The Early Neolithic settlement of Tășnad-Sere (Satu Mare county, north-western Romania).

The UCL excavations (2012-2019)

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***Cuvinte cheie**: neolitic timpuriu, așezare plană, metode de săpătură, nivel de ocupare, gropi și gropi de stîlpi*

Rezumat

În vara anului 2012, Ulrike Sommer (University College London, Marea Britanie), a demarat o săpătură arheologică în situl neolitic timpuriu de la Tășnad-Sere în colaborare cu Ciprian Astaloș și Cristian Virag (Muzeul Județean Satu Mare). Săpăturile s-au încheiat în 2019 după opt campanii de săpături a câte șase săptămâni. Cu cca. 17000 obiecte descoperite și înregistrate tridimensional, evaluarea finală a cercetărilor va mai lua timp. În prezentul articol sunt raportate complexele descoperite și oferim o scurtă descriere a obiectivelor cercetării și a metodelor de săpătură.

Introduction

In the summer of 2012, Ulrike Sommer from University College London started a joint excavation with the Muzeul Județean Satu Mare; the local representatives were Ciprian Astaloș and Cristian Virag. The excavations finished in August 2019 after eight six-week seasons each year. With ca. 17.000 finds with a three-dimensionally recorded provenance, the final assessment of the excavation will take some time. In the present report, we will report the features uncovered and give a short discussion of the objectives of our excavation as well as the methods used accordingly.

The aims of the excavation were twofold: to understand the adaptation of incoming agricultural population to changed environmental conditions, and to understand the depositional processes operating in early Neolithic open settlements.

1. The adaptation of early Neolithic populations to a new environment

Tășnad-Sere is located on the boundary between two ecotopes: the hills of the Dealurile de Vest in the East and the Great Hungarian Plain in the west. A number of other early Neolithic settlements in Northwest Romania are located in a similar position, for example Homorodu de Sus[1] (Fig. 1).

There are two theories on the mechanisms for the first Neolithic settlement of the Upper Tisza region: (1) following the Danube to the west and then up the Tisza; and (2) from Central Transylvania, where Gura Baciului near Cluj is still the earliest Neolithic settlement in Romania, and through the valleys of Zalău and the Crasna etc.[2] to the North and West. In both cases, the foothills of the Carpathian Mountains would have been the location where the cultivation methods originally developed in a dry, steppe type climate with winter rain were adapted to the different conditions found in the Pannonian Plain and generally in the more temperate and wet environment of Central Europe with a higher amount of summer rainfall[3] (p. #3).

The Great Hungarian Plain was a predominantly swampy area till the drainage works started by Joseph II of Austria. Especially the areas of the Northern Tisa and the Bodrog form a complex network of dunefields and former swamps even today. The Ier-marshes southwest of Carei were famous for their eels in the 19th century and were completely drained only in 1960s. L. Marta[4] has suggested that the distribution of Bronze Age tells round the Ier-marshes indicates the use and control of these rich aquatic or rather palustrine resources by local elites, which strikingly illustrates the productivity of the marshes.

The plain was also an excellent hunting ground, with wild cattle, red and roe deer in the gallery forests as well as wild horses, wild asses and hares in the open plain.

The inundated areas would have been unsuitable for sheep and goats[5], but provided rich forage for cows and also pigs. The water-chestnut is still common today in areas like the Hortobágy (Fig. 2) and would have been an easily harvested source of carbohydrates for humans and pigs. Remains of *Trapa natans* are as yet unknown from early Neolithic settlements in the Carpathian basin, but have been regularly found in the circumalpine lakeshore settlements[6] and in several sites in Serbia and Montenegro, among them the Vinča settlements of Opovo and Gomolava[7].

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1 Bader 1968.
2 Lazarovici 1980, Lazarovici/Lazarovici 2011, Virag 2005, Luca/Suciu/Dumitrescu-Chioar 2011.
3 see Kertész/Sümegi 2001; Банффи 2014 for a detailed discussion of the influence of the environment on the spread of the SCK in general.
4 Marta el al. 2010.
5 Ivanova et al. 2018, 12.
6 Heer 1865; Karg 1996; Karg 2006; Tolar et al. 2011.
7 Borojević 2009.

