# NEOLITHIC IN MACEDONIA: RECENT RESEARCH AND ANALYSES





# НЕОЛИТОТ ВО МАКЕДОНИЈА тековни истражувања и анализи

## NEOLITHIC IN MACEDONIA RECENT RESEARCH AND ANALYSES

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НЕОЛИТОТ ВО МАКЕДОНИЈА ТЕКОВНИ ИСТРАЖУВАЊА И АНАЛИЗИ NEOLITHIC IN MACEDONIA RECENT RESEARCH AND ANALYSES

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#### Igor Tolevski

### Foreword

This is the 6<sup>th</sup> volume of the edited book that is related to already traditional conference of the Center for Prehistoric Research, particularly focused on the Neolithic of Macedonia and the Balkans. Same as the conference this publication also brings together various specialists exploring different modes of life of the first farmers inhabiting the Balkans, thus promoting new perspectives in research methods and proposing a variety of possibilities in the understanding of the agricultural societies.

Arousing from the papers presented on the conference this publication intends to archive the current knowledge gained from the more intensive exploration of the Neolithic communities in the Balkans. Being exposed to meticulous audience the presentations were facing thorough discussions and therefore were developed into papers with solid data and elaborations on the social, economic and ritual life of the people that introduced novel modes of living in Southeast Europe approximately 8500 years ago. In that manner this volume also exposes the latest research of the Neolithic pottery, tools, diet and architecture of the first farmers in this region.

This year's edition of the 'Neolithic in Macedonia' volume starts with two papers on pottery. First one is Clare Burke's observation of the technological features of the Starčevo pottery and how the relationship in pottery making can be detected among several neighboring settlements in the region of Lebane. Furthermore she identifies the traces of Anatolian traditions in the vessels production in the Balkans that additionally confirms the evident links between these regions. The following paper also elaborates the pottery making but in terms of its aesthetic components. Ljubo Fidanoski emphasizes the notion of proportions in modeling of the Neolithic vessels and that they were produced in terms of protomatematics and anthropometry.

With the subsequent papers the volume shifts from pottery production to manufacture of lithic tools and food economy. The work of Vesna Vučković and Elena Stojanova Kanzurova is focused on the lithic technology, particularly the one from the site of Tumba Madjari. They identify the local resources and the technological skills the craftsmen used in order to fabricate the flint tools in the Middle Neolithic of Skopje region. The following paper considers the use of plants and domestic space among the Neolithic tells of Pelagonia. Sabanov, Antolin, Soteras and Naumov demonstrate the advantage of archaeobotanical analysis in detecting the crops that were majorly employed in the diet, but they also highlight the observation of micro-refuse remains in order to trace the activities performed in the dwellings.

The next paper also deals with the region of Pelagonia and particularly with the latest research on the site of Vrbjanska Čuka. Naumov, Mitkoski, Talevski and Stojanovski present the contextual data from the excavation of this tell in 2020 and 2021 with particular focus on the architecture and its features in different Neolithic levels. This volume is enclosed with the last paper authored by Igor Tolevski where he also gives a report overview of the latest excavation on the site of Bojkovci in the region of Radoviš. He brings the site in the environmental context and demonstrates the characteristics of the architecture and material culture in this Late Neolithic settlement.

Although being composed of several papers this edition of 'Neolithic in Macedonia' gives an extensive elaboration of the latest knowledge in terms of technology, economy and habitation of the first farmers. All these papers provide thorough examination of the material culture, architecture and organic remains in order to demonstrate the modes of everyday life of the agricultural societies from the beginning until the end of the Neolithic period. Furthermore the authors promote novel research approaches and state of the art methods in order to reach a consistent notion of the world in which these farmers lived. That is moreover the substantial principle of the Center for Prehistoric Research which intends to encourage the implementation of the advanced multidisciplinary methods in prehistory and to present their outcome in this volume that has been continuously published since 2016.

#### Клер Бурк Оддел за археолошки науки, Австриски институт за археологија

#### **Clare Burke** Archaeological Science Unit, Austrian Institute for Archaeology

### Врски на керамиката: Репертоарот на керамиката Старчево во Свињаричка Чука, Србија

### **Potting Links**: The Starčevo Ceramic Repertoire of Svinjarička Čuka, Serbia

#### Апстракт

Трудов, накусо, ги резимира првичните набљудувања на производството и употребата на фазата Старчево керамичка колекција од новооткриениот локалитет Свињаричка Чука, како дел од проектот НЕОТЕК. Со вклучувањето на типолошки и технолошки пристапи, на макроскопско ниво, веќе се очигледни врските со други локалитети, особено во околниот регион, не само во однос на идеите за тоа како треба да изгледа еден керамички сад, туку и во однос на тоа како треба да биде изработен, вклучувајќи ги наследените врски со анадолското керамички традиции.

Клучни зборови: технологија на керамички садови, Старчево, Србија, неолит

#### Abstract

This paper briefly summarises preliminary observations about the production and consumption of the Starčevo ceramic assemblage from the new site of Svinjarička Čuka as part of the NEOTECH project. Through integrating typological and technological approaches, it is already possible to see at the macroscopic level strong links to other sites, particularly in the same the surrounding region, not only in terms of ideas about what a vessel should look like but also in terms of how it should be made, including some potential ancestral links to Anatolian potting traditions.

Keywords: Pottery Technology, Starčevo, Serbia, Neolithic

#### Introduction

The Early Neolithic is a fascinating period of cultural and evolutionary transition in relation to the organisation and expression of human groups which has been related to population expansion and migration (Ammerman and Cavalli-Sforza 1973; Whittle et al. 2002; Özdoğan 2011;

Porčić *et al.* 2020; Leppard 2021). Advances in conceptual and scientific methodologies have helped archaeologists to begin to unravel the complex trajectories of how the Neolithic way of life materialised and operated in different places during different periods. There is a general argument for the spread of a 'Neolithic Package' of technology, agriculture and group settlement organisation from East to West, although different models are heavily debated. Within this framework SE Europe, particularly the Balkans, represents an important connecting zone where the traditional characteristics of a Neolithic way of life appear from around 6200 BC.

In Neolithic studies, ceramics have played a vital role as a technology and material culture type which becomes increasingly adopted and widespread across large areas, demonstrating a shift in the types of materials used for containers. This shift has been dominantly explained as being the result of establishing settled communities (Kaiser and Voytek 1983), and certainly ethnographic evidence does support the notion of a connection between pottery making and sedentism (Arnold 1985, 113–118). Within the framework of such ceramic research, it has long been recognised there are strong stylistic similarities in some pottery types over very large areas (Çilingiroğlu 2010, Urem-Kosou *et al.* 2017; deGroot 2019a; deGroot 2019b) which have traditionally been interpreted within two frameworks; The first is to use the presence/absence and relative abundance of typologically distinct pottery to examine relative contemporaneity between sites and regions in terms the stage of Neolithization and which epoch of the Neolithic the material represents (Nikolić 2005; Pavúk 2016). The second, which is directly linked to the first, is to help define and map the possible routes of Neolithic life-ways (often assumed to be along coasts and river routes), and cultural boundaries.

In SE Europe in particular, the spatial distribution of certain assemblages and characteristic vessel types (especially related to painted pottery), has resulted in the definition of a range of cultural groups connected to different geographical areas and particular type sites where these cultures were first defined. Within this, the Starčevo and wider Starčevo-Körös-Criş groups have formed an important focus being widely distributed in Serbia, Romania, parts of Albania, Croatia, Macedonia, and Hungary. The Starčevo group is characterised by the presence of zoomorphic and anthropomorphic figurines (commonly interpreted as female), labrets, bone spatulas, incised 'cult' tables, pit structures, the presence of particular crop and animal husbandry strategiesand often most commonly related to the presence of a specific repertoire of ceramic vessels which has formed a particularly important research aspect focused on typology.

The typological examination of Neolithic ceramics has been pivotal in identifying potential connections between different locations, however, it is becoming increasingly clear with the excavation of more sites that the broad grouping of assemblages within cultures has unintentionally masked important nuances (Stojanovski 2014) in terms of not only the style but the execution of different ceramic classes. With the increased integration and sophistication of lab based ceramic analyses related to the production and use of these ceramic containers it is clear that whilst there are broad similarities, typological nuances are also reflected in ceramic production choices (Dzhanfezova *et al.* 2014; Spataro 2019; Spataro *et al.* 2019; Dzhanfezova 2021; Papadakou *et al.* 2021), supporting a general re-evaluation of current models with scholars increasingly arguing that the development of the Neolithic cannot be contained and understood within a single model (Naumov 2015; Nikolova 2007:96; Stojanovski 2014: 1, Çilingiroğlu 2005; Fidanoski 2019). Instead, the archaeological and scientific evidence is highlighting the need to work at multiple scales, importantly including more detailed characterisation of local trajectories and adaptations within the broader shared cultural koine these assemblages appear to represent. In this vein, this paper presents a brief overview of the typological and technological characteristics macroscopically recorded for Starčevo ceramics excavated from the new site of Svinjarička Čuka in south-central Serbia which are being investigated as part of the FWF funded NEOTECH project (award no. P32096, PI – Prof. Barbara Horejs). The integrated approach being adopted, frames the Starčevo ceramics excavated from Svinjarička Čuka within the chaîne opératoire (Leroi-Gourhan 1943) to understand the sequence of actions and choices potters were making, the repertoire of vessels they were making and similarities to other sites and published analyses to understand their technological trajectory within current models. In terms of identifying cultural coherence, it is particularly important to consider whether it is possible to see the same learnt practices at the site and between sites. Certainly, it is well documented in psychology, sociology and ethnography that a person or groups decisions and bodily actions are deeply embedded in socio-cultural norms and contexts of learning (Lemonnier 2002; Mauss 2009 {1934}; Wenger 1998), as fellow group or society members help guide a person's behaviour and choices (Kohring 2013: 107). In terms of ceramics, this not only relates to how groups believe a vessel should look like but also how it should be made, with its manufacture requiring hard earned and well-practiced knowledge and skill. As such, whilst the visual appearance of potteryis more susceptible to changes from external factors such as changing tastes or contexts of use, the raw materials and manufacturing methods are less malleable and form an important avenue of research. Certainly, analytical work done by Spataro (2019) does suggest a strong degree of shared technological concepts for the production of Starčevo pottery related in particular to the choice of similar clay types within parts of Serbia and Romania at least.

#### The Site and NEOTECH Project

The site of Svinjarička Čuka is located on a small-elevated terrace near the Svinjarička River in Lebane, not far from the Byzantine city of Carčin Grad. The site was first identified in 2017 during a survey as part of a collaboration between OREA, The Archaeological Institute Belgrade and the Archaeological Museum of Leskovac with excavations beginning in 2019.

The excavations to date have uncovered archaeological features and material culture dating from the Iron Age through to the Early-Middle Neolithic (Horejs *et al.* 2019). The Neolithic at the site (5600 cal BC, although material currently being dated from the 2021 excavations is expected to be earlier) is represented by a large abundance of Starčevo material culture such as pottery, cult tables, labrets as well as a range of archaeobotanical and zoological remains. Additionally, features such as vitrified daub with preserved post marks, and fragments of probable ovens or hearths have also been uncovered confirming domestic occupation (Horejs *et al.* 2019).

Key aims of the NEOTECH project are to examine the development and trajectory of lithic and ceramic technology during the early Neolithic through analysis of material excavated from the Svinjarička Čuka site. The ceramic work being undertaken by the author examines the raw materials, forming and firing technology and surface treatments of the pottery, using an integrated methodology that brings together macroscopic observation, thin section petrography and scanning electron microscopy (SEM). The results of the analysis are integrated within the contextual and chronological information to examine the spatial and diachronic trends present in the ways that pottery was made and consumed, and how this relates to similar information of certain pottery types and finishes.

#### The Pottery - Typology

The pottery excavated to date contains the common range of vessel types that are typical for middle to late Starčevo with a dominance of large and more commonly small jars. The former typically have a rim diameter of 35–45 cm and appear more globular in profile with slightly flaring, everted or to a lesser extent rolled rims. Small jars usually have a conical or narrow mouth, or a slightly flaring rim, with rim diameters ranging of around 12–14 cm. These jars occur alongside a range of open bowl shapes, the largest being conical with an average rim diameter of 30 cm, some examples displaying a crenulated or wavy rim, consistent with Early Starčevo (Perić pers comm.). The large conical open bowls are accompanied by finer biconical and lesser proportions of s-profile bowls, with average rim sizes between 15–20 cm. What is notable is that although there is not standardisation in terms of vessel execution, there is a degree of consistency in terms of the relationship between vessel type and its dimensions. Whilstdisplaying a degree of variability in terms of rim diameters, the range of difference between vessels of the same type is usually within 1cm, and wall thickness variation is limited to within 0.5 cm. These dimensions are comparable to those from other sites within the same pottery types (e.g. Blagotin, Vuković 2004).

In terms of surface finish, the material is overwhelmingly dominated by pseudo barbotine or roughed surface finishes associated with jars, conical bowls and narrow mouth vessels, alongside a smaller amount of true Barbotine, and few impresso wall fragments (**fig. 1**), which supports a middle to late Starčevo relative date (Dimitrijević 1974; Spataro 2019, 43–44). These are accompanied by the application of barbotine or incised flat disks or rosettes such as those from Gălăbnik (Pavúk and Bakamska 2021, 132), which are usually added to larger jar shapes, there is also the use of mixed media on a single vessel such as half roughened and half smoothed or barbotine and incised decoration (**fig. 1: A**). Incised decoration comprises of linear and cross-hatch motifs from a broad range of sites such as Blagotin (Vuković 2004) and within Grivac III material (Bogdanović 2008, 102).



fig. 1

Painted pottery relates to open bowl shapes, particularly s-profile and biconical types which are commonly very fragmented and form a small proportion of the assemblage within the stratigraphical units recorded to date, but are again consistent with a middle and more likely late Starčevo date (Dimitrijević 1974). The motifs are dominantly dark black linear motifs on red fired or slipped/painted backgrounds (**fig 2: B**), and it is likely that the red coating relates to the application of ochre as seen at other sites (Dzhanfezova *et al.* 2014; Spataro 2019). This is also supported by the recovery of an ochre fragment during the 2021 excavations but the raw materials use for pottery making will need to be confirmed through SEM-EDS analysis planned for 2022. There are also examples of brown to black painted motifs on cream backgrounds, some on naturally cream fired pottery including highly burnished examples matching well with examples such as those from Gălăbnik Horizon X (Pavúk and Bakamska 2021, 171, abb. 89, 1) and Starčevo Grad (Fewkes *et al.* 1933), and others which appear to have had a cream slip or paint applied onto the vessel with the brown painted motif being added afterward (**fig. 2**, all buff with dark painted sherds). This includes an example of a biconical bowl (**fig. 2: C**) that appears to be a direct match for an example from Čekmin (Bulatović and Jović 2009, 340, Fig. 59).

The painted motifs are mostly dominated by small cross hatch patterns near the rim, or grouped linear motifs applied vertically on the vessel walls (**fig. 2: B**) such as examples from Donja Branjevina (Karmanski 1979: TXXVII; Karmanski and Biagi 2005, 182–183). In rare cases we also have some examples of spiraloid motifs on bowls (**fig. 2: D**) comparable to Gălăbnik Horizon VIII (Pavúk and Bakamska 2021, 172, abb. 90, 6) and a funnel neck or amphora type jar (Burke *in press*). Of particular note in terms of painted pottery was the excavation in 2021 of a sherd with a partially preserved 'three fingered' motif directly comparable to the example from Gălăbnik Horizon 10 (Pavúk and Bakamska 2021, 171, abb. 89, 15).



fig. 2

When taken together the dominance of barbotine and roughened/pseudo barbotine finish, dark linear painted pottery and rare spiral motifs, alongside the small number of biconical shapes, suggests the pottery is consistent with Starčevo IIb-III typo-chronological phases (Arandelović-Garašanin 1954; Nikolić 2005; Spataro 2019, 43). The absence of polychrome and of white painted pottery, in combination with the comparatively small amounts of impresso, suggests that the pottery is within the earlier part of this typo-chronological range but most of the material is probably not before Starčevo II, with similar pottery styles and decorative frequencies at Rudnik III-IV (Dimitrijević 1974, 74; Nikolić 2005, 55–56), Dubrava I (Nikolić 2005, 57) and Tečić (Галовић 1962 cited in Nikolić 2005, 58). However, the increasing presence of crenulated rims on conical bowls and appearance of more monochrome and burnished sherds suggest the excavations are already approaching or within early Starčevo levels.

#### **Technological Features**

Although lab-based analyses are ongoing, it has been possible to identify some important insights into the ceramic fabrics, forming and firing of the pottery at a general macroscopic level and with the aid of a DinoLite digital USB microscope.

