Secondarily used sherd, tool? *(Fig. 18).*
Sherd of a big vessel, which formed in an oval shape. Its edges all around lightly abraded, in some part moderately abraded. The exterior surface is black, inside grey, yellow.
Feature no. 68; S.no. 72; Wt.: 15–16 mm.

99. Secondarily used sherd, tool? *(Fig. 18).*
Sherd of a big vessel. Its edge strongly abraded in a 8 cm long area, where a nicely curved line was formed, the breakage surfaces here are nicely rounded. The exterior surface is brown, orange, yellow, grey patchy, inside black.
Feature no. 6; S.no. 6; Wt.: 11–12 mm.

100. Amphora *(Fig. 19)*.
Neck fragment. The rim of the vessel was damaged during its use. Later the neck intentionally broke off all around in the same level. Then the breakage surface abraded.
From east of Feature no. 151; S.no. 187; Wt.: 8 mm.

101. Cup *(Fig. 19)*.
Rim, neck, belly fragments of a cup. Its handle broke off during its use. One drilled hole was made on the neck, 1 cm under the rim, at the side of the handle. Probably a rope was attached here to replace the function of the handle.
Feature no. 56; S.no. 56; dR.: 5.2 cm.

102. Cup *(Fig. 19)*.
It has a cylindrical neck and a slightly pressed body. Decorated with vertical fluting on its belly. Its rim is chipped at two places, those damaged surfaces and the whole rim is worn.
Feature no. 58; S.no. 61; dB.: 3 cm; H.: 5.8 cm; dR.: 5.2 cm; Wt.: 3–5 mm; Inv. no. 2010.8.61.83.

103. Jar *(Fig. 19)*.
It has a long, cylindrical neck, pressed body. Probably during its firing, small bursts occurred on its rim and its belly. Its rim is lightly worn.
Feature no. 57; S.no. 66; dB.: 4 cm; H.: 10.2 cm; dR.: 8 cm; Wt.: 3–6 mm.

104. Cup *(Fig. 19)*.
It has a cylindrical neck and a slightly pressed body. Decorated with vertical fluting on its belly. Its handle broke off during its use. The biggest part of the rim is chipped, damaged, only 4 cm is intact on the right side of the handle. The handle was attached at its base by a round handle-peg to the vessel body. The upper end of the handle was attached to the inner surface of the rim, here is a joining surface which shows 7 mm overlapping. Two drilled holes were made on the neck, both right under the rim, and none of them perforated the wall of the vessel.
Feature no. 77; S.no. 179; dB.: 3 cm; H.: 6.2 cm; dR.: 4.8 cm; Wt.: 3–5 mm.

105. Divided bowl *(Figs 19–21)*.
This piece is differ from the well known type of these bowls. It has a simple conical shape instead of an inverted rim. Also the position of the divider wall is unique, instead of separating the vessel into two third and one third, it is at the middle of the vessel and creating two equal spaces in the bowl. Its buttons on the top of the junction of the divider wall and the rim are simple knobs, with finger impressed small hollow on them, instead of big, flat, disk-like round buttons. The edge of the rim and the dividing wall is decorated with tool imprints. There is a horizontally elongated knob on the exterior, under one of the buttons. To have a knob on this type of bowl is also unique, instead of a handle, and its position too, because the handles normally placed at the perpendicular axis of the dividing wall at the side of the smallest divided part. On both exterior sides, where the dividing wall joins the vessel-body, there are small channels from the base to the rim; these are also unique, since at these junctions usually vertical ribs are placed. The dividing wall is cracked around its middle, during drying, because this crack is 3.5 mm wild. On the interior surface of the bowl, there is a cereal chaff leaf imprint, close to the base. On the opposite side of the vessel, on the exterior surface there is a grain imprint. Inside beige, yellowish, the exterior is blac, brown, yellow, orange patchy in a flame pattern.
Feature no. 9; S.no. 140; dB.: 8.4 cm; H.: 10 cm; dR.: 21 cm; Wt.: 4–10 mm; Inv. no. 2010.8.140.1.

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