There would have been extremely limited space for growing cereals, restricted almost completely to the levees of the rivers[8]. Big fields are not to be expected before the introduction of the plough in the Baden-Horizon[9]. Cereals adapted to wetter conditions, like rye and oats were only domesticated in the Late Bronze- and Iron age, but a change in the ratios of hulled to free-threshing cereals is to be expected[10], with hulled cereals having a better resistance to rust and other diseases[11].

The Neolithic economy arose on the "hilly flanks of the Fertile Crescent" as Braidwood[12] memorably put it, and spread to western Turkey, Greece and the Balkan Peninsula from there. The domesticates brought to Europe[13] are also of Near Eastern origin. This is evidenced by the distribution of the wild progenitors of these crops, as well as genetic studies. Wild forms of domestic cereals have also been found in Greece[14] and wild legumes were used, for example, in several Mesolithic sites in southern France[15], as well as in Spain[16] and the Argolis[17]. There is no indication, however, that these local resources were taken into cultivation by the incomers[18]. According to genetic studies, the einkorn of the Neolithic farmers originated in SE-Turkey[19]. Comparable studies of the pulses are still missing, but the Early Neolithic grains were larger on average[20]. The present archaeobotanical record would indicate that the number of domesticates, especially of pulses in use was severely reduced during the spread to the Central- and Northwestern Europe[21]. Only in Spain a broad range of pulses is found[22], but then, everything but cereals is notoriously under-represented in the archaeobotanical record.

The wild progenitors of sheep and goats are restricted to the western Zagros[23] and eastern Anatolia[24], while wild cattle and wild pigs also occur locally across most of Europe. S. Bökönyi[25] (1962, 1974) has indeed argued for a local domestication of cattle, but genetic studies

[8] Whittle 2007.
[9] see Bogaart 2004 for the LBK; Bogucki 1993, Fansa/Burmeister 2004 for the use of draught animals.
[10] Conolly et al. 2008
[11] Dreslerová et al. 2017, 523.
[12] Braidwood 1948, 108ff.
[13] Zohary/Hopf's 1988 "founder crops".
[14] Franchti, wild einkorn: Hansen 1991; Hansen/Refrew 1978, wild barley: Asouti/Ntinou/Kabukcu 2018, 12
[15] Abeurador: Vacquer et al. 1986; Dourgne, Sapètre: Marinval 1986, van Willingen 2006, 93-94, Gehlen 2010, 673.
[16] Cave Santa Maira: Aura et al. 2005.
[17] Franchthi: Asouti/Ntinou/Kabukcu 2018, 13.
[18] contra Kislev 1989.
[19] Kilian et al. 2007, Pourkheirandish et al. 2018.
[20] Franchthi: Hansen 1991.
[21] Coward et al. 2008; Marinova/Valamoti 2014; Kreuz/Marinova 2017.
[22] Stika 2005.
[23] Zeder/Hesse 2000, Gade 2000.
[24] Naderi et al. 2008, Daly et al. 2018.
[25] Bökönyi 1962, 1974.

have now shown that bovids were brought from the Near East in a domesticated state[26]. Only the pigs show a strong inbreeding of local wild populations[27].

Sheep and goat normally dominate early Neolithic assemblages both in Anatolia and SE-Europe[28]. Sheep may have been easier to control before the size reduction of cattle[29], although primitive breeds like the Soay are both more agile and much more unruly than modern sheep. Sheep also provide more manageable amounts of meat when butchered and reproduce faster than cattle.

Sheep and goat are both adapted to open, hilly to mountainous territories. The dense dark woodlands of Central Europe would have offered very limited forage, especially for sheep, before extensive woodland managing techniques came into being. Other than that, only very limited open meadows would have been available, mainly on the banks of rivers or above the treeline in the mountains, an area that is outside the early Neolithic settlement area. There is evidence for coppicing from 4300 in Central Europe[30] and ca. 3800 BC in Britain[31], but that would have provided fodder for cattle rather than sheep.