#### **Fabrics**

In terms of the ceramic fabrics there are broadly three groups all based on a fine sandy or gritty, mica rich clay and have been described elsewhere (Horejs et al. 2019; see images in Burke *in press*). The first is a fine version of the clay that includes the presence of organic inclusions the abundance of which indicates purposeful tempering in many cases. The second is also fine but in this case it contains red-brown-orange rounded to sub-rounded inclusions with or without organics, and the third is sandier and gritty with the inclusion of moderately hard white and semi-translucent inclusions, again with or without organics. The first fabric is associated with a range of jars, conical bowls and narrow mouthed vessels, as well as a small proportion of painted fineware bowls, the fabric with red-brown-orange inclusions is commonly associated with smaller jars and narrow mouth vessels, and the gritty or sandy fabric is mainly associated with biconical incised vessels, although there are cross-overs and this is not a hard or fast categorisation. Certainly, the extensive comparative macroscopic and petrographic studies of Early Neolithic and Starčevo pottery types (Spataro 2019; Dzhanfezova 2021; Papadakou et al. 2021) has indicated that potters making early Neolithic pottery may have used the same clay types irrespective of location but there was variation in terms of the addition of organic temper. Petrographic analysis is now underway to add detail to the macroscopic observations.

#### Forming

Forming is a fundamental aspect of pottery technology, involving the development of specific motor-habits and is not as easily modified or open to modification as other aspects such as pottery decoration which is more heavily influenced by external factors such as changing fashions. As such, examination of forming offers an important avenue to determine networks and trajectories of shared technological knowledge and learning.

Vessels from Svinjarička Čuka have dominantly been formed using slab and coil techniques combined with pinching, or using pinching and scraping techniques. These techniques are evident from examination of surface morphology, surface traces and breakage patterns that highlight relic coil and slab joins, finger, knuckle and thumb impressions, as well as striations from the dragging of inclusions (Horejs *et al.* 2019, 199, Figure 21). In terms of the slab technique, in some instances there is evidence that some vessels have been made in layers being built up one on top of the other which has resulted in a distinctive pattern of breakage or the peeling away of these slab layers (**fig. 3: A**). Alongside these, we also have vessels with slab bases either as additions to preformed vessels, or as slabs on which the vessel walls were added (**fig. 3: B**). Interestingly, a similar methodology was used to make bases at several Anatolian sites, perhaps suggesting an earlier technological ancestry in the region (Burke and Horejs 2021).

Currently, the author is working on the Svinjarička Čuka material to identify if there are relationships between fabric and forming techniques which could indicate specific technological or potting groups, or if these forming approaches cross raw material boundaries, as seen for example in the material from Çukuriçi Höyük (Burke and Horejs 2021; Burke *in press*).

Coiling as a primary forming technique has been recorded by Spataro at multiple sites within her large comparative study (2019, 364) and is a well-known forming technique for Neolithic pottery from Hungary (Gomart *et al.* 2020), Greece (Youni in Wardle *et al.* 1996; Pentedeka and Kotsakis 2008; Pentedeka 2015, 272), Bulgaria (Salanova *et al.* 2010; Vieugue *et al.* 2010) and Anatolia (Çilingiroğlu 2012, 67; Gerrisen *et al.* 2013; Burke and Horejs 2021). However, whilst on a broad level, sites seem to share basic forming methods, traditionally pottery forming has not been a central focus in early Neolithic pottery studies as such it is hard to comparably document things such as the combined use of flat slabs and layering and the methods for base manufacture which would give deeper insights into shared spheres of learning and technological practices.

#### Decoration

Whilst many sherds show polishing there is less evidence for burnishing, most likely due to a combination of taphonomic degradation of the surface, and from use, the latter particularlynotable on vessels with interior burnishing which are rare but most likely relate to vessel function (Burke *in press*).

The most common decorative treatment is a roughened or Barbotine surface. In many examples with these finishes it is possible to see that the roughened and Barbotine surfaces were applied as an additional layer of wet clay to a preformed vessel rather than the vessel surface being



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roughened. This layered approach is well recorded at other sites such as Kovačke Njive (Vuković and Svilar 2016).

The few sherds of impress recorded have multiple execution techniques and motifs (**fig. 1**) which include crescent shapesmost likely made with a fingernail, either in rows or across the whole vessel (**fig. 1: D**), incisions displaying rough edges consistent with a shell or potentially the roughened end of a wooden or bone implement, again in rows or across the whole vessel (**fig. 1: F**), and rounded indentations made with some form of smooth-edged tool (**fig. 1: E**). We also have examples of the 'wheat grain' motif which appears to be a combination of the application of a thick clay layer which was pressed to form organised vertical bands (**fig. 1: B** and **C**), that were subsequently incised (rather than being pinched), something also noted at Kovačke Njive by Vuković and Svilar (2016, 79), although some examples also look at if parts of the clay were pinched.

The linear incised and cross-hatched incised decoration in all cases appears to have been done with a tool, with some examples displaying ragged edges and uneven pressure suggestive of a stick or twig, whilst others are deeper with smoother lines possible from a bone or stone tool.

#### Firing

Much of the pottery displays orange, red or brown ceramic colours consistent with exposure to oxygen, whilst the presence of some firing clouds suggests uneven atmospheric conditions. The common presence of darker cores within the breaks of vessels, both thin and thick-walled types, suggests firing was short and it may have been that pottery was fired for a short time and then left to air cool or some examples may have been dowsed in water.

Trends that fit well with those noted by Spataro (2019) and Vuković (2004) amongst others. The common interpretation is that firing was perhaps in open conditions such as a pit where conditions were not well controlled, but as Vuković points out, we should also consider alternative possibilities, certainly firing may have also taken place in hearths and ovens (as seen at Ulucak in Anatolia, Cevik 2016) that are traditionally interpreted in relation to heating and food preparation.





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#### **Pottery Use**

Although not part of the NEOTECH project, the author has also begun to record information about potential use of the Starčevo pottery at Svinjarička Čuka, noting the presence of chemical alteration, abrasion and deposits on the interior of vessel surfaces (Burke *in press*). Within this work the author also noted the common occurrence of 'drilled' holes which do not perforate the vessel on the interior bases of red slipped pedestal bowl bases (**fig. 4**).

Sometimes these were singular 'holes' but in many cases, there were multiple, or examples of one with the start of another next to it. In all examples these clearly relate to secondary use of these vessels as we have many examples of the same vessels without such indentations or holes. Notably, these holes have been recorded at other Early-Middle Neolithic sites and in relation to pedestal bases, such as Donja Branjevina (Biagi et al. 2005) and Pavlovac-Čukar (Vuković 2018 and pers. comm.) with the idea they could relate to spinning bowls, comparable to examples noted in modern contexts (Forte and Lemorini 2017: 178, Figure 8). However, after consulting with a number of textile experts, including experimental archaeologists, the general consensus has been that these pedestal bases would not be suitable as they are generally too large, with a surface that would be too rough and would create an uneven spinning motion (Miloglav pers comm.; Pointer pers comm.; Radini pers comm.; Kani pers comm.; Petty pers comm.). An alternative idea may be that these pedestal bases were used as caps for fire bows or bow drills (also suggested by Brandl pers comm.; Pointer pers comm.; Petty pers comm.). It is suspected the latter is more likely as a stone drill head was excavated this year confirming the use of such tools at the site (Brandl pers comm.). The secondary use of these pedestal bases may have been related to their size and shape which fits well in the hand and would allow a good grip whilst applying pressure to the bow of the drill or fire bow.

#### Conclusions

Although these are early observations from the ongoing work at Svinjarička Čuka, it is already possible to see that many aspects of the ceramic assemblage match trends found at other sites, not only in terms of shapes and decorative finishes but also in relation to elements of raw materials, forming, firing and evidence of secondary use. It is expected that as more lab-based analysis is undertaken it will be possible to provide detail about the degree to which the paste recipes used to make the pottery match those from other sites, in particular to Spataro's observations that potters working the Starčevo tradition used similar clay types and preparation methods irrespective of location, something also echoed in the work of deGroot (2019b, 61).

The ceramic results so far from Svinjarička Čuka fit well with those from other sites both within the Balkans but also further afield and suggest the presence of a shared Neolithic pottery concept not only related to how a vessel should look, and its general proportions or size, but also fundamental aspects of production and use which more likely suggest shared technological and consumption behaviours indicative of coherent cultural groupings, including potential technological similarities to pottery production in Anatolia. With continued work integrating typological and lab-based analyses it is hoped that the author can begin to piece together the trajectory of pottery technology at the site and understand its place within the wider koine of Starčevo ceramic production and consumption practices.

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#### **Used Illustrations**

Fig. 1. Starčevo sherds displaying a range of decorative styles. Photos: F. Ostmann.

Fig. 2. A range of painted Starčevo bowls. Photos: F. Ostmann.

Fig. 3. A displayed a breakage pattern indicative of layering slab formation; B shows the join between a slab base and the wall. Photos: F. Ostmann.

Fig. 4. Pedestal bases with semi drilled holes. Photos: F. Ostmann.

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Љубо Фиданоски Музеј на град Скопје

Ljubo Fidanoski Museum of the City of Skopje

Очите бараат убавина: Витрувиев поглед кон македонската неолитска керамика

### The Eyes seek Beauty: A Vitruvian Perception on the Macedonian Neolithic Ceramics

#### Апстракт

Едни од најраните документирани пристапи за одделување на убавото од неубавото е забележано во Египет и античка Грција, и повеќе или помалку се базира на мешавина од математички (геометриски) методи и концепти, и практичното искуство од разни занаетчиски вештини (техне). Тука пред сè, се мисли на Египетскиот канон во претставувањето на човечко тело, како и на канонот на Поликлет за идеалната фигура на човечкото тело, веројатно базирана на Питагорејското учење за пропорциите. Во историјата на уметноста, генерално се земаат овие примери како историски најрани реперни точки за проучување на теоријата за убавото, "божественото убаво", хармонијата, итн. Но, треба да се има предвид дека тука станува збор исклучиво за пристапи кои историски се документирани со пишани извори. Обиди за третирање на теми сврзани со убавото и хармоничното во предисториските култури и културите без писмо се релативно ретки. Оние автори кои се занимавале со овие прашања генерално се задржуваат на археолошката и етнолошката материјална култура, односно се занимаваат со посебни аспекти од културната антропологија кај предисториските и заедниците без писмо. Без потврда од некакви пишани сведоштва или други конвенционални (традиционални) податоци, проучувањето на стремежот на човекот да замисли и создаде убав предмет е навистина тешко. Сепак, во бројната материјална култура на предисториските заедници низ целиот свет постојат докази кои можат да посведочат за високиот интелект на древниот човек, но и за неговите творби кои допираат суштински прашања. Во текстот подолу се сместени размислувања за менталните процеси и достигнувањата на неолитските заедници во Северна Македонија (а со тоа и на поширок простор во Југоисточна Европа, па дури и Анадолија). Со други зборови, тука читателот ќе може да ја види оригиналноста и универзалноста на некои геометриски аспекти (особено пропорционалноста), во изработката на голем број керамички предмети од неолитскиот период (меѓу 6000 и 5500 години пр.н.е.). Благодарение на материјалот претставен тука се забележуваат јасни протоматематички/геометриски идеи изведени на навистина голем број керамички предмети користени во неолитското секојдневие, идеи кои веројатно се темелат на праисконската желба за задоволување на визуелна хармонија, складност и убавина, токму онака како што Витрувиј и други древни филозофи, математичари, занаетчии, уметници и други творци ја доживувале.

Клучни зборови: неолитска материјална култура, керамички предмети, пропорционалност, протоматематика, метрологија, антропометрија, ергономија

#### Abstract

One of the earliest documented approaches for differentiation of beautiful from unattractive is confirmed in Ancient Egypt and Greece, and more or less it is based on mixture of mathematical (geometrical) methods and concepts, and practical knowledge sourced from various craft skills (the 'techne' itself). In that sense one can consider the Egyptian canon about human body representation, 'the Canon' of Polycleitus also about human representation, and most probably written on the basis of Pythagorean mathematical precepts in proportion. In art history, generally, these are (historically) earliest examples/cornerstone points for studies about theory of beauty, 'the Divine Beauty', harmony, etc. However, it should be stressed that in these examples historically documented approaches and written sources are attested. Efforts for treatment of subjects associated with beautiful and harmonious in prehistoric and illiterate cultures are relatively rare. The authors who researched these topics are, generally, involved within archaeological and ethnological material culture, i.e. they explore specific aspects of cultural anthropology. Without verification of written sources or other conventional (traditional) data the study of human's affinity to invent and create beautiful object is a hard task. Yet, in the abundant material culture of prehistoric communities thorough the world there is evidence which can testify about early human's high intellect, but also about his creations which trigger questions relevant and actual even today. In the paper below some insights about mental processes and achievements of Neolithic communities in North Macedonia (and also at wider geographic area of Southeast Europe, and even Anatolia) are elaborated. In other words, to the reader the originality and universality of some geometrical aspects (especially proportionality) in creation of large number of ceramic objects from the Neolithic period (between 6,000 and 5,500 BC) will be presented. Based on the archaeological material clear proto-mathematical/proto-geometrical ideas realized on vast number of ceramic artefacts used in Neolithic everyday life are illustrated, ideas which probably are founded on primordial aspiration for fulfilment of visual harmony, balance and beauty - exactly in the way Vitruvius and other ancient philosophers, mathematicians, craftsmen, artists, and other authorities understands.

*Keywords:* Neolithic material culture, ceramic objects, proportionality, proto-mathematics, metrology, anthropometry, ergonomics

#### A (Neolithic) introduction

The levels of mankind development stands on our perception about the relation between human towards himself, the relation between human to another human, the relation of human towards nature, as well as, the results/products obtained by these relations. History, archaeology, cultural anthropology and other sciences and disciplines, to date, have largely contributed in the discoveries about mankind development processes and in the very discovery of human as a rational being. However, there are a large number of processes which these sciences in their fields of interest cannot answer and in addition they create new more complex questions, dilemmas, hypotheses, etc. In that stage of research they burden the efforts of discovering the reasons and consequences of human's life and creation. Generally, to date, well known and defined are the basic cultural, historical, social, economical, and even political properties of mankind, as well as, chronological determination of most important occurrences in local, regional and global context.

Neolithic in its essence is rather complex (and from anthropological point of view) relatively long phase of natural, economical, and socio-cultural, reason-consequential change in mankind development, whether chronological interval or geographical area of research. In short, in this New (or Late) Stone Age which starts at the very end of Epipalaeolithic or Mesolithic (especially in the territory of Near East and Anatolia) the human, although not for the first time, begins to think about taming the nature. Although, this topic is complex - depending predominately on archaeology and cultural anthropology - and from a different point of view also depends on philosophical and religious subjects, in its essence tries to discover certain rational intentions of human on the basis of archaeological facts. Such examples are the sites in the aforementioned territory where at one relatively limited geographical area several economies intertwine, economies with relatively similar architectural objects and artefacts, and even with similar characteristics on symbolic representations within material - Göbekli Tepe, Karahan Tepe, Nevali Çori, 'Ain Ghazal, Çayönü, Jerf el Ahmar, etc. (Kujit 2000; Cauvin 2002; Schmidt 2010; Hauptmann 2011; Rollefson 1986; Benz and Bauer 2013; Stordeur 2015). For these great civilizations, which on one or other way, are only pioneers of Neolithic, the efforts about cultural and historical interpretation are at least, condemned to smallscale success, because they fail to answer on the essential questions - about their instant emergence, which even at their earliest phase (approximately 12,000 years BC within the very end of hunter-gatherer communities) is represented by monumental architecture and complex ritual and social aspects.

Bearing in mind the fact that – in the dawn of Neolithic, at the aforementioned territory – the monumental architecture emergence, side by side with its technological and symbolical aspects we can conclude that the mental basis on Neolithic development was set. Actually the mentioned nature taming is the essence and the best definition of this period in western Asia which lasts about three millennia (9,500–6,500 BC). Namely, in the territory of modern day States of Turkey, Syria, Iraq, Iran, Israel and Jordan, human for the first time in the Neolithic period succeeded in taming wild plants and wild animals into domestic forms and varieties which we use today. Simultaneously with domestication (and probably directly dependable on these key occurrences in civilization history), human also for the first time settles in houses which constructs and builds by himself within systematically organized permanent settlements, which in some cases are even urbanized. Within these above all, mental and material changes – human conquests another civilization victory – the emergence of food preparation and cooking in ceramic vessels.

Ceramics is probably an experimenting product of early men communities which even in the Upper Palaeolithic period (34,000–18,000 BC) started to practice manufacture of clay objects documented at several sites in Europe (Vandiver *et al.* 1989; Sinopoli 1991, 1; Rice 1999, 4; Budja 2005, 61–62). These early experiments with clay have a specific form – various anthropomorphic and zoomorphic figurines without detailed stylization, and they represent the first step of human into 'alchemy'. This early emergence of ceramics shows human's desire to understand the world around him – and in a certain way he accomplished that some 30,000 years ago. However, the 'historically real' ceramics emergence, in its basic kind – as a vessel for food preparation and cooking, i.e. as an object with dominant utilitarian character (and in a specific aspect secondary symbolic character too) emerges in different places in the world, and in different chronological intervals, but in relatively similar social, economical and cultural conditions (Barnet and Hoopes 1995; Hoopes 1995; Pavlů 1996; Rice 1999; Budja 2001). There are several hypotheses about processes which contributed to ceramic vessels production (Vandiver 1987; Brown 1989; Hayden 1990; Hoopes 1995; Arnold 1996; Rice 1999).