However, there are strong indications that the mountains were used if not permanently settled during the LBK, based on the evidence for from mining[32]. Isotopic studies of both cows and male humans[33] indicate regular transhumance to the hills bordering the loess plains, a result that is supported by pollen evidence. There is no reason why the same may not have been true for the SCK. There is evidence for SCK-presence in the foothills of the Carpathians, while lithic raw materials, which partly originate from trans-montane areas[34] indicate that the mountains were crossed as well.

There is a visible adaptation to the local climatic conditions in Hungary in the Middle Neolithic (LBK/Vinča-Horizon), with an increase in cows and pigs[35], and it is this type of economy that is is then transmitted to Central Europe with the spread of the LBK[36].

2. The archaeological taphonomy of Neolithic flat settlements

[26] Troy et al. 2001, Bollongino 2006, Scheu et al. 2008, Ajmone-Marsan/Garcia/Lenstra 2010; Pitt et al. 2019
[27] Frantz et al. 2015, 2019.
[28] Conolly et al. 2011.
[29] Manning et al. 2013b.
[30] Billamboz 2014; Jacomet et al. 2016.
[31] Etton: Pryor 1998, fig. 141.
[32] Haematite: Zimmermann/Goldenberg 1991, Goldenberg/Kaiser/Maass 1998; Goldenberg et al. 2003.
[33] Knipper 2009, 2011; Bentley/Knipper 2005.
[34] Chmielewski/Astaloș 2015.
[35] Bökönyi 1974; Bartosiewicz 2005, 2012.
[36] Manning et al. 2013a; Ivanova et al. 2018.

The previous rescue excavations of the Satu Mare museum in Tășnad Sere, directed by C. Virag and C. Astaloș had uncovered a substantial "occupation layer" above the pits and postholes that are traditionally used to reconstruct early Neolithic houses. Occupation layers are quite common in Southeast-European flat settlements and, of course, in tells. Further west, in Central Europe, they are only occasionally found in the LBK[37], for example in Altdorf-Aich, Bavaria[38], Bottmingen Bruderholz, Kt. Basel[39], Clieben, Saxony[40], Hanau Klein Auheim, Hesse[41], Jablines, Île de France[42], Kitzingen Mühlberg, Bavaria[43] Kilianstädten, Hesse[44], Olszanica[45], Prellenkirchen, Niederösterreich[46], and in Echilleuses, from the Villeneuve-Saint-Germain group[47]. All in all, they are probably more common than generally acknowledged, but often removed undocumented. There are a number of LBK-settlements where a large volume of finds came from the "ploughsoil", for example Bietigheim-Bissingen, Baden-Württemberg (personal observation). In Jablines, 72% of all finds originate from the occupation layer[48]. In some cases, the distribution of finds in an occupation layer is recorded spatially and used to interpret the use of houses and settlement areas, but often the finds are treated as unstratified and their provenance is only recorded in a very coarse grid or not at all.

Finds in pits, on the other hand, are regarded as stratified. Excavations in layers is extremely difficult for early Neolithic pits, as the fill is normally very dark or completely black due to the presence of chernozem on the surface and a substrate that is also rich in humus. Sometimes, a slightly lighter sediment is observable in the upper part of a pit, but normally, burnt layers are the only layers clearly visible at all. They tend to indicate that the infills of the pits often have a concave shape. In spite of this, pit-fills are often treated as a stratigraphic unit, or the provenance if finds is only recorded by the position in relation to the section and in artificial spits of varying depth[49].

Often, houses without preserved floor surface, i.e. assemblages of postholes, are dated by the contents of adjacent pits, or the pit-fills are used as the basis for the settlement chronology in

[37] Stäuble/Wolfram 2012.
[38] Euler 2011.
[39] d'Aujourd-Hui 1965, 67.
[40] Steinmann 2010.
[41] Sommer 2006, Wolfram 2008.
[42] Hachem 2000, 308.
[43] Endrich 1952, 17 and Taf. 5.
[44] Gallay 1991.
[45] Milisauskas 1976; Milisauskas 1986; Milisauskas/Kruk 1993, 72-75.
[46] Ruttkay/Wessely/Wolff 1976, 846.
[47] Hachem 2000, 308.
[48] Hachem 2000, 308.
[49] Stäuble 1997, For a general discussion, see Petrasch/Stäuble 2016.

general, especially since seriation and PCA have become a common tool for chronological analysis[50]. These analyses rest on several assumptions. In the case of pitfills, it is either assumed that depth equates age in horizontally deposited layers, or that all the finds in a pit are more or less contemporary. In a second step, it is assumed that finds in a pit are contemporary with the adjacent house and, indeed, only originate from one specific house. In some cases, different types of pits are considered separately. L. Hachem[51] has suggested the existence of social rules on where to deposit specific types of refuse.

However, there are several ways finds can get into pits:

1. Pits are dug to depose of rubbish and deliberately filled in with the rubbish of the adjacent house by its inhabitants

2. Pits are dug for other purposes (storage, or the extraction of building materials) and used for the disposal of rubbish once they become defunct, either during or after the uselife of the adjacent house by the inhabitants of other houses

3. Pits are dug for other purposes and get backfilled by erosion once they have become defunct.

The formation of "occupations layers" is also rarely discussed in any detail. The following options are possible:

1. Rubbish is dropped "in situ", that is, in the place it originated, and stays there. This option was considered by Lüning[52] for the fill of the Schernau pit-houses (Bischheim culture).

2 Disposal of rubbish outside the houses, which then either stays in situ or is moved around by various processes, including treadage, rooting animals and small-scale erosion

3 Rubbish deposited on the surface is moved about by major erosion processes or water-action.

Of course, a combination of the above processes is also possible and, indeed, probable.

In addition, materials can be separated prior to discard[53], for example, by reuse-value/intended re-use, potential danger, nuisance and size[54]. Rubbish disposal can be organized on a household level or on the level of the whole settlement[55]. In contrast, differences in pit-assemblages could also simply be caused by the distance to an activity area and not be related to any maintenance

[50] Schwerdtner 2007
[51] Hachem 2000, 310.
[52] Lüning 1981.
[53] e. g., Hoppe/Kuhlmann 2012.
[54] for a detailed treatment, see Sommer 1991.
[55] Fritsch 1998.

activities at all, with the assumption that the pit-contents are simply a sample of in situ-surface material or caused by "minimal movement" or expenditure[56].

As variously discussed[57], the organisation of rubbish disposal depends on diverse factors, among which the intended length of stay, the amount and nature of rubbish produced, density of settlement and cultural attitudes to rubbish seem to be the most important. A "rational" attitude to the treatment of rubbish is often counteracted by sheer laziness. Cultural rules and habituation has to be set in motion in order to ensure appropriate behaviour[58].

In the absence of visible layers, one of the few methods to assess the amount of movement of artefacts after they broke, and thus, by implication, the treatment of rubbish is by refitting[59]. There are very few studies of refitting of LBK objects, as the refitting rate tends to be very low[60], which points to a very low preservation rate in pits. In addition, the soft fabric of early Neolithic pottery and their often quite worn edges make secure fits[61] very difficult.

In Palaeolithic archaeology, the orientation and inclination of finds is routinely used to understand depositional processes. If the long axes of finds points predominantly in one direction, this can indicate fluvial action or gelifluction, and the angle of artefacts in relation to the prehistoric surface can indicate trampling. As the clay soil at Tăşnad develops deep cracks in summer, any artefacts with a near to 90° angle to the horizontal could have fallen down a crack and may have to be excluded from further analysis.