- 1. Architectural hypothesis or theory about vessel creation based on architectural construction techniques.
- 2. Culinary hypotheses or theories about ideas of Prehistoric human for creating a vessel in which food will be prepared, cooked, and served as a final product, i.e. a relation or a medium between food and object.
- 3. Resource intensification theories or efforts for social interpretation of ceramics emergence in the time interval of hunter-gatherer and sedentary society shifts, as well as, other social varieties in different communities.
- 4. Social/Symbolic elaboration a theory which suggests that ceramics was created for the hunter-gatherer needs, manufactured by shaman-potters as a special objects necessary for symbolic and ritual activities.

The earliest ceramics production emerges in several centres: North-east Asia, mainly the territories of Eastern Russia, China and Japan (approximately 15,000 BC); South-west Asia, the area of the Fertile Crescent – Near East and Anatolia (between 9,500 and 8,000 BC); Northern Africa (approximately 9,000 BC); Europe, especially Balkan Peninsula (approximately 6,500 BC); and North and South America (approximately 5,000 BC) (Тодорова и Вайсов 1993; Rice 1999; Kuzmin *et al.* 1997; Kuzmin 2002; Kuzmin 2006; Kuzmin and Vetrov 2007; Derevianko *et al.* 2004; Chi 2002; Gopher *et al.* 2001; Perlès 2001). Therefore, the ceramics discovery (whether autochthonous or as a result of exchange/knowledge/skill) and later ceramics production, emerges in all continents where human communities exist, and generally from socio-cultural aspect, communities which practice hunter-gatherer subsistence strategies or transitional forms of earlier hunter-gatherer communities to later sedentary-pastoral groups.

After the profound cultural, economical and social changes in hunter-gatherer into sedentarypastoral communities in Near East and Anatolia, stabilization in everyday life happens, and these communities carry out the complete Neolithic 'package'. This is evidenced by the prompt enlargement of houses and settlement, the variety of artefacts of various raw materials and function, and especially the already active agricultural and pastoral economy. These properties of the large number communities and settlements, particularly in this part of Asia, besides economical and cultural stabilization, directly depend on the long-term (at least two millennia) continuous life with precisely set system/s, and more or less, similar economical, proto-religious and cultural organization. With this Neolithic communities setting in the aforementioned region in Asia, well established elements of a large civilization (exchange, skills, crafts, religious forms, customs, traditions, etc.), and even a specific conservativeness (maybe an elements of standardization) in material culture is evident. Besides these social aspects the importance of the fine (warm) climate conditions (at the end of the Holocene, and lasting until the end of 7<sup>th</sup> millennium BC) should be noted, which later (approximately 6,200 BC) are characterized by severe climate fluctuations (Тодорова и Вайсов 1993, Todorova 2007; Weninger et al. 2007; Weninger et al. 2009; Budja 2007).

About the emergence of the Neolithic in Balkan Peninsula (which is the first emergence of Neolithic in Europe) is discussed in many occasions (Childe 1958a; Childe 1958b; Gimbutas 1976; Garašanin 1979; Тодорова и Вайсов 1993; Cavalli-Sforza and Cavalli-Sforza 1995; Van Andel and Runnels 1995; Scarre 1995; Санев 1995; Whittle 1996; Thorpe 1996; Özdoğan 1999; Bonsall *et al.* 2000; Bailey 2000; Thissen 2000; Price 2000; Tringam 2000; Zvelebil

2001; Kotsakis 2001; Perlès 2001; Perlès 2003; Pinhasi 2003; Runnels 2003; Rowley-Conwy 2003; Ammerman and Biagi 2003; Sanev 2004; Lazarovichi 2006; Budja 2007; Chapman 2008; Naumov 2009a). In research so far various interpretations about Neolithic genesis in the Balkans and Europe were made, and by far the most dominant is the theory of Anatolian Neolithic genesis in the Balkans. Briefly, it is considered that in the middle of the 7<sup>th</sup> millennium BC a Neolithic colonization begins first on the Greek islands and in its continental part, and later (in the second half of the same millennium) the Neolithic way of life extends through the large area of South-east Europe – the territories of today's Republics of North Macedonia, Albania, Bulgaria, Kosovo, Serbia, Croatia, Romania, etc.

In its initial phase – arriving at Balkans, the Neolithic communities with Anatolian origin, without question (above all mentally, a surely in some extent, and materially) bear the most important human aspects: knowledge, skills, crafts, traditions, religious beliefs, and economy (Perlès 2001; Perlès 2003; Özdoğan 2002; Özdoğan 2008; Özdoğan 2011; Budja 2009; Çilingiroğlu 2005). Through time, parallel with the Neolithic dispersal a certain changes in material culture are attested which suggests on separation of older near-eastern and Anatolian traditions (although, still some old traditional features of the artefacts are present). But these changes, as time goes by, especially at the end of the 7<sup>th</sup> millennium BC enlarge, thus creating the ground of the first authentic Balkan Neolithic communities.

No matter in what extent the Anatolian traditions in material culture were kept, in the Balkan Neolithic communities several categories archaeological heritage of various origin and raw material have been documented. To date, from the researched Neolithic sites large numbers of movable and unmovable artefacts, as well as, abundance of biofacts, and their derivatives (modified products of biological origin) have been discovered. Thanks to biofacts it is confirmed that Balkan Neolithic economy is dominantly agro-pastoral, in which domestic forms of animals are herded - dog (the only animal domesticated earlier in Palaeolithic period), cattle, sheep, goat and pig, as well as, domestic forms of wheat, barley, oat, etc. As in South-west Asia, the Balkan Neolithic communities used tools and jewellery made of bones, stone, ceramics, antler, shell, and most probably wood. They hand made large quantities of ceramic artefacts – vessels, objects with symbolic characteristics (figurines, altars, house models, stamps, etc.). From the unmovable archaeological material culture - large number of settlements with organized structure, as well as, houses made of stone, almost always of wooden structure, and wattle and daub have been documented. In the house's interior almost in every example a fireplace or oven, and is some cases other utilitarian (most commonly clay) objects (platforms, bench and bed-like objects, etc.) were discovered.

The Neolithic in North Macedonia is not an exception of the general image about this first ceramic period in Balkans. It is characterized with the same agro-pastoral economy in which main role is domestic animal and plant herding, with marginal hunting activities (Moskalewska and Sanev 1989; Ivkovska 2009). Directly dependant on this economical context are settlements which in dominant cases bear traces of long-term continuous life, with several generations – a state well documented in the multilayered site stratigraphy, and particularly in the construction of houses on above another in consecutive phases or subphases. Houses almost without exception were made of wattle and daub – a wooden construction covered with several layers moist clay, gable roof and typical Balkan Neolithic inventory (ovens, fireplaces and sometimes platforms) (Grbić *et al.* 1960; Garašanin 1979; Bilbija 1986; Гара-шанин и Билбија 1988; Санев 1988; Санев 1994; Санев 1995; Стојанова-Канзурова 2008; Tolevski 2009). According to material culture in Macedonian Neolithic, three cultures have



#### fig. 1

been suggested (fig. 1): the largest, Amzabegovo-Vršnik in East and North-western parts of North Macedonia; Velušina-Porodin in South-western parts (Pelagonia Plain); and Zlastrana in Ohrid region (Garašanin 1979; Здравковски 1990; Санев 1994; Санев 1995; Fidanoski 2009a). Concerning periodization within Amzabegovo-Vršnik culture two phases have been attested – Early Neolithic phase (Amzabegovo-Vršnik I) and Middle Neolithic phase (with two subphases Amzabegovo-Vršnik II and III), according to Gimbutas chronology (Gimbutas 1976, 29). The Velušina-Porodin culture is Early Neolithic with four subphases (I-IV), according to researchers [Симоска и Санев 1975, 77–78, 82]. Similarly, Zlastrana culture is also considered as Early Neolithic, but due to small-scale research so far, there have not been established precise phases or subphases (Кузман 1990, Kuzman 2007, 23-26). The absolute chronology was made on the basis of 14C analyses on material collected from several sites within different phases, thus giving the following dates range: Early Neolithic from 6,100 to 5,800 BC; Middle Neolithic from 5,800 to 5,300 BC; and Late Neolithic from 5,300 to 5,000 BC. In this relatively long period of time the Neolithic man from North Macedonia was exceptional craftsman, using various tools made of chipped and polished stone, as well as, different types of antler and bone tools, jewellery made of shell and tusk, and other objects without precisely defined purpose. But the one thing in which the Neolithic communities in North Macedonia were mostly skilled is ceramics - the various objects which they made and use in different contexts, occasions and purposes.

### Neolithic ceramics in North Macedonia - the basic features

In Macedonian Neolithic cultures (and even broader in Balkan Peninsula), in the archaeological literature, ceramics was always the starting point for definition of the origin and fitment of Neolithic communities, their characteristics, as well as, a basic tool for chronology and periodization classification of this prehistoric period in general (Grbić et al. 1960; Корошец и Корошец 1973; Gimbutas 1976; Garašanin 1979; Гарашанин 1989; Китаноски и Симоска 1985; Санев 1994; Санев 1995; Sanev 2004; Здравковски 1990; Здравковски 2008; Lazarovichi 2006; Fidanoski 2009a; Fidanoski 2009b; Naumov 2009a). Within analyses of ceramic material usually three basic elements are processed, upon which the basic conclusions for the collections are made - form analysis, decoration analysis, and functional analysis. This paper will not be exception of that methodology (which in its essence is rather conventional and even conservative from modern archaeological methodology standpoint), but a different approach in ceramic material analysis will be presented.

Neolithic ceramics collection in Macedonian sites is a result of intensive production with great quality and quantity. In ceramics category large number of artefacts have been documented, which according to form and function can be separated in several groups: vessels, anthropomorphic vessels, anthropomorphic house models, house models, altars, figurines, stamps, and other objects. Within researched sites, absolutely dominant are ceramic vessels, which generally, suggest their utilitarian (practical) character, unlike the other groups, which more or less, bear symbolic properties. However, this is a general differentiation, and it should not be taken as granted, because even some vessels have symbolic characteristics, and vice versa, some altars or house models may have more practical and less symbolical character, and of course, there are objects which cannot be precisely defined.

Ceramic vessels in the Macedonian Neolithic collections, generally, have been classified and characterized by few common elements - the start of production, methods of production and final product, i.e. clay preparation, shaping, decoration, and firing (Fidanoski 2009b). At the very beginning, before vessels manufacture, the Neolithic communities used at least four different fabric types of clay: with organic temper, with mineral temper, combination of these two, and clean clay (without temper). Vessels were handmade, probably with various tools, thus classified with at least four techniques of manufacture.

- construction investment.
- dimensions), the jars, because of the firmness it gave to the vessel.
- toward the walls and the rim, simultaneously being coated with wet clay.

1. The *first technique* (and the simplest one) is shaping a vessel from a ball of clay or clay mass by pinching a hollow in the centre of a lump of clay and forming the vessel with the thumb and fingers. It is due mostly to the shape itself which doesn't seek special

2. The second technique (coil made) is actually building a vessel of clay bands which are placed in vertical rows one above the other. It is the most used technique for production of many vessel types. This technique was used for the most frequent vessels (with different

3. The *third technique* (slab construction) originates from the Neolithic cultures from the Near East (Vandiver 1987). It is about the so called technique of construction with clay 'plates' or slabs which are placed at the bottom of the vessel and are complemented

4. The fourth technique in fact is open for interpretation, i.e. it can be perceived as combination of the first technique with others (for example shaping a vessel from a ball of clay or clay mass by pinching a hollow in the centre of a lump of clay and forming the vessel with the thumb and fingers, and attaching of other part - clay mass) or a technique which is used for vessel creation upon previously defined model.

Four basic types of ceramic vessels could be distinguished in the Macedonian Neolithic: plates, bowls, jars and askoi; and besides these, there are complementary ceramic forms: cups, ladles, lids and flat bases. After form definition (and typology definition upon which general periodization of Macedonian Neolithic has been done), the surface treatment of vessels, also contains at least four degrees of processing.

- 1. The *first degree* is characterized by roughness of the vessel surface, where no trace of smoothing tool could be registered. This technique is called rustication and results from the surface of the vessel not being treated at all.
- 2. The second degree is surface treatment with smoothing without visible signs of roughness. Smoothing tool traces are visible, but there are cases where parts of same vessel were smoothed with different intensity (somewhere better, somewhere worse).
- 3. The *third degree* is characterized by intense smoothing, or burnishing, of the vessel surface. In rare cases smoothing tool traces are visible, moreover, the smoothing is so intense on a larger vessel surface, and so if put in a certain angle vessel shine appears. However, even with this technique the vessel surface could still be uneven.
- 4. The *fourth degree* of surface treatment is the highest achievement of this action. It is a ceramic vessels burnishing and polishing technique, and smoothing tool traces could not be seen. The surface is very highly burnished and the polishing is so intense that the whole surface glitters evenly.

Decoration analysis is an important element of ceramic vessels research, which also defines the nature (especially symbolic aspects and function) of vessels. In Balkan Neolithic archaeology (except form analysis) on the basis of decoration techniques the basic periodization was made. The decoration of vessels was performed with seven basic techniques, but also combination between these was also practiced.

- 1. Barbotine is a positive technique (adding clay mass) which is characterized by throwing wet clay on the vessel surface (prior to firing).
- 2. Application is also a positive technique performed with adding clay mass on the wet vessel surface (prior to firing).
- 3. Impression (also known as impresso) is a negative technique (reducing the clay mass) performed with tool impression (very often with finger nail) on the wet vessel surface (prior to firing) and/or reduction of a part of the clay surface.
- 4. Stabbing (incising) is a rarely applied negative technique and is characterized by stabbing of the wet vessel surface (prior to firing) with a tool.
- 5. Incrustration is a negative technique and is performed with incrustration of a certain ornament on the wet vessel surface (prior to firing) which is later filled with a pigment (most often a pastous colour).
- 6. Channelling is a negative technique which is characterized by reduction of thin layers of the wet vessel surface (prior to firing) so a wave-like surface is achieved.
- 7. Painting is a positive technique characterized by painting ornaments on the wet vessel surface (prior to burnishing and firing).

The Neolithic vessels' colours depend on the choice of clay used in manufacture and the way the vessel was fired (Gardner 1976; Grbič et al. 1960, 36; Стоилов-Бункера 1992; Fidanoski

2009b). The clay and its chemical features have a special significance for the vessel production, and they especially influence the firing process. In other words, the clay structure in some cases could allow deformities during the firing, or, it could not influence at all the possible unwanted changes of the shape during the heat treatment. Moreover, some of the oxides in the clay react differently during the firing, especially because of the temperature change that they could result in differential coloration within a single vessel. However, these processes were pretty well controlled by the Neolithic potter. Witnessing that, we have high-quality ceramic vessels and other ceramic artefacts from all Neolithic phases in North Macedonia. Generally, the larger part of ceramics before firing was coloured in different colours and different hues – red, orange, yellow, brown, grey, and black. In order to get darker hues the Neolithic potter used lower temperatures and very often reduction conditions (decreasing the oxygen flow). The lighter hues (especially the red and the orange) were achieved with oxidation (increased oxygen flow) - higher temperatures, and longer duration of firing. Unlike the aforementioned procedures of firing and colouring, there are examples which were not intentionally coloured - they got their colour by chemical reactions of the clay and its changes during firing processes. According to the profile-section of the fragmented Neolithic ceramic vessels and other ceramic objects the conditions in which it was fired could be estimated. The so-called 'biscuit' profile (black within, other colour on the surface) is very frequent and it points to an insufficiently high temperature and short-lasting firing. Unlike this, the profile-section that has no difference in colour (except of the examples which are completely black or grey) points to a longer-lasting firing on higher temperatures. According to the research on ceramic vessels in the Macedonian Neolithic so far, the temperatures did not exceed 950 °C (Gardner 1976, 174).

Within the Neolithic cultures in North Macedonia there were vessels which were made with the typical techniques described above. Having in mind that the vessels were primarily used according to the aims and the taste of the Neolithic potter and consumer, they could not be rigidly grouped. Therefore, the ceramic vessels classification in technological groups should be made conditionally, according to the making modes. The ceramics could be divided as fine and coarse.

- 1. Fine ceramics is comprised of coloured and uncoloured examples, in rare cases with is from 0,3 to 1 cm (rarely above 1 cm).
- below 1 cm.

These are the general characteristics of ceramic vessels discovered in Macedonian Neolithic sites. Again, I stress the fact, that these artefacts are handmade - created in a relatively early phase of ceramic production. However, the vessels demonstrate high achievements of the Neolithic potter which will be presented in this paper.

Within ceramic material collected from Macedonian Neolithic research various objects with different characteristics on several levels - manufacture, form, function, symbolic, etc. Above

poor surface treatment, and dominantly with intensively smoothed, burnished, and polished vessel surface. Within this group dominant decoration technique is painted ornamentation, as well as, the other techniques, except barbotine and impression. This group is comprised of good and long duration of firing, and wall thickness of these vessels

2. The coarse ceramics often is characterized by uncoloured examples whose surface is rough and poorly smoothed. The vessels of this group were often fired on lower temperature, and also as within the previous group, all the ornamenting techniques were used, except painting. Concerning wall thickness, it is usually from 1 to 3 cm, and in rare cases it is in the paper all ceramic objects groups were mentioned, but in this analysis anthropomorphic house models and figurines are of special interest. Briefly, these objects are authentic and unique, and they are different with vessels almost in every aspect, and in addition, they are diverse even in their group/s. The nature and their meaning is still unclear, but there are specific visual characteristics which can lead to some conclusions. Unlike ceramic vessels, which have three basic form characteristics - recipient, belly and bottom, house models and figurines bear completely different properties of form. Anthropomorphic house models are hybrid in their appearance - upper anthropomorphic part and lower part made as different geometrical forms (square, trapeze, rectangle, etc.), and on both parts (within some examples) few openings can be noticed. Figurines, on the other hand, are characterized with corporeal elements and within their description basic anatomical terminology is used.