When looking at pits, the orientation and inclination of finds should allow a separation between "placed" finds (flat), and finds incorporated in the soil eroding into a pit. In practice, the interpretation is more complicated, as the surface of a pit at a specific point in time can have been uneven, and the pit may have contained organic artefacts that affected the orientation of inorganic finds before their complete decomposition. If artefacts got into pits by erosion, their inclination should be broadly similar and follow the orientation of the layers of soil being washed into a pit.

Site and size-distribution of sherds and burnt clay is also a good indication for the exposure to trampling. The smaller sherds are on average, the longer they can be assumed to have been exposed on the surface. Size should thus help to differentiate between primary, secondary and residual deposits and help to identify the intensity of trampling. Breaking a pot will produce

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[56] Müller 2009, 196, "Grundannahme der kurzen Wege".
[57] Hodder 1982, Sommer 1991, Sommer 1998.
[58] Sommer 1998, Elias 1939.
[59] Cziesla et al 1990, Nagy 1999.
[60] Drew 1988, de Grooth 1988, Kloos 1997, Claßen 2005, fig. 2.
[61] Zusammenpassungen, cf. Cziesla et al. 1990.

small sherds, but also quite large ones; thus an untrampled broken pot will have a much larger variance of sherd-sizes than a residual assemblage. Assuming that artefacts in pits were not subjected to further mechanical stress, the size and size variation of sherds in pits should indicate at which stage in their post-breakage live they got there. Rounding of sherd edges and surface erosion are also indicative of time spent on the surface, however, rounding is difficult to quantify, and the drying clay soil of the site tends to pull off the surface of pottery, so we could not use the latter trait.

We are recording sherd weight and thickness for every find. The relation between weight and thickness can be used as a proxy for surface area, provided that there are no big differences in the types of clay used or clay preparation, which does not seem to be the case in the SKC[62]. B. Vindrola[63] has developed a method to automatically calculate surface area and the roundedness of sherd shapes from photographs. This method will be applied to all finds from the UCL-trench and should be very useful for elucideating the taphonomic history of this area. In addition, the microstratigraphy of finds, which was routinely recorded for every excavated square should help to decide whether artefacts broke in situ or were deposited as sherds - for example, in a basket as part of the general refuse from housekeeping activities.

The excavation

The UCL-Trench at Tășnad Sere was dug as part of a rescue excavation, but also included the research objectives outlined above from the very beginning. The site of Tășnad Sere was chosen because excavations by the Museum in Carei and later rescue excavations by the Museum Satu Mare had been going on since 2001 (Fig. 3). The results included the discovery of three houses in 2009[64]. This meant that the site was already comparatively well-known and remains of SKC houses were definitely located nearby. We thus hoped to avoid problems in the interpretation of a very fine-grained excavation without any knowledge of the bigger picture, which made, for example, the understanding of the excavation results in Ecsegfalva[65] rather difficult.

The area on the right bank of the Cehal canal had already been explored by N. Iercoșan[66] in 1989. It was in no immediate danger of being built over for further touristic development, as it is located on the flood plain and is owned by the town. However, it may be eventually redeveloped as part of the general spa area.

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[62] Spataro 2008, 2011, Spataro et al. 2019.
[63] Vindrola Padros et al. 2019.
[64] Virag 2015.
[65] Whittle 2007.
[66] Iercoșan 1995.

The Neolithic occupation layer is covered by ca. 1.5 m of alluvium (Fig. 4). This can be divided into two layers by colour. This division is accompanied by changes in soil chemistry as well[67]. The occupation layer is visible as a dark grey to black layer of ca. 30 cm thickness. It sits on the dark-yellowish bleached (Sw)-horizon of a pseudo-gley. The bottom of the occupation layer is not perceptible at all during excavation, but the lower parts of the black and clayey layer are more or less devoid of finds. Presumably, humus was washed down from the occupation horizon into the natural. The boundary between the two is also masked by numerous concretions of iron- and manganese-oxides and big worm-casts. Neither postholes nor pits are visible in the occupation layer or this transitional layer, they only become visible once it has been removed. Sometimes their position is indicated by finds at a level when the surrounding area is already devoid of artefacts.

Methods

Our excavation methods were geared to answer the taphonomic questions outlined above. We adapted practices commonly in Palaeolithic cave excavations, as described, for example, by J. Hahn for the Upper Palaeolithic site of Geißenklösterle, Germany[68] for our purpose.

The 8x10 m trench was divided into m^2-squares, which were excavated in 5 cm spits (Fig. 5), unless actual layers or features could be observed, in which case the features were excavated separately, but keeping up the spit and square system. In order to make sure that no features were missed, the surface was periodically cleaned once the same spit-level was reached in a larger area. During the excavation, the spit-heights were controlled using nails at the corners of the squares as level pegs, which were set at specific heights and checked before the excavation of any spit commenced. Due to different speed of excavation, the level pegs of one square could be at different spit-heights, which tended to cause considerable confusion. As the excavation progressed, nails had to be driven deeper, which may have slightly changed their position.

The documentation was based on a modified MOLAS-System[69], that is, single context recording, but each square and spit was documented separately and a record for the whole site was created as well. Features were normally half-sectioned according to the continental recording system and received a separate number.

Excavation was done by trowel inside the occupation layer and by spade and shovel in the upper, dark parts of the natural. All finds >1 cm were left in situ and documented by planning

[67] Sommer/Amicone/Chernysheva 2019.
[68] Hahn 1988.
[69] Museum of London 1994.

in 1:10, by a photogrammetric record for each excavated square and with the total station. Each find received a separate number, marked on the plan, corresponding to the automatically created number on the total station, and label which recorded orientation and inclination of the find as well as the date and excavator. Finds smaller than 1 cm and finds accidentally displaced during excavation were registered by square and spit only. A 10 l archaeobotanical sample was taken from each square and spit and processed by bucket flotation. In addition, soil samples were taken for basic soil characterization, future phytolith analysis and soil chemistry and microbiology. We also took micromorphology samples from postholes, pits, and the interface between alluvium II and the occupation layer as well as the occupation layer and the natural.

The excavation was mainly done by undergraduate students from UCL, with a few students from other universities joining the excavation. For many students, this was their first real excavation, and many struggled with the recording system. As a result, the data for artefact orientation from the first three years of excavation are very coarse[70]. The excavation also took far longer than originally envisaged.

The local soil at the site is a heavy alluvial clay deposited by the Cehal. While this sediment presented some advantages in terms of preservation of chemical and microbiological information (see below), it is very difficult to excavate. When dried out, it is far too hard to work with a trowel. It forms surface crusts between 1-2 cm thick, which will come off as one during excavation and make the detailed excavation of spits and finds impossible, especially for inexperienced diggers. It also develops cracks, which can easily break apart freshly excavated pottery. In the first year of excavation, we left the trench open and watered it copiously from the Cehal-channel every evening. This posed the danger of contamination and was also not very effective, as the water simply puddled at the lowest point of the trench. In the following years, individual squares were watered with clean water in the evenings and during the breaks, and the whole trench was covered in plastic sheets to prevent evaporation. This kept the soil in workable condition. The constant wetting and drying may have contributed to the deterioration of the condition of the sherds, and we have not found any method to prevent the peeling off of their surface. Several samples were taken from the sherd impression in order to preserve the outermost surface of the pots, but have not been analysed yet.

Features

The UCL trench contained a pit in the SW-corner. The trench was therefore extended to the south, but the pit still could not be excavated in its entirety. The pit was ca. 0.5 m deeper than

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[70] Sommer/Astaloș 2015.

the occupation layer. We also uncovered two rows of postholes and several single postholes (Fig. 6). The postholes are generally quite small, between 20-30 cm in diameter and rather shallow (Fig. 7). They would be quite easy to miss under the conditions of a rescue excavation, which may help to explain the general rarity of house-plans in the Upper Tisa region.