Concerning preparation of ceramic anthropomorphic house models and figurines it is safe to say that Neolithic potter used the same or at least similar clay fabrics as the ones in vessels. Anthropomorphic house models were made with the more complex technique –shaping a form and attaching of other clay mass (technique 4 described in vessels). Figurines, on the other hand were made by two techniques, shaping and modelling (technique 1 in vessels), and the more complex method described above. In both groups of objects another technique is registered (not used in vessels) - use of wooden construction covered with clay mass (Темелкоски и Миткоски 2005; Sanev 2006; Hansen 2004; Naumov 2015). Surface treatment techniques are the same like the described for vessels manufacture (four levels), and the same applies with decoration techniques with three exceptions - barbotine, channelling, and painting are almost never practiced. Bearing in mind the same raw material (ceramics) for all referred groups and objects concerning firing and colour, the same rules as in vessels applies.

#### The basis and the research (so far)

The Neolithic in North Macedonia, and broader in Balkans was, and still is very interesting for great number of domestic and foreign explorers. Since the first half of 20th century important data about what Neolithic at this territory represents have been obtained. In this period, although small-scale, these are pioneering, extremely important explorations, research which by the methodology used in that time were more 'conventionally' oriented towards cultural-historical interpretations. On the basis of these primary archaeological explorations, the ones from the second half of the same century, particularly in former Yugoslavian, Bulgarian and Romanian archaeological schools, are characterized with, more or less, contemporary (for that time) research methods, like interdisciplinary approaches and increase of quality and quantity of the excavation techniques. Key years in this period are the sixties and seventies when large number of sites was excavated very common by mixed domestic and foreign teams consisted of specialists from different fields. Actually, in this period (especially after the seventies) great deal of data and basic conclusions (in some extent even today correct) on Neolithic were obtained. Great number of scientists was and is studying Macedonian Neolithic, whose works are referent and unavoidable in any archaeological, field or cabinet, research, like: Grbić, M. and D. Garašanin, J. and P. Korošec, Benac, Jovanović, Srejović, Gimbutas, Sanev, Saržoski, Simoska, Kitanoski, Todorović, Bilbija, Zdravkovski, Kuzman, Jovčevska, Naumov and others). Thanks to these, but also to a lot more scientists which were not mentioned, today a large Neolithic database exists, database consisted of large number of objects, contexts, artefacts, etc. - which although to date were subject of various analyses, still conceal specific aspects.

In this work artefacts from the following sites and cultures will be analyzed.

- 1. Barutnica-Amzabegovo, Rug Bair-Gorobinci, Damjan-Radoviš, Tumba-Madžari, Cer-5,800-5,300 BC).
- 2. Veluška Tumba-Porodin, Porodinska Tumba-Porodin, Gurgur Tumba and Đorev Rid-Su-Early Neolithic, 6,000–5,500 BC).

The material analyzed here was selected on the basis of its form, its preservation level (very often a complete example or in lack of a complete example an example with better preserved part with specific characteristics, for example like clear section line), and its distribution in collections (a selection of typical, common forms). In the work and in its illustrations, also a selection of the most representative examples was made. I stress that in large extent within different objects categories discovered in Macedonian Neolithic illustrated here typological and other form characteristics prevail. However, bearing in mind that we are dealing with handmade objects exceptions in collections should be expected. Unfortunately, some photographs are made in slightly higher perspective, i.e. they are not precisely photographed (in right perspective) in section, a situation which in some extent complicates the used methodology of research - object placement in coordinate system and into a geometrical form. However, it is only a minor angle which does not bias the general image of this analysis. Concerning methodological approaches in form analysis, they are well known in literature and they are in detail mentioned below. For better comprehending the objects and their properties they will be placed in coordinate grid and into a specific geometrical form or into a combination of geometrical forms.

Typology is one of the basic approaches in objects analysis. It incorporates different aspects of a certain object which can be visually defined. In this work the basic interest is set on specific ceramic objects - vessels, anthropomorphic house models and figurines. For the first category (vessels) there are many detailed methodologies of research, unlike the other two categories where typological analyses are not detailed and clear, i.e. they are based on individual needs of researchers and they are adapted to fit in different typological patterns, systems, etc. (which is understandable bearing in mind these objects form properties).

The earliest approaches in typology definition within archaeological objects were made by Spaulding, Gardin and De Heinzlein in the fifties and sixties in 20th century (Djindjian 2009, 62) One of the pioneer works in this field is the work of Shepard (1956) including all aspects in ceramic vessels research, and later on the same topic, the work of Rice (1987) also is crucial. In the middle of the seventies until the end of eighties new ideas and insights, as well as, revaluation on older methodologies in typological analyses emerge, like the work of: Wilcock, Shennan, Main, Djindjian, Hall, Hagstrum, Hildebrand, and many others (Djindjian 2009, 66). These works concerning ceramic vessels typology are always based on the basic instrument in technical drawing - placement on coordinate system. On the basis of vessel's image in the coordinate system or other similar methods (for example, the mosaic method or sliced method), and later with statistical operations valuable data for vessel's properties in different cultures was provided. Unlike vessel category, the typology of the other two categories of objects, anthropomorphic house models and figurines, bearing in mind their form (asymmetrical, more complex, and often hybrid appearance) is more relied on diverse interdisciplinary, often humanistic in nature, and in some cases even philosophical approaches and methods (Ucko 1962;

je-Govrlevo and Podselo-Stenče, sites which belong to the Amzabegovo-Vršnik culture (with chronological interval from Early Neolithic, 6,100–5,800 BC until Middle Neolithic,

vodol, sites which belong to Velušina-Porodin culture (with chronological interval from

Ucko 1996; Leroi-Gourhan 1967; Cpejoвиќ 1968; Gimbutas 1982; Gimbutas 1989; Letica 1988; Talalay 1994; Talalay 2000; Meskell 1995; Biehl 1994; Biehl 1996; Biehl 1997; Biehl 2006; Bailey 1994; Bailey 1996; Bailey 2005; Tringham and Conkey 1998; Baŭcob 1992; Vajsov 1998; Sanev 2006; Hansen 2007; Becker 2007; Becker 2010; Lesure 2011; Naumov 2009b; Naumov 2009c; Naumov 2010b; Naumov 2014; Наумов 2015; Чаусидис 2008; Chausidis 2010; Наумов и Чаусидис 2011; Kawashima 2005).

The history of archaeological thought is rich with miscellaneous scientific and non-scientific interventions in its development. Both, scientific and non-scientific efforts in archaeology, help in the research of mankind history and provide diverse insights in the reconstruction of the past. If scientific efforts in archaeology are the pillar of discovering the past and history (interdisciplinary approaches in archaeology or archaeometry), then non-scientific or more controversial interpretations of an archaeological object directly help in exclusion of specific theories and interpretations, thus bringing back the process of more reliable and profound hypotheses. Actually, archaeology which from exotic, adventurous, amateur, and even political discipline (especially as discipline in function of history in the period of 19<sup>th</sup> until the beginning of 20<sup>th</sup> centuries), transformed to a modern cultural anthropology – today is treated as a full-scale humanistic science. However, in its essence archaeology is an interpretational instrument of more interdisciplinary approaches (biological, physical, chemical, mathematical, geological, sociological, anthropological, religious, etc.) from which results it draws conclusions. In the very conclusions, both scientific and non-scientific efforts may have crucial role in the definition of one artefact/ community/culture/complex/people/civilization, etc.

Bearing in mind that in this work will be presented another modified approach in the perception of specific objects and their manufacture from the Macedonian Neolithic, I will mention some similar research efforts in literature. Briefly, according to the researched ceramic material in the Macedonian Neolithic specific proto-mathematical and ethno-mathematical concepts emerge, especially in the manufacture procedures and the very objects.

\* \* \*

The earliest moments in mankind history concerning mathematics is tied with the earliest historical civilizations, i.e. societies which are literate and societies which write narrative information about themselves (generally in archaeological/historical periodization this societies are treated as Bronze Age, characterized with well developed economy, strong and stable governing system, and developed urbanization). The societies from the end of 4<sup>th</sup> millennium BC in Mesopotamia and Egypt are the best example of the aforementioned beginnings of mathematics, i.e. they are the (historically) first civilizations which practice arithmetic and geometry (Cajori 1909; Rouse Ball 1960; Merzbach and Boyer 2011; Hodgkin 2005; Katz 2009; Høyrup 1991; Høyrup 2011; Robson 2000). Somewhat later in other parts of the world (and in relatively similar cultural and social conditions), as the cultures of India and China, important achievements in mathematics have been recognized. However, the most advanced studies in mathematics were made in ancient Greece as a result of several mathematicians and schools which studied various topics in nature and society, like: Thales of Miletus (ca 628-548 BC); Anaximander (611–545 BC); Pythagoras of Samos (580–500 BC), Hippocrates of Chios (470–410 BC); Plato (429–348 BC); Eudoxus of Cnidus (408–355 BC); Euclid (middle of 4<sup>th</sup> until middle of 3<sup>rd</sup> centuries BC); Archimedes of Syracuse (287–212 BC); and many others (Cajori 1909; Rouse Ball 1960; Merzbach and Boyer 2011; Hodgkin 2005; Krantz 2006; Katz 2009). On the basis of theirs mathematical and philosophical studies and discoveries in the world of art the best known canon for ideal human figure, which is based on natural harmony and mathematical proportionality, is the Canon of Polycleitus (fig. 2). Although not directly based on empirical mathematical rules there are theories that suggest its foundation on Pythagorean mathematics (Tobin 1975, 307; Riegel 2011, 60). That the same mathematical rules were applied for the much older Egyptian canon for human figure presentation is very plausible, even ideas that the Egyptian canon was the role model for the Polycletian canon were proposed (Høyrup 2000, 48–50). For the Polycletian canon it is thought that it is directly bonded with the human body and its parts, i.e. originates from the smallest human body part – the little finger, and by ratios between other parts – finger, hand, torso, head, proportionality was established by which beauty/beautiful appearance derives (Vitruvius III, I, 9; Oxford 1970, 930; Tobin 1975, 307; Iversen 1975; Høyrup 2000, 48-50; Riegel 2011, 62).

For the human body is so designed by nature that the face, from the chin to the top of the forehead and the lowest roots of the hair, is a tenth part of the whole height; the open hand from the wrist to the tip of the middle finger is just the same. (...) The length of the foot is one sixth of the height of the body; of the forearm, one fourth; and the breadth of the breast is also one fourth. The other members, too, have their own symmetrical proportions, and it was by employing them that the famous painters and sculptors of antiquity attained to great and endless renown.

Vitruvius, The ten books on architecture, III, I, 2 (Translation by Moris Hicky Morgan, 1914)

Thus, in theory of beauty it is considered that 'beauty' is founded on mathematical rules, i.e. mathematical proportion (which contents geometrical, arithmetical and harmonic proportion) (Oxford 1970, 930; Tobin 1975, 307; Roero 1999, 17; Riegel 2011, 62). Under the same principles in the world of ancient Greece architectural objects were constructed (Wilson Jones 2000, 73), and they too obeyed the same rules about proportionality and beauty, which again Vitruvius vividly illustrates:

Thus in the human body there is a kind of symmetrical harmony between forearm, foot, palm, finger, and other small parts; and so it is with perfect buildings. II, II, 4

The design of a temple depends on symmetry, the principles of which must be most carefully observed by the architect. They are due to proportion. In Greek  $\dot{\alpha}v\alpha\lambda\gamma(\alpha)$ . Proportion is a correspondence among the measures of the members of an entire work, and of the whole to a certain part selected as standard. From this result the principles of symmetry. III, I, 1

Vitruvius, The ten books on architecture (Translation by Moris Hicky Morgan, 1914)

Probably the fundamental units of measure practiced in all mankind are based and derived from the human body. Vitruvius and other authors write on this subject too:



fig. 2

Further, it was from the members of the body that they derived the fundamental ideas of the measures which are obviously necessary in all works, as the finger, palm, foot, and cubit. These they apportioned so as to form the "perfect number", called in Greek  $\tau \epsilon \lambda \epsilon_{i} \sigma_{i}$ , and as the perfect number the ancients fixed upon ten. For it is from the number of the fingers of the hand that the palm is found, and the foot from the palm. (...) Therefore, if it is agreed that number was found out from the human fingers, and that there is a symmetrical correspondence between the members separately and the entire form of the body, in accordance with a certain part as standard...

Vitruvius, The ten books on architecture, III, I, 9 (Translation by Moris Hicky Morgan, 1914)

It also became necessary to measure the length and contents of objects. The standards were rough and often taken from parts of the human body, and in this way units originated like fingers, feet, or hands. Names like ell, fathom, cubit also remind us of this custom. (Struik 1954, 5)

Many authors point that primary ideas about number, counting, and some of the units of measure originate from the human body (Vitruvius; Struik 1954; Merzbach and Bover 2011, 2–5; Iversen 1975; Wilson Jones 2000, 73; De Cruz 2008). Thus, the human body is the borderline between mathematical concepts of proportionality and the theory of beauty. In addition, probably from it the most important units of measure were derived (large part from which are still in use), and in some cases even official recognized standards are founded. In contemporary studies of mankind history it is accepted that basic units of measure were established in Mesopotamian, Egyptian, Greek, Roman, and other civilizations (Dilke 1987; Høyrup 1991; Wilson Jones 2000, 73; Stieglitz 2006).

... [The 'tools' of the Egyptian, Chaldean or Greek builders] were eternal and enduring, precious because they were linked to the human person. The names of these tools were: elbow (cubit), finger (digit), thumb (inch), foot, pace, and so forth. (...) Let us say it at once: they formed an integral part of the human body, and for that reason they were fit to serve as measures for the huts, the houses and the temples that had to be built. (Le Corbusier 1956, 19)

Here also, the data are gathered from the earliest literate societies, and in large number of cases they were proved with material evidence. But, what was going on concerning mathematics (mathematical ideas or the first efforts of man practicing mathematical concepts) before the literate societies, there is insignificant number of studies.

Unlike the aforementioned (historical and literate) societies which left behind, besides diverse material culture, visual and written heritage of their intellectual skills, prehistoric cultures form the Palaeolithic and Neolithic did not left any written traces. These illiterate, but extraordinary skilled craftsmen left behind them very rich material culture, in which, specific protomathematical and metrological contexts are attested.

For the prehistoric period there are no documents; hence, it is impossible to trace the evolution of mathematics from a specific design to a familiar theorem. But ideas are like hardy spores, and sometimes the presumed origin of a concept may be only the reappearance of a much more ancient idea that had lain dormant. (...) We can make conjectures about what led people of the Stone Age to count, to measure, and to draw. That the beginnings of mathematics are older than the oldest *civilizations is clear.* (Merzbach and Boyer 2011, 7)

Mathematics initially arose from a need to count and record numbers. As far as we know there has never been a society without some form of counting or tallying (i.e. matching a collection of objects with some easily handled set of markers, whether it be stones, knots, or inscriptions such as notches on wood or bone). If we define mathematics as any activity that arises out of, or directly generates, concepts relating to numbers or spatial configurations together with some form of logic, we can legitimately include in our study protomathematics, which existed when no written records were available. (Joseph 2011, 30)

In the large quantity of mathematics history research, in some extent, the authors argue about the origin of some mathematical discoveries (for example the Pythagorean Theorem), so to say, some of the authors are not convinced about their Mesopotamian, Egyptian or Greek origin (Gerdes 1985; Dilke 1987, 18; Hodgkin 2005, 44-45; Krantz 2006, 3; Katz 2009, 19). These concerns should not surprise bearing in mind that mathematical concepts exist in the human mind. In this context, today, there is a discipline or topic in mathematics which is entitled as ethno-mathematics (rarely proto-mathematics) defined as the cultural anthropology of mathematics and mathematical education (Gerdes 1994a, 19) or according to D'Ambrosio's<sup>1</sup> anthropological mathematics, which deals with mathematics of illiterate (historical and contemporary) societies. Ethno-mathematics involves the following fields of interest:

- indigenous mathematics,
- sociomathematics,
- mathematics in the (African) socio-cultural environment,
- mathematical methods spontaneously,
- transmitted orally from one generation to the next,
- oppressed mathematics,
- non-standard mathematics,
- hidden or frozen mathematics,
- folk mathematics.