A rather enigmatic linear feature ran across the north-eastern part of the site (Fig. 8, ca. 40 wide and 30 cm deep. The fill of middle-grey silty clay was sharply delineated in the upper parts, getting more indistinct towards the bottom due to worm-action and leaching. It was rather poor in finds. The section was cleaned back beyond the trench proper to clarify its stratigraphic position. The feature is overlain by the alluvial layers (Fig. 9). It forms an angle of about 70° to the row of posts. Its interpretation is unclear, the sharp edges do not fit the normal appearance of a ditch. The soil is much less clayey than the occupation layer, and it seems too narrow for a mudbrick wall. Maybe it indicates the position of a sleeper beam.

Despite large scale flotation, very few carbonized plant remains were recovered. Adhering clay particles may prevent charred remains from floating, but there were almost no plant remains in the heavy fraction either, and the processing by Petér Pomazi using the "wash-over method"[71] also yielded extremely few seeds. While the light charcoal may have been removed by water action, this should not have happened in the lower parts of the occupation layer and the pit. Another possibility is that the changing moisture-content of the soil, with annual swelling and shrinking may have crushed the fragile charred remains[72].

As there are numerous impressions of cereal grains and chaff on the pottery, cereals were definitely processed on the site. Assuming that most carbonized remains are produced by burning the waste from crop processing, there are several reasons why no carbonized remains were found:

-there were few cereals present on the site

-the waste was not burned, but used as fodder

-crop processing was done outside the settlement[73], which is especially common for free-threshing cereals[74], or there was a sharp separation of activity areas inside the settlement. The lack of micro-refuse from lithic reduction may support this assumption.

-crop processing without parching[75].

[71] Kreuz/Marinova 2017, 644.
[72] cf. Asouti/Ntinou/Kabukcu 2018.
[73] Bouby et al. 2019, 28.
[74] Ivanova et al. 2018, 647.
[75] Bouby et al. 2019, 28; Antolín 2016.

Bone-preservation was good in the deeper layers of the pits discovered during the rescue excavations. In the UCL-trench, however, bone preservation was generally rather poor. Bones were rare, and the few pieces encountered were very fragile; often it was impossible to recover them. The soil is slightly alkaline, thus the bad preservation is probably caused by leaching by fluctuating ground-water. The finds-distribution by depth suggests that spit 8 and below offered the best conditions for bone preservation.

An analysis of all the animal bones from the site by Georgeta El Susi[76] shows that 41,7% of the animal bones from the whole site were from wild species, which is a very high value but comparable to other sites in the Hungarian plain[77].

New methods developed

Elena Chernycheva[78] joined the excavation in 2015. She introduced systematic sampling for soil chemistry and microbiology. Four soil samples were taken from each square in spit 8 for the whole trench. Not all of them have been analysed yet, but the samples from the western part of the trench show interesting results[79], with higher values of organic C, Ca, S, P and N indicating areas were organic refuse was concentrated (Fig. 10). In addition, Chernycheva identified lipophagic and thermophilic bacteria in the area surrounding pit 1. From 2016 onwards, we have taken soil samples from every square and spit, but the analysis has not yet been conducted.

As the trench had been watered with water from the Cehal channel in 2012, there was always a probability of contamination. Therefore, a small test-trench was dug in 2017 north of the main UCL-trench, adjacent to Iercoșan's old trench from 1989, to get a fresh section and take a column of uncontaminated soil-samples as well as replacement micro-morphological samples.

Silvia Amicone[80] has analysed thin-sections of pottery samples and also phytoliths embedded in the pottery. These may be helpful in identifying the season of pottery production.

Marina Paraskova (UCL) conducted an analysis of postholes for her MSc dissertation. They turned out to have the same chemical composition as the occupation layer, which indicates that they were filled with soil from the occupation layer, which unfortunately means that it will not be possible to detect postholes in the occupation layer by using the p-xrf, which would make

[76] El Susi 2018.
[77] Vörös 1980, Ivanova 2018.
[78] Elena Chernycheva, Institute of Physicochemical and Biological Problems of Soil Science, Russian Academy of Sciences, Pushchino.
[79] Sommer/Amicone/Chernysheva 2019.
[80] Silvia Amicone, CCA-BW, Angewandte Mineralogie, Eberhard Karls Universität Tübingen, Tübingen. See Sommer/Amicone/Chernysheva 2019.

excavation so much faster. It also means that the finds in the postholes most probably derive from the occupation layer and thus cannot be used for dating puposes.
A P-xrf analysis of a soil column from the southern section of the trench was done in 2015[81] and supported the optical assessment of the stratigraphy. A second set of samples from test-trench 7 was taken in 2017.

Results

Now that the excavation has finished, the systematic analysis of finds and finds distributions can start. It is already clear that the distribution of the finds in the occupation layer is not homogeneous. Concentrations of finds were encountered about 1-1,5 m distant from each other at varying depths. Their size could indicate separate dumping events of rubbish, maybe from a basket. Very often, these concentrations are dominated by the remains of one pot, but also contain sherds of other pots, characterised by a different colour, as well as some lithic refuse and hearth remains. The sherds of the different pots tend to be mixed and also intercalated microstratigraphically. The breakage of one specific pot may thus have initiated cleaning episodes. Obviously, the refuse cannot be connected to any house, given the size of our trench, but it seems likely that it was deposited on an empty plot. If this interpretation is correct, these dumping events would represent mini-Pompeii events, as all the finds in a concentration were deposited at exactly the same moment in time (taphocoenosis) and originate from the same area. There were several almost complete pots, most of them located near the bottom of the occupation layer on what may have been the original ground surface (Fig. 11).
The pottery in the pits seems to be better preserved than in the occupation layer, which may indicate some deposition of secondary refuse. But this needs to be investigated systematically. Chernycheva's results indicate that the pit in UCL-trench 1 also contained a lot of rotting organic refuse. Indeed, it may have been covered by a heap of rubbish that was deposited above ground through the continued use of the same location even after the pit was filled in completely. That would also explain the relative scarcity of finds around the pit. Again, interpretation must wait until all the soil samples have been processed. Chernycheva's studies indicate a whole new field of methods that can be applied to buried anthropogenic palaeosoils. Clay sediments seem especially promising, as they retain both chemical and microbiological traces.
The two rows of postholes discovered both run southwest-northeast, but at a slight angle to each other. The postholes are rather small and shallow, unlike the posts discovered in 2009[82]. They clearly do not belong to one structure. Either each wall belongs to a different building, with the

[81] Sommer/Amicone/Chernysheva 2019.
[82] Virag 2015.

other wall outside the trench, or they could be fences. There are further, slightly bigger postholes in the southern and eastern part of the trench, but they do not form any obvious pattern. Pit 1 strongly hints at the presence of a house in the vicinity. The trench is too small to convincingly interpret these features, and the function of the linear feature remains an enigma.
While there were numerous lithic finds, predominantly obsidian, there was almost no micro-refuse, so flintknapping did not take place in the excavated area.

Conclusion

The lack of plant remains hampers any conclusion about the economy, but the animal bones indicate a surprisingly high importance of hunting. This may have been complemented by the use of aquatic resources like water birds, fish, especially eel, which do not leave behind much traces, and freshwater molluscs. Eel were very important in the Ier marshes up to the last century[83]. Equids bones indicate the use of the plains, while brown bear is found only in mountainous areas today. Stable isotope studies of both wild and domestic animals would help to identify the exact range of terrain the animal resources were acquired from, as well as the relation between terrestrial and aquatic resources for human consumption.
The taphonomic questions can only be finally answered once refitting and a spatial analysis of all of our finds have been performed. This should provide a unique source of detailed information on refuse disposal and sediment movement inside a Neolithic open settlement. While the clay soil of Tășnad Sere has been a nightmare for excavation, it provides excellent preservation conditions for microbiological remains. The result of these analyses and the distribution of palaeobacteria both in relation to various features and at various depths promises the most exciting and innovative results of our excavations.
The almost glacial page of our excavation will probably look scary to many colleagues, and it will not be feasible under normal conditions. Still, this excavation can help to identify methods and areas of research that can also be used under rescue-conditions.

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