Ethno-mathematics is the study of mathematical ideas of nonliterate peoples. We recognize as mathematical thought those notions that in some way correspond to that label in our culture. For example, all humans, literate or not, impose arbitrary orders on space. Particular orders develop within cultural contexts and their form and content will necessarily be expressive of the culture in which they arise. (Ascher and Ascher 1986, 125)

Although relatively new field of interest, there is significant amount of different ideas, insights and research of mathematical concepts within illiterate communities from various periods in Africa, Asia, and America (Zaslavsky 1973; Ascher and Ascher 1986; Ascher 1988a; Ascher 1988b; Ascher 1997; Gerdes 1994a; Gerdes 1994b; Gerdes 2003). Large part of this research point out to a specific mathematical discoveries (often in geometry) which originate from diverse practical, but also symbolic aspects, which in their essence define the culture - the methods of objects manufacture, counting and ways of counting, artefacts' ornamentation, games, riddles, puzzles, etc. However, how much further we go back in time, in the same time the research reduces. From the earliest chronological period in which human has active role in nature - the Palaeolithic, some mathematical tendencies in various cultures can be traced. According to some authors, as McPherron, Hodgson (McPherron 2000; Hodgson 2006; Hodgson 2011) the

• spontaneous mathematics – each human being and each cultural group develops certain

• oral mathematics – in all human societies there exists mathematical knowledge that is

<sup>1</sup> Ubiratan D'Ambrosio – Brazilian mathematics educator and historian of mathematics.



cognition of symmetry is connected with symmetrically chopped lithic tools from the Acheulean culture (more than 500,000 years ago), and probably is based on biological factors within human's neuropsychology.

Interestingly, a typical Acheulean handaxe displays mirror symmetry along its foremost axis that is manifest in the obvious bilateral symmetry that corresponds to the vertical axis of the mirror symmetry to which the human visual system is particularly attuned. This provides additional evidence that the tendency towards symmetry in

the first handaxes was constrained by practical determinants and implicit visuo-spatial/motor attributes relating to the extrastriate $\rightarrow$ intraparetial ventro-dorsal stream. (...) The non-functional symmetry of Acheulean bifaces could thereby have initially been based on a bias of the human perceptual system for perceiving symmetrical/prototypical objects as part of a more consciously disposed creative engagement with the world. Crucially, not only has symmetry perception been linked to the intraparietal sulcus as part of the visuo-spatial/motor pathway, but has also been implicated in aesthetic judgments that, in turn, have been associated with the social abilities of the more forward areas of the brain in the sense that the aesthetic activity observed in the intraparietal area was found to overlap with both the appreciation of symmetry and social criteria. This finding suggests that aesthetic awareness engages social abilities by way of the intraparietal sulcus and thus provides further confirmation that the exacting symmetry of later Acheulean handaxes was most likely linked to a proto-aesthetic sense. (Hodgson 2011, 43–45)

One of the greatest cultural anthropologists in the history of modern science, Leroi-Gourhan (Leroi-Gourhan 1967, 90–92), recognized a specific model in the so-called Paleolithic 'Venuses' (anthropomorphic figurines) depictions (**fig. 3**). The author, without detailed calculations, rather subtle, proposed geometrical basis/rules for the appearance of these magnificent artefacts older than 20,000 years, unlike Abraham and Thompson (2006) which treat the meaning of Leroi-Gourhan models more open-minded, thus, creating the so-called 'Canon of Lespugue' and opening diverse questions. In the same context is the research of Baйcob (Baйcob 1992) about Late Neolithic and Chalcolithic ceramic anthropomorphic figurines from Hamangia culture (in Republics of Romania and Bulgaria), which according to the author bear concrete metrical proportionality (**fig. 4**).

About the topic and period which are of interest in this study, the Neolithic proto-mathematical concepts, there is some research. One of the earliest explorations concerning mathematical knowledge, beginning since 19<sup>th</sup> century, regards the construction and disposition of Megalithic objects through West Europe. These are profound studies from which contemporary science gathers data about the first illiterate communities which actively practiced apparent mathematical (often geometrical and astronomical) calculations (Struik 1948; Struik 1954; Hawkins 1965; Wood 1978; Thom 1971; Thom and Thom 1974; Thom and Thom 1980).

Sometime later, in the eighties and nineties, increase of studies on symmetry and specific geometrical ornamentation from aspects point of view on different ceramic objects derived from diverse illiterate communities (ancient and contemporary) (Crowe 1971; Crowe 1975; Crowe 1990; Crowe 2004; Washburn 1977; Washburn 1984; Washburn 1995; Washburn 1999; Washburn and Crowe 1988; Jablan 1989; Jablan 1995; Eglash 1995; Gerdes 1992; Gerdes 1994b; Gerdes and Bulafo 1994; Høyrup 2000; Robson 2000). Although scarce, there is research on specific metrological concepts in some prehistoric communities in Europe and Asia, from which obvious measurement systems and even proto-forms of standards are registered (Thom 1971; Keightley 1995; Dzybiński 2007; Dzybiński 2008; Dzybiński 2009).

fig. 4

1

About earliest counting, its relation with numbers emergence and especially about beginnings of writing and by that relation with earliest mathematical occurrences, large number of studies has Schmandt-Besserat (Schmandt-Besserat 1982; Schmandt-Besserat; Schmandt-Besserat 1996; Schmandt-Besserat 1999; Schmandt-Besserat 2007; Schmandt-Besserat 2009). Closest to the subject of Neolithic man perception of geometry and geometrical concepts within Neolithic objects are the relatively large number of studies involved in painted ornamentation on ceramic vessels discovered in Balkan Peninsula and broader in Europe (Struik 1954; Николов 1983; Николов 2002; Washburn 1984; Høyrup 2000; Tasić 2008; Тасић 2009; Naumov 2010a). In all of the mentioned studies there is one common conclusion – the Neolithic man/potter had excellent knowledge in geometry, and by ceramics he transmitted significant part of his knowledge, whether we talk about cultural, religious, economical or even political ideas. Therefore, Neolithic ceramics is a sum of several mental concepts of these early men, which by all means, were brilliant in geometry, and in a way also in mathematics.

So, from Thom's (1971), 'British Megalithic Yard', then the theories about metrological concepts within some European Late Neolithic and Chalcolithic cultures (Вайсов 1992; Dzybiński 2008), to Keightley's (1995) 'Chinese Neolithic Inch', it is time to get acquainted with the harmonious proportions within Macedonian Neolithic material culture (Фиданоски 2016; Фиданоски 2017).



#### Ratios and proportions in form - Proto-mathematical concepts in the Macedonian Neolithic

#### Vessels

In Balkan Neolithic the most common objects are ceramic vessels, very often in fragmented state – a result of the multilayered stratigraphy of the sites, unlike the completely preserved vessels which in very rare cases are unearthed in closed contexts/units (pit, house, grave, etc.). Until now thanks to the field and cabinet research a large database about ceramic vessels from all Neolithic phases in the Balkans and in North Macedonia was created. From this database today we have information about techniques of manufacture, form, decoration, function, as well as, other data about other aspects of ceramic vessels. Also, on the basis of ceramic vessel's characteristics specific chronological systems and general periodization about Macedonian Neolithic were made.

Detailed studies about ceramic vessels from Macedonian Neolithic were made by several authors (Grbić et al. 1960; Корошец и Корошец 1973; Gimbutas 1976; Gardner 1976; Garašanin 1979; Гарашанин 1989; Санев 1994; Санев 1995; Sanev 2004; Fidanoski 2009a; Fidanoski 2009b; Naumov 2009a), therefore, in the work below I will address to a particular types of vessels in which specific proto-mathematical concepts, i.e. mathematical proportionality is attested. The accent is on three types of ceramic vessels which are common in Macedonian Neolithic sites - bowls, jars, and askoi (**Pls: 1-10**). In this analysis only plates and cups are left out, which generally comprise around 30% of the total material. It should be noted that in the total material bowls and jars are around 50 to 60%, whilst, askoi which are unique by their appearance and generally are dominant in specific Neolithic sites in North Macedonia, comprise around 10 to 15% of the total material (Fidanoski 2009b). Speaking on the topic of form analysis not only here, but also in the Balkans the situation is similar, hence, bowls, jars, and plates are dominant forms for Balkan Neolithic, unlike askoi which are rare examples of ceramic vessels.

As it was already mentioned the periodization of Macedonian Neolithic is made on form analysis and decoration of ceramic vessels. Briefly, the Neolithic is divided in three basic phases (and also specific subphases) – early, middle, and late phase, from which the ceramic vessels belonging to the first and second phase are very similar, unlike the ones from the late phase. Therefore, in this analysis the Early and Middle Neolithic examples will be equally treated, i.e. treated as heritage of same communities which, more or less, practice the same or very similar traditions.

#### **Bowls**

This form of ceramic vessels is frequent in Macedonian Neolithic sites, and generally represents around 20 to 25% of the total material (Pls. I-III). Typological classification on bowls (also known as beakers) was made on Nikolov's (Николов 1998, 7) methodology, and according to it, bowls are: open vessels in which the vessel's rim diameter is smaller than the maximal vessel's diameter (belly diameter), but it is 2/3 larger than it, or in cases where the vessel has cylindrical upper part, rim diameter is equal of the maximal vessel's diameter, whilst height is smaller or equal to 2/3 of the maximal vessel's diameter. Bowls are handmade vessels with three variants of the body - ellipsoidal, semi-spherical, and cylindrical (Fidanoski 2009b, 69-71). Depending of the body height to rim diameter ratio there are shallow bowls (with ellipsoidal body) and deep bowls (with semi-spherical and cylindrical body). Shallow bowls have ellipsoidal form, enlarged in horizontal line, and often stressed rim, slightly pulled out or pulled in. In this variant of bowls the bottom is always rounded, without stressing. Shallow bowls are characteristic for the Early Neolithic in Velušina-Porodin culture and represent one of the forms which differentiate it from the other large Neolithic culture in North Macedonia (Amzabegovo-Vršnik). In this study the shallow bowls are not analyzed due to their specific (shallow) form which relies on different (diverse) proportions, unlike the deep bowls which are made on precise mathematical proportions. Deep bowls, characteristic for the Early and Middle Neolithic culture Amzabegovo-Vršnik, are vessels with almost equal height and width, and the rims are similar as the ones of shallow bowls. Depending of the period there are examples with unstressed bottoms, with ring-shaped or short bottom (Early Neolithic), and examples with high, conical bottom (Middle Neolithic). Concerning size, deep bowls can be treated as vessels with medium sizes – where rim diameter, as well as, height and width is between 14 and 20 cm. The manufacturing techniques of these vessels are probably techniques 1. (shaping a vessel from a ball of clay or clay mass) and 4. (shaping a vessel from a ball of clay or clay mass and attaching of other part - clay mass). These vessels' wall thickness is ranging between 0,4 and 0,7 cm. The clay usually is well refined (without temper), sometimes it has small amount of mineral temper, while clay with organic temper is very rare. The surface treatment in most of the cases is with well smoothed – polished (4. degree) or burnished (3. degree). The firing most commonly was on high temperatures, while colours and hues can be different - the most frequent ones, as red and orange, and less favourable brown, grey or black. According to the basic properties of these vessels they belong exclusively to the fine ceramics technological group. Bowls decoration which is also chronological marker, was made exclusively with painting (7. technique) – white painted ornamentation on reddish background in the Early Neolithic and dark (red, brown or black) painted ornamentation on the same, reddish background in the Middle Neolithic. It should be stressed that the undecorated examples are more frequent, which suggests to a different approaches in same bowl forms concerning utilitarian function and/or symbolic character within Neolithic households. Exactly this special character of bowls, especially the decorated ones leaves large space for interpretations concerning their function - which probably at some examples (undecorated) was purely utilitarian (food preparation, cooking, etc.), while at some, (decorated) was symbolic. At the very end, I stress that the bowls from Amzabegovo-Vršnik culture are products of continuous production of concrete vessel forms derived from established technology of manufacture and clear defined appearance – a state well documented at Macedonian Neolithic sites. In other words, due to their frequency, identical appearance, and decoration techniques, in a way, it can be concluded that this vessels are standardized.

#### \* \* \*

Mathematical aspects which the author of this study tries to present are in context of form, and indirectly one can notice such also within painted decoration motives, elements, and composition. Until now, analysis of geometry within painted decoration was made by several authors (Санев 1988, Sanev 2004; Naumov 2009с; Naumov 2010a; Fidanoski 2009b). If one analyzes bowls form from the Early Neolithic a basic model appears - (the most frequent) rounded rim modeled on rounded belly, finishing in rounded bottom (often ring-shaped). In the Middle Neolithic the described form continues, but most dominant is the same form, where the bottoms are finished on pedestaled, high, and hollow conical bottoms. Within Middle Neolithic bowls the form is always the same, small differences appear in rim finishing: rounded rim in low or great angled pulled out or in; flat rim (directly passing in the belly – cylindrical neck); and flat rim (slightly pulled in – conical neck). It is noticeable that variants which have slightly pulled out rim dominate, which diameter is, more or less, equal to the belly diameter (the maximal

If Neolithic bowls are placed on coordinate system, one basic tendency appears – equality of the objects height and width. Bearing in mind that primary in archaeology material culture is interpreted and later (and on the basis of material culture) human's courses of action, from conventional archaeological aspect, it is hard to interpret ancient human's intentions. However, in this case there is evidence that Neolithic potter tried to create vessels with equal height and width. In Early Neolithic within bowls with short, ring-shaped bottom the recipient is deeper (and the bottom shorter), and within Middle Neolithic bowls (the examples with high conical bottom) the recipient is shallower and the bottom is higher. Therefore, the Neolithic potter relied on actual (mental, practical, instrumental...) model with clear shape – equal in height and width. Still, these are general, hypothetical tendencies which should be comprehended conditionally, especially because Neolithic vessels were handmade. Concerning the manufacturing procedures of Middle Neolithic bowls with high conical bottom, it is certain that the upper part (rim and belly) was separately made, and the lower par (the bottom) was secondary attached on the upper part before firing. So, to equal the vessel's height with its width, the Neolithic potter in advance knew the exact ratios (dimensions) of the upper and the lower part, and in this way he made the basic proportion – the equality, in respect with bottom's height.

According to largest part of Early and Middle Neolithic variants of bowls in Macedonian Neolithic (but also in broader Balkan area from the same period) repetitive and similar dimensions of these artefacts are noticed. From a certain point of view that means forms of standardization were employed, but in the same time, it can also mean that these dimensions are optimal or practical for that form and function. Bearing in mind that rim diameter (and belly diameter) is equal with the height and it is ranging between 14 and 20 cm (most common is between 14 and 16 cm), it can be concluded that there were also specific metric concepts engaged. Within large amount of the material from Cerje-Govrlevo - the author of this study registered repetition in diameter of the high conical bottom - ranging between 6 and 8 cm (7 cm bottoms were most frequent). If one calculates the ratios between rim (and belly) diameter, the bottom's diameter is 1/3 of the rim's (and belly's) diameter (and 1/3 of the height). This mathematical proportion maybe is a result of other practical needs. As it was already said the basic units of measure are derived from the human body, so it is plausible that these dimensions originate from the human hand. Although, so far we do not have material evidence about average hand dimensions of the Neolithic population from North Macedonia, on the basis of archaeological and historical data for the ancient units of measure (from Egypt, Mesopotamia, Greece, and China) (Dilke 1987; Keightley 1995; Wilson Jones 2000; Stieglitz 2006), from the contemporary anthropometrical







fig. 5c

research (Buryanov and Kotiuk 2010), and from dimensions of modern human hand's dimensions some boundary values can be established.

As an example I will present the dimensions of my hand (from joint to joint): 1. the length of the thumb is 7 cm; 2. the length of the thumb's joint to the tip of the first finger is 16 cm; 3. the length of the thumb's joint to the tip of the middle finger is 18 cm; 4. the length of the thumb's tip to the little finger's tip (converged fingers) is 18 cm; and 5. the length of the thumb's tip to the little finger's tip (spread fingers) is 22,5 cm (**fig. 5a-c**). It should be mentioned that boundary values of my hand should not be very different with the values of Macedonian Neolithic man's hand. According to the calculated mean stature of the analyzed Neolithic individuals is ranging between 149,5 and 156,5 cm, gathered from the Barutnica-Amzabegovo site, and also ranging between 161 and 162 cm from the skeletal material provided from the site Pista-Novo Selo (Nemeskéri and Lengyel, 383; Вељановска 2006, 348). My height is 180 cm, and is rather higher than the average Neolithic man height (150 < 180 cm), but bearing in mind that physically engaged people (as Neolithic men) have proportionately larger hands, then the differences are insignificant.

The earliest historical documented units of measure are from Egypt and Mesopotamia, and in some extent they are the basis for the units of measure used in Ancient Greece (Dilke 1987, 10). The Egyptian linear units of measure are based on the royal cubit ('forearm') - approximately 52,3 cm, and from it the following divisions are certain: a palm (the width of the palm excluding the thumb) and digit (finger's width), i.e. 4 digits (4 x 1.87 cm) equals to palm (approximately 7,5 cm) equals to cubit (7 x 7,5 = 52,5 cm) (Dilke 1987, 23). In Mesopotamia linear units of measure are based on Sumerian cubit (kuš) – approximately 49,5 cm, which equals to 30 digits (1 digit = 1,65 cm) (Dilke 1987, 25). Unlike these standardized units of measure which are derived from the human body and because of the relatively shorter stature (compared to modern men) and smaller body size, the Greek linear units of measurement were slightly different and were derived from the basic unit - foot. Due to intensive trading between Greek and other Mediterranean cities, in the Greek cities (polises) the value of the foot ranged between 27 and 35 cm (Dilke 1987, 26). Then again, because of the trade and other economical factors the foot was also balanced with the cubit (in Greek pechus) – 1 cubit equals to 11/2 feet; 1 foot equals to 4 palastai (palms); 3 palastai equals to 1 spithamē (span between thumb and little finger); and 4 daktyloi (finger's width) equals to 1 palaste. Transformed in centimetres the Greek linear units in derived from palm are with these values: a) the length of the thumb to the end of the palm is between 7,5 and 8 daktyloi (15,3–16,3 cm); b) the length of the middle finger to the end of the palm or orthodoron is  $10\frac{2}{3}$  daktyloi or up to 21,9 cm; and c) palm span up to 24,8 cm. One of the earliest graphic representations about linear units of measure is the famous metrological relief from Salamis (5th century BC) on which cubit, palm, palm span and foot are engraved (fig. 6).

With its anthropomorphic design (Salamis relief) the new discovery eloquently confirms what is obvious from numerous texts, that ancient units of measure derived - or were thought to have been derived - from the human body. (...) So while Salamis Man cannot be a direct ancestor of Vitruvius's it is probably an earlier ifestation of the same desire to legitimate a metrical system by reference to a human archetype. (Wilson

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fig. 5c

#### Jones 2000, 75, 84)

Within specific Neolithic artefacts discovered in China, Keightley (1995) argues that they obey on precise metrical system derived from the human body. In other words, according to him large amount of jade congs found in the graves of Linagzhu culture are created and made 'by the rule of the thumb' (Keightley 1995, 25).

Since the transverse width of the second, lower joint of my middle finger also measures approximately 23 mm, one might imagine that the Liangzhu artisans might have laid that joint against the jade. In this case, classical documents support such a hypothesis and encourage me, for reasons given below, to refer to the Neolithic unit as an "inch" or cun, the word used in Zhou and Han texts (...) Second, there was a strong Han tradition that defined the "inch" on the basis of the fingers and that, I believe, transmitted Neolithic practice. (...) if we assume, as suggested above, that the cun was the width of the digit, then it would have made excellent sense to form a shi span of eight rather than ten digits because it is easy and even natural to lay eight digits side-by-side, with four from the left hand laid next to four from the right. The "span" of the eight digits alone-if one takes the "digit" to be 23 mm as suggested above-would have been  $(8 \times 23 =)$  184 mm, thus 80 percent of the 230 mm chi (...) I would note, however, that when I lay my two palms side-byside, including the thumbs in the span, measuring the distance from the top joint of my left little finger to the top joint of my right little finger, the span is, in fact, approximately 23 cm, precisely the span of the Han chi. The way in which the 23 mm or 23 cm finger or hand measurements keep reappearing suggests once again that the cun and fen of early China were indeed based upon these *body parts*. (Keightley 1995, 26–27)

At the very end, according to Buryanov and Kotiuk (2010), there are clear proportions between hand fingers of modern human. According to the results of the aforementioned study, on the basis of hand measurements of adult individuals, the average mean of the tip of the middle finger to the end of the palm is 15,7 cm. Therefore, probably it can be assumed that Polykleitos creating his famous model (canon) of human figure presentation was aware of these proportions, and I think that much earlier, the Neolithic communities were aware of the proportions and practically used them in various objects manufacturing.

According to the aforementioned proportions between height and width of Early and Middle Neolithic bowls, especially the Middle Neolithic ones, where a specific ratio between the height or width and the diameter of the bottom, as well as, the size span, a concrete manufacturing model emerges. The equality of the proportionality of height and width suggests that Neolithic human was aware of the basic rules of geometry and mathematics. Also, on the basis of large amounts of analyzed bowls repetitive dimensions are attested, which, I think that are kinds of units derived from the human hand. This theory has its confirmation in linear units of measure and metrical systems from many historically documented cultures and civilizations. Besides that, this unified form of Neolithic vessels, altogether with the similar size distribution suggests that some kind of a standardized system was applied for a long period of time.

From aspect of decoration within Macedonian Neolithic bowls, which is white or dark painted on red or orange background, also precise geometrical concepts are confirmed. The Neolithic potter used various painted elements and motives which comprise simple or complex compositions, with one common feature – almost every example had symmetry within. In Early Neolithic most common are painted geometrical motives – straight, curve or zig-zag lines, dots, dots in combination with lines, triangles, squares, rectangles, circles, ellipses, grid zones, and sometimes rhombi as well. Besides this, also vegetal motives (plant leafs imitations), as well as, combinations of geometrical and vegetal motives were favoured, always in specific parts (zones) of the vessel – in the Early Neolithic usually in vertical zones. Within Middle Neolithic bowls, the same tendency continues, but predominate parallel straight or curved lines, spiral motives, and motives human hand alike. In context of decoration more precise symmetry practicing is evident, and the decoration zones dominantly are horizontal. It should be stressed that within Neolithic bowls every decoration unit (element, motive, and composition) has its precise place and zone on the vessel. Equivalent with form and decoration these vessels are in a way proof of 'Neolithic harmony'. They are Neolithic products and from mathematical and philosophical aspect they have definite precision and beauty, based on units and proportions from nature, in this case the human body.

#### Jars

Jars (also known as jar-like) vessels, as bowls, are one of the most frequent forms in the Macedonian Neolithic collections and comprise 20 to 30% of the total material (Gimbutas 1976, 37, 43; Garašanin 1979, 89–92; Санев 1994, 30; Fidanoski 2009b, 71–72). The typological classification was also made on the basis of Nikolov's (Николов 1998, 7) methodology and according to it, jars are: closed vessels with relatively short body, on which often a neck was placed, the height is equal or larger than 2/3 of the maximal vessel's diameter (belly diameter), and the rim diameter is smaller or equal to 2/3 of the maximal vessel's diameter. However, it should be pointed that there are jars or jar-like examples which are similar with bowls or askoi and sometimes it is difficult to separate one of another. In the Neolithic material from North Macedonia the variety in jar forms is evident (Pls. IV-VII). Hence, some examples have higher height and smaller maximal (belly) diameter, some have larger maximal diameter and shorter height, some have wide recipient and short neck, and vice versa, there are examples with slim rim and tall neck, etc. Directly dependant on Neolithic potter's craftsmanship, but also client's needs and tastes, the rims were diversely made, with or without stressing, to follow the crosssection line of the neck, to form short and wide, or slim and tall neck, with conical or cylindrical forms, and other intermediate models. The same can be said about bottoms - they were made in different ways, stressed or not stressed, rounded, flat, pedestal bottoms, etc. Handles were often made on these vessels - by two, by three or by four examples on one specimen, vertical or horizontal, pulled out of the clay or additionally attached, small, large, etc. Bearing in mind the diversity of jar-like forms and their distribution in sites collections, their variety in size should not be a surprise; from small (5 to 10 cm in height) to large specimens (up to 1 m high). Directly dependant on their size is their wall thickness which ranges from 0,5 to 3 cm. Concerning manufacture and production, all of the aforementioned techniques were practiced, and the same situation is with the clay temper, which can be consisted of all earlier elaborated types. The jars surface treatment is also practiced in all four levels, and relatively often in one example two different levels were applied - the upper part burnished or even polished, and the lower part roughened or poorly smoothed (interestingly in most of the cases the distinction of levels is precisely in half of the vessels surface). The firing and colouring also can be different - there are examples fired at low and high temperature, and the same is with colours where all of the typical hues were accomplished, especially red, orange, yellow, brown, grey, and black. Concerning decoration a general tendency is registered – dominance of undecorated specimens. Unlike bowls, within jars all decoration techniques were applied, and in many examples combinations of different techniques are attested. Bearing in mind that this vessel type has diverse form variants, and also based on surface treatment, firing, colouring and decoration, they belong to the both (fine and coarse ceramics) technological groups. The diversity of these vessels supports broader interpretations concerning function, and therefore, it can be assumed that they were utilized in different ways - food preparation, storage, transportation, and also as a tool within various craftsman or symbolic activities. The mentioned properties do not allow exact relative chronology dating, thus it is more of a result of form and function than on chronological phase or culture.

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As it was with bowls, within jars also specific geometrical and proto-mathematical concepts are registered especially in proportionality of height and width. But, contrary to bowls which bear one basic form, the differences of forms in jars is obvious. These are the most common examples, with: relatively slim rim and medium tall (often conical) neck and hard rounded (or rounded-carinated) belly; wide rim and short neck (in some cases without neck) and rounded belly; wide rim and short neck and hard rounded belly; and, thin rim and tall slim neck with hard rounded belly. Bearing in mind these general variants, as well as, in between combined (derived) variants some differences are noted within rim proportionality, belly diameter and bottom diameter. In some cases there is tendency where rim diameter is 1/3 of the vessel's height and width and is equal with bottom's value, unlike other cases where rim diameter is 1/2 of the vessel's height and width. There are also examples where rim diameter is (almost) equal of the vessel's height and width (jar form which resembles bowls). The one thing which is in common for jars and bowls is the tendency to maintain equal proportionality between height and width. Within all jars variants (although not always with great precision) an equal value of the vessel's height with its maximal (belly) diameter is registered.

As it was already mentioned between bowls and jars there are evident differences concerning proportionality. Contrasting to bowls which have precise equal values of rim, belly and bottom diameters, concerning height to width ratio within jars this is not a rule. Thus, the various variants of jars depending on the diameters and in relation with height and width ratio a general conclusion can be drawn - the manufacturing rules are not so much based on mathematical proportionality, they obey other needs, maybe practical, ergonomical or aesthetic. If one accepts jars' dimensions which in most of the cases are with medium size (height and width between 20 and 35 cm) probably one can assume that a certain ergonomical and practical concept was applied. In other words hand measurement units were engaged within jars too, thus keeping the values within one palm or foot. Besides that, it should be noted that in order to model and shape these vessels, the Neolithic potter have had to pull his hand into the vessel, thus leaving at least 7-8 cm of the rim's diameter. As in bowls, within jars too ergonomics must have played great role because manoeuvring with a vessel with ergonomically optimal dimension is far simpler than with vessels with inappropriate dimensions in respect with the human body. In my opinion, here too the story begins and ends with dimensions and units derived from the human body.

In this research diverse variants of jars or jar-like vessels were presented, vessels which dominantly belong to the coarse ceramics technological group, but also vessels which belong to the fine ceramics technological group - where the surface treatment is of highest (fourth) degree and some of them are decorated with painting. These vessels too bear precise geometrical concepts and rules in the ornamentation. Contrasting to bowls, within jars in lower number is with geometrical motives and the larger part is 'figural' (combination of geometrical motives which resemble to figural objects). The painted ornamentation in jars too, was manufactured in precisely determined parts (zones) with precise symmetry and elements, motives and

composition/s repetitiveness. Therefore some conclusions could be drawn – the jars too obey to rules of proportionality in form (regardless of diverse variants), they too rely on precise geometrical rules in decoration, as well as, to a certain level of standardization in relation with optimal ergonomical units and dimensions. For all these properties one thing is in common again they are based on mathematical proportionality derived from nature – the human body.

#### Askoi

Typological classification of these vessels in Neolithic literature has not been done so far. However the author of this paper has made an effort to classify these unique ceramic vessels by form, decoration and function (Fidanoski 2009b, 72-73; Фиданоски 2011, 82). From the Balkan's Neolithic research so far data about askoi is scarce which suggests that these vessels are exceptionally unique. In North Macedonia the situation is rather different - here askoi have been found in dozen sites from which in Skopje region they are most abundant, and they represent 10 to 15% from the whole ceramic vessels collections. Askoi are asymmetrical, spherical or semispherical handmade vessels with five handles and excentrical neck (Pls. VIII-X). There are several variants in askoi form – elongated bellies horizontally or vertically, and shorter or taller necks (wider or thinner bellies/neck respectively). Also, the handles position varies within different specimens - although a favorite handles placement is plausible - one handle on one side against four handles on the opposite side. The rims are almost never stressed which is the case also with bottoms - they are almost always rounded. These vessels probably were made with two techniques - vessel modeling (technique 1) and combined technique of modelling and clay 'gluing' (technique 4). One of the most striking elements of these vessels is their walls thickness which in rare cases exceeds 0.5 cm. Also, almost by without exception the askoi in the clay fabric have always large amounts of vegetal temper - most commonly chaff, which altogether with the practicing of such thin walls probably is due to their special function (transport), by which even larger specimens have low specific weight. The askoi belong to the coarse ceramics technological group, and the surface treatment shows traces of roughening (level 1), or in very rare cases some specimens have smoothened surface (level 2). The firing was always at lower temperatures and directly is connected with the firing approaches (reduction of oxygen or oxidation) which are not unified even at one single ceramic vessels collection. Therefore various colours with all nuances are detected – grey, brown, yellow, orange, red, and even black in some cases. Concerning size, these vessels may have various dimensions, small askoi have maximum 20 cm in height, middle-sized askoi 35 cm in height, and large askoi above 35 cm in height respectively. According to the data for askoi from Skopje region, the most common size category is the medium one, small askoi are rare, and the large ones are unique. At the very end, as it was already mentioned, according to their manufacture and low specific weight, i.e. thanks to exceptionally thin walls and large amount of vegetal temper in clay the askoi probably were used for transport and storage.

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Askoi, contrary to bowls and jars are much less frequent in Balkan's Neolithic ceramic collections. However, in North Macedonia, especially in some sites (cultures) and regions they are more common, and according to form and decoration techniques they obey to a certain level of standardization. Namely, within askoi too, specific form rules which were practiced are attested - they were always made of two parts, lower, spherical part (the belly) and upper part or the tall, cylindrical neck. One of the things which define these vessels as rare, untypical Neolithic form is their excentrically placed neck onto the belly. Regardless of size, the neck and the rim are always

slim dimensioned to allow entry of the potter's hand inside the vessel, and therefore there are some differences between small sized examples and the medium ones in the proportions of the neck with the belly. However, I argue that all of the askoi, particularly the examples from Skopje region (Cerje-Govrlevo and Tumba-Madžari sites) have been made by precise rules concerning proportions between height and width. When placed in cross-section, the askoi made by the Neolithic potter obey rules of specific mathematical tendency: a) the height of the neck equals the radius of the circle inscribed on the belly; b) the belly is twice larger than the neck; and c) the height to width ratio is 3:2.

As it was already stated there are some deviations in neck and belly proportions (height and width proportions) especially in small and large sized examples. But, bearing in mind that the most common are medium sized askoi in which neck and belly proportions are very exact it is safe to say that they also show particular mathematical proportionality. The most evident deviations are noted in small sized examples which due to the practical need - in order to allow pulling the potter's hand in, they must have wide neck, and in contrast to this, the larger examples have almost equally slim neck with the medium sized examples, probably due to storage capacity and vessel's static. Askoi, as well as, some jars belong to the coarse ceramics technological group, which generally is referred as ceramics with dominant utilitarian functions, i.e. as objects for everyday use without special symbolic characteristics - but, they too obey to specific mathematical rules in the process of manufacturing and later in appearance. This in every way corresponds with ergonomical and practical needs of their creator and client, but always in respect with precise proportions of height and width.

#### Anthropomorphic House Models

Anthropomorphic house models which in literature are also known as: Great Mother - Goddess, Mother - House; and in general as anthropomorphic altars (Gimbutas 1989; Колиштрковска-Настева 2005; Sanev 2006; Zdravkovski 2006; Чаусидис 2008; Chausidis 2010), as their name suggests - they are objects with hybrid appearance of human and object (probably a house). Anthropomorphic house models are perhaps the most complex ceramic objects that represent the human body or architectural object (Naumoy 2009b, 106), and by that they are one of the most characteristic, authentic and representative artefacts of Macedonian Neolithic. Their presence is documented in several sites in Skopje region, in Amzabegovo-Vršnik culture (Tumba-Madžari, Cerje-Govrlevo, Sredselo-Mrševci, Podselo-Stenče, and others), and in Velušina-Porodin culture (Veluška Tumba-Porodin, Porodinska Tumba-Porodin, Đorev Rid-Suvodol, and others). In these and other sites and in different phases (dominantly in the Middle Neolithic phases) dozens of fragments, and rarely complete examples were unearthed, which suggest to a specific need and tradition of manufacturing. Attempts for classification and more detailed analyses of anthropomorphic house models was made by several authors (Gimbutas 1982; Gimbutas 1989; Георгиев и Билбија 1984; Санев 1988, 15–18; Sanev 2006; Чаусидис 2008; Chausidis 2010; Naumov 2009b, Naumov 2013; Наумов и Чаусидис 2011), in which their basic properties (more or less similar concerning forms and technology of manufacture) were defined. The basic form of these objects is comprised of two parts: the lower part resembles an object with squared, rectangular or slightly trapeze form; and the upper part is almost always with (slim) cylindrical form ending like anthropomorphic head with complete facial and even hair representations (Pls. XI, XII). In Macedonian Neolithic several variants of the aforementioned basic model have been found, from the simplest, where the lower part is regular square and the upper part only a cylinder; than combinations of simpler lower part (regular square) and more complex upper part (for example hands bent on the lower part); and more complex appearance of the complete object, detailed in almost every part. Very often, at the lower part which is closed from every side openings with various forms and dimensions have been made, as well as, small circle holes opened at the very angles on the upper part of the object (the roof of the house). That the lower part probably symbolizes house good examples to confirm that are the cases from Velušina-Porodin culture, where often the lower part of the objects have roofs of gable type. The anthropomorphic part, i.e. the upper part always was made as cylinder, very often without corporal features (exception is the example from Cerje-Govrlevo where the breasts and the belly are stressed, showing woman in labour). Some examples have hands bent on the roof of the house, and the faces also can be schematized or more realistic. Frequently within anthropomorphic house models details have been accented – realistic jewellery, hair styles, architectural elements on the house, etc. I should be stressed that all of the examples are hollow, both upper and lower part. In that context, also another detail is interesting – at the top of the head, in most of the cases a small circle hole was made. Concerning sex of the anthropomorphic house models, probably they represent female individuals, but maybe some of them, especially some of the examples from Velušina-Porodin culture represented males (based on our subjective perception exclusively on the facial characteristics). From technological aspect it is safe to say that these objects were made in two parts – as they look – upper and lower, i.e. with combined technique of modelling and clay 'gluing' (technique 4). For the manufacturing of the upper part it is suggested that wood was used, covered with clay, and later fired, thus creating the hollowness of the cylinder (Sanev 2006, 187). The clay fabric in most of the cases is consisted of organic temper, and in rare cases is with mineral temper or without temper. Concerning surface treatment most frequent are examples finished with second degree or low level of smoothing, and rarely third degree smoothing or burnishing is attested. Similarly as with ceramic vessels from the coarse ceramic technological group, the firing was made on lower temperature, which is confirmed by the so-called 'biscuit' cross-section of the objects walls, ranging in thickness between 0,7 and 2 cm. Anthropomorphic house models have the typical Neolithic ceramic colour, derived from the chemical processes in firing procedures - hues of brown, orange an yellowish colour, and objects with red colour (hues) are scarce. The dimensions of these objects are more or less in medium range, they vary in height between 30 and 40 cm, although very rare smaller exampled are registered (20 cm). Speaking about function, these objects are still enigmatic. Bearing in mind that even for much 'simpler' artefacts (vessels, tools, etc.) their function is still unanswered, than for these objects the situation is much more complex – logically, because we are dealing with 'anthropomorphic-architectonic hybrids'. Generally, it is prevalent opinion that they were used for specific symbolic activities connected with these essential categories in Neolithic: woman, house, household and community.

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At first sight considering variety of anthropomorphic house models forms it appears that they are objects with different appearances – every one of them with its special details and features, relying on different procedures of manufacture. This premise is correct until the moment when they are placed in coordinate system - or using the same methodological approaches as for vessels. Their appearance is based on basic geometrical solids – cylinder (upper part) with square or rectangle (lower part), and therefore it is logical/natural to separate these two forms/ parts (the cylinder or the anthropomorphic part, and the square/rectangle or the architectural object). When placed on coordinate system, again precise mathematical tendencies appear. Starting from the upper (anthropomorphic) part or the cylinder (in some cases with hands represented) and finishing with the lower (architectural) part, apparent proportionality within object's height and width is shown. Namely, in some cases, the cylinder has value of

1/2 in aspect of the lower part, within other cases the same ratio is 1/3 and one example from Porodinska Tumba represents the authenticity of these objects within its culture by realistic house representation, thus creating a third variant of anthropomorphic house models. The same ratios are attested for the lower part too. If one part of these objects are placed and perceived as geometrical solids, than there are examples comprised of two squares (rectangle) - their height is twice larger than their width, and there are examples which have height of 1/4 larger than width. Therefore, it is safe to say that within anthropomorphic house models, also certain mathematical proportions were applied. Also, there are examples which cylinder's height is lower than lower part's width, but always, the complete object's height is never larger than its width (as the mentioned ratio - twice larger than their width). Nevertheless, I argue that within these objects specific proportions during modelling and manufacturing were engaged. This is well documented with the examples from Skopje region sites, similarly situation as with the askoi.

It can be concluded that anthropomorphic house models also rely on specific mathematical rules during manufacture, especially in aspect of upper and lower part's width, as well as, the ratio of complete height and width. I argue that they too, are results of the efforts to accomplish harmonious appearance, which might technically not be mathematical, but intellectually and technologically represents similar efforts like the concepts of ancient mathematical beauty harmonious and proportionate, and in relation with the human body. At the very end, that this suggestion is possible - in some extent is confirmed by the anthropomorphic house models dimensions which are ranging in values of Greek foot (rarely in lower values).

#### **Figurines**

Figurines are one of the most interesting, but in the same time one of the more complex Neolithic artefacts' categories, which up to date in North Macedonia, and broader in the Balkans and Europe were subject of great interest. About their characteristics, as manufacturing techniques, forms, decoration, function, and even their socio-cultural influences in Neolithic communities great number of referent analyses have been published (Ucko 1962; Ucko 1996; Leroi-Gourhan 1967; Срејовиќ 1968; Gimbutas 1982; Gimbutas 1989; Letica 1988; Talalay 1994; Talalay 2000; Meskell 1995; Biehl 1994; Biehl 1996; Biehl 1997; Biehl 2006; Bailey 1994; Bailey 1996; Bailey 2005; Tringham and Conkey 1998; Вайсов 1992; Vajsov 1998; Sanev 2006; Hansen 2007; Becker 2007; Becker 2010; Lesure 2011; Naumov 2009b; Naumov 2009c; Naumov 2010b; Naumov 2014; Наумов 2015; Наумов и Чаусидис 2011; Chausidis 2010; Kawashima 2005). These artefacts from quantitative aspect are one of the rarest in Neolithic collections. Bearing in mind Macedonian Neolithic sites state of research a few unearthed figurines at each site (unlike vessels, animal bones, etc.) is the usual figurine distribution state. In the figurine category both anthropomorphic and zoomorphic examples are included, from which the later are not subject of interest in this study. Zoomorphic figurines are excluded because they do not bear any obvious mathematical proportions - an expected situation given the diversity of animal forms in Macedonian Neolithic, as: deer, cattle, sheep, goat, pig, dog, snake, frog, birds, etc. (very often with unclear anatomical features). The subject of this study - and can be applied within this category of objects - is the analysis of the mathematical proportionality in figurine manufacture, which model of origin was probably the human body. Unlike the so far presented Neolithic artefact categories, thanks to Naumov's (Haymob 2015, 117) research we have exact, total amount number of published anthropomorphic figurines (complete and fragments) – 289. Although, at first sight it looks like a modest number, in contrast to that – their diversity in form, manufacturing techniques and look - they are the most authentic and

most original artefacts representing a site, community, culture, etc. The only thing common for every single example is the body which is cylindrical, and all of the other features (head, limbs, secondary sex characteristics, jewellery, etc.) often are very diverse (Pl. XIII). Generally, anthropomorphic figurines discovered in Macedonian sites have schematized look of the body, where usually some partial anatomical characteristics (hands, thighs, backs, etc.) are stressed. In some examples there are extra details added on the head (eye, ears, nose, mouth, hair style, etc.); but detailed representations of limbs is very rare. On the other hand, there are examples whose arms are more realistic and different stature is attested (stretched, bent, fold, etc.), and examples whose arms are rudimentary also can be found. Similar to this is the treatment of legs - there are examples with more realistic look and stature, and vice versa, there are examples whose legs do not have any details. However, steatopygia is dominant characteristic which originates from much earlier human body interpretations - the Palaeolithic cultural milieu an occurrence which with minor exclusions is well confirmed among many Neolithic sites in broader European territory. Concerning secondary sex characteristics within anthropomorphic figurines, they too are schematized – most frequent examples have incised or applied (pseudo) geometrical motives resembling genitals. Again, according to Naumov (Наумов 2015, Сл. 2.11., 121), female figurines are dominant, figurines without shown sex are around three times lower in the average distribution, male and double-sexed figurines are represented by few examples. The question of sex within figurines representation and interpretations about it are subject of different studies, and therefore in this analysis it will not be addressed. Concerning manufacturing procedures figurines bear the same or very similar techniques used within vessels and anthropomorphic house models. In Macedonian Neolithic collections besides ceramic figurines two stone examples have been found (Наумов 2015, 192–193). These two examples are made of marble, modeled with chopping, smoothing and polishing. The ceramic figurines were made with techniques 1 and 4 – conventional hand modelling and combined technique of modeling and clay 'gluing'. Rarely wooden constructions (and in only one case from Tumba-Madžari an unique bone construction) covered with clay are detected - as procedures used in two-part made examples for additional attaching (Наумов 2015, 195).

The clay temper used for figurine manufacturing can be the same as in vessels or anthropomorphic house models – refined clay, with mineral or organic fabric or combination of the last two. Within figurines, also the same four techniques of surface treatment were practiced, more or less, equally practiced. Similar as in the other ceramic objects categories are the firing and colouring - with a dominance of light brown hues. It should be stressed that within figurines well fired examples are discovered and also poorly fired examples are common, most often with coarse surface treatment. In this way the variety of manufacturing procedures is obvious which is not the case with decoration techniques - the figurines are decorated in only two techniques - incision (most often for sex representation – genitals) and applied clay mass (most often for details – face, jewellery, etc.). The dimensions within these objects are, more or less, in the range between 3 and 13 cm in height, although, the medium sized (6 to 9 cm) are dominant. The function of figurines is still open subject for interpretations, generally, it is thought that they were active participants or important ingredients of specific symbolic activities connected with spiritual life aspects of these early communities.

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Anthropomorphic figurines unlike other Neolithic artefacts are more diverse concerning basic forms. Contrasting to other objects categories which are based on simpler form elements (the anthropomorphic house models have two parts – upper anthropomorphic and lower architectural part, and the vessels have up to three parts - rim, belly and bottom), figurines have

four basic elements of form – head, hands, body and legs. In addition to that, these separated elements can be more variable (turned head, bent or stretched hands, converged or spread legs, etc.). Besides that, within figurines different variants concerning head to body proportion and body to legs proportion, and in some extent in body stature proportion itself, also can be found. Therefore, as other aforementioned Neolithic objects which are always handmade, figurines do not always rely on strict mathematical rules or proportionalities. Also, bearing in mind that figurines in their essence are human body interpretations – here different tendencies of later (in time) rules or (Egyptian or Greek) canons for human body representations are noticed. For Neolithic figurines it is doubtful to claim that they obey to precise rules of proportionality, but it is plausible to assume that there are specific tendencies practiced within their manufacture. There is at least one specific tendency noticed in the basic form - the height is two times greater than the width. Also, within all examples the head is 1/4 of the body height, and the hands (especially at specimens with bent hands) are at the ideal centre of the figurine. The ideal centre of the figurine also is the borderline/starting line from which legs start, no matter their stature. Concerning body width it is safe to say that it do not rely on particular ratio to height, although there are examples where the width is ideal 1/2 of the height, but also examples with wider or narrower width are registered. I will stress again that figurines cannot be equally treated as other categories due to their diverse form variants. After all they are human body interpretations, no matter if they were made by concrete model of real man or they are a material product of various cognitive concepts. If they obey to a precise proportionalities it cannot be confirmed, but existence of affinities towards particular ratios within body treatment and its elements is evident. The assumption that there are certain geometrical rules and proportionality within Prehistoric figurines was made long time ago by the famous cultural anthropologist Leroi-Gourhan (1967, 90–92) about much older (Palaeolithic) figurines known as 'Venuses'. Therefore the possibility that there is at least tendency of specific proportionalities within human body representation practiced by Neolithic communities is very probable - which maybe in the best way is confirmed in other (Late Neolithic and Chalcolithic) cultures in Balkans, like Hamangia culture (Вайсов 1992). At the very end, size does matter, especially speaking about their height a dominance of 'thumb', 'digit' or 'palm width' values are at sight – ranging between 6 and 8 cm. If this is accidental or it is not, I cannot be sure, but this tendency too according to my opinion is a result of the natural, i.e. anthropological units of measure practiced at figurines too.

#### **Discussion and Concluding Remarks**

The Human mind always had affinities towards specific spiritual and material occurrences which through any manufacturing and production reflect in manmade objects. This is evident especially in ancient civilizations where objects and today for us, valuable artefacts, besides practical bear symbolic values, too. Therefore, since oldest times or since human uses his intellect for survival, later in search for more comfortable life – his mind creates objects properties and in the same time models them according to his practical, but also symbolic needs. In world's history the knowledge of ancient civilizations of Mesopotamia, Egypt, Greece, India, China, and others, especially in mathematics, astronomy, architecture, etc. is well known. Thanks to their (historical) written documents about their intellectual activities we can worship their milestone achievements in the history of mankind. But, we should have in mind that, earlier before these civilizations, as well as, later in time, existed large numbers of illiterate in many cases Prehistoric cultures and communities which although did not left any (written) traces, they left some objects which suggest to a specific proto-mathematical knowledge especially in geometry and proportionality. These proto-mathematical tendencies are firmly connected with nature and early human consciousness about his place in nature. Because of this we should not be surprised that within large number of Neolithic communities (in this study about Macedonian Neolithic) these tendencies are confirmed. This is the period which lasted almost one millennium between the end of 7<sup>th</sup> and the middle of 6<sup>th</sup> millennium BC (Early and Middle Neolithic in Southern part of Balkan Peninsula). Neolithic as one of the earlier stages in mankind development no matter in which geographic area emerges, in its essence is firmly bonded with ceramics itself. Generally, besides aforementioned economical and social aspects of the shift of one into other period, in the Neolithic the ceramics plays one of the most important roles in the collective consciousness, symbolic and cultural aspects of this period. Thus, in the most frequent ceramic objects categories in Macedonian Neolithic, as vessels, anthropomorphic house models and anthropomorphic figurines clear proto-mathematical tendencies are documented, as well as, usage of anthropological units of measure in objects manufacture. In other words, the Neolithic potter from North Macedonia, and most probably in the wider Balkan's territory, practiced certain proportionality concepts of object's height and width, and used units of measure created by himself, i.e. according to his body - digit, palm, hand, etc. Although this occurrence is documented in many Prehistoric and illiterate societies, historically for the first time is confirmed within the aforementioned Mediterranean and Eastern civilizations. But, these units of measure although in Macedonian Neolithic (historically) not confirmed are present and very precise within large number of artefacts as vessels, especially bowls, and in some extent within other categories of objects as well. This, altogether with the concepts of proportionality suggests practice of firm functional, ergonomical, and symbolic aspects – in the object itself a specific unit of measure is used, unit derived from the human body, and the same unit is proportionally modified for the final purpose – achievement of certain mental model with special aesthetic value. This aesthetic value is identical with the (later) knowledge of ancient philosophers, mathematicians, artists, craftsmen, etc. - the beauty comes from nature or from mathematics and the human body. Therefore, in the earlier Prehistoric societies as in this example - Macedonian (Early and Middle) Neolithic man was fully aware about nature and himself, equally using concrete, mental and practical, mathematical and economical concepts with one (subconscious) goal - to achieve the primordial element in human mind, the desire for beauty, or according to later authors – as Vitruvius, the following:

For the eve is always in search of beauty, and if we do not gratify its desire for pleasure by a proportionate enlargement in these measures, and thus make compensation for ocular deception, a clumsy and awkward appearance will be presented to the beholder.

Vitruvius, The ten books on architecture (Translation by Moris Hicky Morgan, 1914)

#### **Used illustrations**

Fig. 1. Map of Macedonian Neolithic cultures and important sites (Naumov et al. 2009, Fig. 1).

Fig. 2. Models of the 'ideal human figure' according to Polycleitus (Tobin 1975, III. 11, 316).

**Fig. 3.** 'Geometric background' of Palaeolithic figurines according to Leroi-Gourhan (1967, charts XLIV XLV, 92).

**Fig. 4.** Typological forms' classification on Late Neolithic anthropomorphic figurines, Hamangia culture (Вайсов 1992, 35–70).

**Figs. 5a–5c.** Anthropometric values of human (author's) hand (Фиданоски 2017, сл. 3–5, 146). **Fig. 6.** The Salamis relief, Greece, with basic units of measure depictions (Stieglitz 2006, Fig. 3, 199).

Pls. I-X. (Fidanoski 2009b; Фиданоски 2016; Фиданоски 2017).

Pls. XI-XIII. (Колиштрковска-Настева 2005; Наумов и Чаусидис 2011; Naumov 2009b).

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Bowls from the Early Neolithic phase in Barutnica-Amzabegovo 1 and 2, from the Middle Neolithic phases in Rug Bair-Gorobinci 3, and from the Middle Neolithic phases in Sredselo-Mrševci 4.






















phases in Porodinska Tumba 4.























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# Социо-економската организација на неолитската заедница од Тумба Маџари, Скопје

Socio-economic Organisation of the Neolithic Community from Tumba Madžari, Skopje

#### Апстракт

Досегашните археолошки ископувања во неолитската населба Тумба Маџари во Скопје, дополнети со мултидисциплинарните истражувања, овозможуваат да се согледаат некои аспекти од животот на локалното население во шестиот милениум пр.н.е. Тие, пак, придонесуваат да се направи потемелна реконструкција на младото камено време во Скопскиот регион, како карактеристична географска целина, во која неолитските населби имале посебен развој со препознатлива материјална култура. Резултатите од истражувањата во доменот на литичката индустрија, особено на макро-литичките артефакти од Тумба Маџари, и идентификацијата на локацијата на ресурсите, дават подетални информации за локалното стопанство, технолошките вештини, односно занаетите во оваа населба, која својот економски и културен максимум го доживела во почетокот на средниот неолит.

Клучни зборови: Тумба Маџари, неолит, макро-литички артефакти, суровини, гео-археологија

#### Abstract

Archaeological excavations in the Neolithic settlement of Tumba Madžari in Skopje, so far, supplemented by multidisciplinary excavations, allow us to see some aspects of the life of the local community, in the VI millennium BC. Together, they contribute to a more thorough reconstruction of the New Stone Age in the Skopje region, as a characteristic geographical unit, in which the Neolithic settlements with a recognizable material culture had a special

development. The results of the research in the field of lithic industry, especially the macrolithic artifacts from Tumba Madžari, and the identification of the location of the resources, provide more detailed information about the local economy, technological skills, ie crafts in this settlement, which has achieved its economic and cultural maximum in the beginning of Middle Neolithic.

Keywords: Tumba Madžari, Neolithic, macro-lithic artefacts, raw materials, geo-archeology

#### Introduction

The material culture in the Neolithic settlement of Tumba Madžari in Skopje, in many economic areas, was like other settlements in the region of Skopje, but also beyond the borders of Anzabegovo-Vršnik cultural group, which are chronologically associated with the end of the Early and Middle Neolithic (Стојанова Канзурова 2020, 14; Jovanović et al. 2021,4–7). Archaeological excavations in Tumba Madžari have provided information on the stratigraphy of the settlement, the architecture, and the portable archaeological material (Санев 1988, 9–31; Стојанова Кан-



fig. 1

зурова 2011, 35-50; Zdravkovski 2016). The results of the multidisciplinary research in the field of archaeozoology (Moskalewska and Sanev 1989, 55-79; Ивковска 2009, 83-109), archaeobotany (Stojanova Kanzurova and Rujak 2016, 70), geoarchaeological and sedimentological analysis (Coussot et al. 2007, 267-274; Commenge 2009, 229-240), morphological and technological analysis of bone objects (Стојанова Канзурова во nevam) provided a clearer picture of the economy of this community.

In the researched area of the second and third cultural horizon of this settlement. from the end of the Early and the beginning of the Middle Neolithic, within the Anzabegovofig. 2 Vršnik cultural group, many macro-lithic artefacts have been found. Petrographic, morphometric, and functional analysis have so far been made on only 172 artefacts, for which there are data on the archaeological context (Vučković and Stojanova Kanzurova 2020, 117–139). Only 60% of the processed samples are determined inside the houses. It is difficult to explain, whether the activities related to these objects took place inside or outside the houses in the settlement. According to the number and arrangement in the houses, there are: house 1 (7 samples), house 2 (2 samples), house 3 (2 samples), house 4 (8 samples), house 5 (1 sample), house 7 (5 samples)), house 8 (9 samples), house 9 (6 samples), house 10 and 11 (15 samples), house 11 (3 samples), house 12 (42 samples).

#### Aims and objectives

A geo-archaeological analysis was employed in order to answer several questions concerning the economy of the community of Tumba Madžari, such as the identification of the social value of rocks and their procurement strategy, which informs about the time invested in transport as well as availability, quality, the socio-economic organization of the community, the *community behaviour* and development of an exchange network.

rock	tool type	activities
serpentinite	axes and celts	woodworking (bone), carpentry
limestone	weights for fishing net, semi-finished products, percussive tool, amulet, anvil? REP?, REP	fishing, work on stone, objects with the aesthetic purpose, percussion activity
basalt	pestle, hammer	pulverizing, grindig crushing various materials
(meta)alevrolite	a chisel?	work on stone, woodworking (bone), carpentry
sandstone	abrader, REP	processing substance goods,



rock	tool type	activities	
basalt	pestle, hammer	pulverizing, grindig crushing various materials	
(meta)alevrolite	chisel?	woodworking (bone), carpentry	
serpentinite	axes, celt	woodworking (bone), carpentry	
gabbro	axe	woodworking (bone), carpentry	

t. 2

#### Materials and methods

The analysis of 172 artefacts classified in 18 functional tool types and 13 rock types consists of three stages (fig. 2; T. 1-2). All the raw materials analysed in this study have been classified macroscopically with a hand loupe  $(10x)^1$ . This complex method is established on three analytical steps:

- 1. the correlation between rock and tool type which allows for the separation of specific activities such as grinding, cutting, percussion etc., based on the importance of certain rocks in the manufacture of different tools;
- 2. The next step of the analysis is the correlation between rock type and tool wear. This provides insight into the intensity of the use, quality of raw material, and the correlation between rocks and mechanical stress of specific activities; and
- 3. The study of procurement strategies is based on the distance between the raw material deposits and settlements. This approach reveals patterns of raw material exploitation and includes possible contacts and exchanges with other communities.

#### Paleoecology, geology, and geomorphology of Skopje valley

The site of Tumba Madžari is surrounded by alluvial and deluvium-proluviums deposits (fig. 1). Permian schists are basic mass of the valley, which is bordered to the western mountains consisting of granite gneisses and marble. The composition of the north-western area includes more marbles (ordinary and dolomite), but above it there are crystalline limestone, tuffites, quartz conglomerates, serpentinite. The northern rim of the valley is composed of amphibolites, phyllites, marbles and, in some parts, schists are associated with diabase, gabbro and diabazic porphyr. Quartzites, phyllites, amphibolites and quartz conglomerates dominate in the southwestern part (Luković 1930, 6-44).

#### Results

A correlation between geology and tool type indicate a connection between limestone with weights for fishing net, semi-finished products of polished edge tools, spindle whorls and net weight for fishing, and basalt was the selected stone for manufacturing hammers and pestles (T. 1; fig. 5).

Around 26 % of tools are made of metamorphic rocks, such as serpentinite, marble, shale and quartzite (fig. 1). They are implemented in manufacturing axes and celts (fig. 5).

Around c. 10% of the artefacts of this site are made of igneous rocks (fig. 1). These rock types were used mainly for manufacturing celts and an axe (fig. 5). Gabbro, basalt, (meta) alevrolite and serpentinite tools show a poor level of preservation, indicating the intensive use (T. 2; Vučković 2019, fig. 6).

The results suggest that c. 59% of the implemented geology came from an area which is c. 10 km around the site. Permian schist as the basic mass of the margins of the Skopje Valley was found in the immediate vicinity of the settlement. Marble and marl deposits are located c. 1 km from the site. Shale and sandstone appear c. 2 km to the northwest. (Meta) alevrolite deposits are located c. 3 to 4 km to the north. Basalt is found c. 3 km to the west. Serpentinite and gabbro sources appear c. 15 to 20 km to the northwest. Although the northern tributes of the Vardar river could be the convenient path to these raw materials (fig.1) We assume that quartzite probably was found in the river beds. The source of tracite is unknown (fig. 1).

#### Discussion

The geo-archaeological study carried out on the Neolithic macro-lithic artefacts yields data on the various values of rocks, dominant economic activities, procurement strategy, time invested in transport and finally, and finally about the social-economic organization of the community from Tumba Madžari.

The correlation between rock type and tool type shows that serpentinite, limestone, basalt, (meta) alevrolite and sandstone were the most significant rocks.

Serpenitnite was used commonly for manufacturing axes and celts (fig. 5). The recent study confirmed that they were involved in organized processing of wood and bone objects (Vučković and Kanzurova 2020). Moreover, polished edge tools present 41.4% of all analyzed items, suggesting that woodworking (bone) and carpentry were dominant in the economy of this community.



Limestone semi-finished products, weights for fishing net and spindle weights as well as an amulet,



marble, shale. basalt, marle, talalevrolite schist, ndstone mestone. ouartzite 92,3% tracite 0.6% 10-20 40-50 ≥50 20-30 30-40

<sup>1</sup> The raw material was analyzed macroscopically by Dušica Petrašinović, petrographer of the High School of Geology and Hydrogeology, Belgrade. She offered a short general macroscopic description of the rocks.



percussive tool, a retouching tool (by pressure), an object that might be retouching tool (by pressure) (fig. 5) suggest various activities such as stone processing, work on soft or not so hard materials, textile production and fishing (T. 1). C. 31% of all studied items were made of limestone, suggesting that it was favorable raw material at the settlement of Tumba Madžari (fig. **3**). It is soft (1–3.5 according to Mohs) but tough rock and can be processed easily by flaking and smoothing (cf. Wright 1992, 54). Furthermore, stone processing was a very important activity and represents 18,6% (fig. 2). A limestone object, which might be used as an anvil (L – TM – 17, 795) and a basalt hammer (L – TM – 57, 792) were also included in stone processing. Basalt indicates planed, the long-termed implementation of the tools. A pestle (L - TM - 11, 793) was also made of this rock and documented in a House 12, the object with several specialized working places, skilled workers and organized production. This item was involved in the organized production and involved in grinding, pulverizing and crushing of raw material by the large active surfaces (pattern 1) (Vučković 2019, chapter 6.4.4; Vučković and Kanzurova 2020 fig. 9/4)

C. 14% of all studied tools are weights for fishing net. This can be explained by a vicinity of the Vardar River and the lake Šamak, and suggests low economic importance of cereal grinding and the role of wild sources in subsistence strategy.

(Meta) alevrolite also belong to the group of objects made of rocks with high social value, and has been recognized based on an item that might be a chisel. This type of polished edge tools was used for processing medium to hard materials by percussion of different intensity (Vučković 2019, chapter 6.3.4.).

Properties of serpentinite and (meta) alevrolite still needed to be examined. The implementation of various rocks in manufacturing polished edge tools, suggesting the difficulty of a regular supply of one specific rock type.

The social value of these rocks can be explained in terms of their availability, quality, behaviour, and mechanical properties.

The second analytical step relates to the breakage pattern of the tools to their respective rock

of raw material. These artefacts were used in grinding, percussion, abrasive work processes, carpentry and bone processing (T. 2; Vučković 2019: fig. A1.10, 12). This has been observed among the items made of basalt, gabbro, serpentinite, and (meta) alevrolite, suggesting their high use value (defined by Risch 2011) or low quality. The importance of the basalt hammer (L - TM - 57, 792) and pestle (L - TM - 11, 793) as well as the (meta) alevrolite object that might be the chisel (L - TM - 137, 1219) have been already explained in lines above.

Serpentinite objects were employed in carpentry and bone processing and included a celts (L - TM - 147, 1171) with flake negatives on the working edges, which was detected in a House 3 and small fragmented axes L - TM - 23, 814, L - TM - 24, 749, 670, and L - TM - 134, with specific use (pattern 3), from a House 12 (Канзурова 2011, 63, 69 сл. 43; Vučković and Stojanova Kanzurova 2020, fig. 9/3).

A fragmented gabbro celt (L - TM - 136) with no changes (FL) on an active edge was documented within House 1 (Vučković and Stojanova Kanzurova 2020).

The results also display that the economy of the community from Tumba Madžari was established on an exploitation of local sources and low transport costs. This means that they were autonomous and self-sufficient at least in terms of raw material. The same behaviour was observed later, among Late Neolithic communities in the western and southern part of the Central Balkans.



fig. 6

type. The results depend on the intensity of the activity carried out with the tools and quality

Fig. 1. Geological map and position of Tumba Madžari (according to Pendzerkovski et al. 1970, Dumurdzanov et al. 2013: 24, fig.1).

Fig. 2. Tumba Madžari: tool types; N= 172. ALS – abrader, LOS – abrasive slab, REN – celt, CHI – chiesel, HAC – axe, BEA – bead, DPP – discoid perforated plate, HAM – hammer, MZ- mace, PEC - percuusive tool, PST - pestle, REP - retoucher (by pressure), ANV - anvil, SFP - semi-finished product, SS/ALS (GRG)- shaft straighteners, SW – spindle weight (whorl), UNK, polished edge tools with traces of secondary modification, UNP - unknow product, WFN - weight for fishing net, IND - raw material, LAS - flack knocked of polished edge tool.

Fig. 3. Tumba Madžari: raw materials and source distance.

Fig. 4. Tumba Madžari: geology; N=172.

Fig. 5. Tumba Madžari: correlation between geology and tool types; N=172.

Fig. 6. Tumba Madžari: preservation of the tools according to geology; N= 172.

**T. 1.** The first analytical step: correlation between rock type and tool type.

**T. 2.** The second analytical step: rocks with the greatest level of wear.

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Употребата на растенијата и домашните простори во раниот неолит во Пелагонија: прелиминарни резултати од интегрираниот археоботанички пристап и проучувањето на микро-отпадоци

The use of plants and domestic spaces in the Early Neolithic Pelagonia Valley. Preliminary results of the integrated archaeobotanical and micro-refuse approach

Овој труд ги сумира прелиминарните резултати од археоботаничките анализи заедно со информациите собрани преку пристапот на микро отпад со фокус на два ранонеолитски локалитети во Пелагонија во Северна Македонија: Врбјанска Чука и Велушка Тумба. Главната тема што се разгледува е употребата на растенија и домашни простори, со аспекти како земјоделството, исхраната и активностите во домаќинството. Се верува дека исхраната и економијата на овие заедници најмногу зависат од земјоделството, а дијахрониските согледувања ја покажуваат неговата поголема релевантност во подоцнежните фази од раниот неолит. Поголемиот дел од посевот се житни култури, а доминантна е еднозрнестата пченица, но и други видови како што се двозрнестата пченица, јачменот и пченицата *Timopheevi*, а кои исто така се изобилни. Мешунковидните растенија како грашокот и леќата биле исто така важни. Сепак, се береле и диви видови кои се носеле во селото, најверојатно за потребите на исхраната. Тоа најчесто биле овошја, апетисани и лиснат зеленчук. Примената на методот со микро-отпадоци ги објасни активностите што се изведувале во куќите и помогна да ги идентификуваме остатоците од отпадот формиран при готвење, просторот за преработка на култури, просторот за отстранување на отпадоци, при што, се објасни и користењето на домашните простори.

Клучни зборови: ран неолит, Пелагонија, палеоисхрана, археоботаника, активности во домаќинството

This paper summarizes the preliminary results of archaeobotanical analyses coupled with information gathered through the micro-refuse approach with focus on two early Neolithic sites in the Pelagonia Valley in North Macedonia; Vrbjanska Čuka and Veluška Tumba. The main topic considered is the use of plants and domestic spaces, with aspects like agriculture,, diet and household activities being discussed. The diet and the economy of these communities is believed to depend mostly on agriculture, and the diachronic observations show its higher relevance in the later phases of the Early Neolithic period. The majority of crops are cereals with einkorn being the dominant one, but other species such as emmer, barley and *Timopheevi* wheat are also significantly abundant. Pulses; like pea and lentil, were important as well. Nevertheless, wild species were also gathered and brought to the village; most probably for consumption purposes. They were most commonly fruits; nuts and leaf vegetables. Micro-refuse approach illuminated the activities which were performed in the houses and helped us identify cooking waste residues, areas of crop processing, areas of litter disposal, and in that way clarified the use of domestic spaces.

Keywords: Early Neolithic, Pelagonia, paleodiet, archaeobotany, household activities

The Neolithic way of life and the subsistence strategies based mainly on agricultural goods have first developed in the Near East and for the first time on the European continent they started to appear in the western Aegean; in regions of modern-day Greece. The oldest evidence for agriculture in these regions starts appearing in the first quarter of the 7<sup>th</sup>millennium BC (Douka et al. 2017; Perlès et al. 2013). The influence started to spread northwards several centuries later initially following river valleys; and there are first agricultural settlements appearing around 6200 BC in the territories north from the border of modern-day Greece (Naumov 2015; Porčić et al. 2020). On its way towards the north; the Neolithic influence started to spread into the regions with a different natural setting for the first time. Namely; agriculture developed in the regions with sub-Mediterranean climate; and initially spread longitudinally staying in the Mediterranean climate zone. When; in the second half of the 7<sup>th</sup>millennium; the influence started moving northward through the Balkan Peninsula the Neolithic way of life started being implemented in the regions of increasingly continental temperate conditions (Ivanova et al. 2018). Due to the environmental constraints the early farmers needed to adapt to the new conditions and develop new strategies in crop and animal husbandry; which is why the studying of agricultural practices; diet and everyday activities of these communities plays an important role for the research of the implementation and spread of the Neolithic way of life. One such region; with evidence for occupation and agriculture in the Early Neolithic; is a valley named Pelagonia; which is the focus for this paper. The Pelagonia Valley is located in the Central Balkans; with a north-south orientation; and connects the area to the Thessalian plain; one of the earliest focuses of Neolithisation.

In the region of Central Balkans; the research of topics such as crop cultivation; role of domestic and wild plants in the diet; and everyday household activities has so far been mainly based on the indirect evidence; such as the finds that can be connected to crop cultivation (tools for soil preparation; sickles; grindstones; objects for storage etc.); vicinity of water bodies or fertile soil; architectural features of the dwellings and so on. Also; conclusions were often made based on the archaeobotanical data from neighbouring regions; such as Greece; Bulgaria; and even Anatolia (Filipović and Obradović 2013). Such evidence gives only a rough picture about the plant exploitation and gives little information on the crop husbandry practices; the diet and the everyday household activities. Archaeobotanical studies play a key role in the understanding of the Early Neolithic economy; especially when it comes to the adoption of new subsistence strategies like agriculture and crop husbandry. Despite the recognized relevance of the region of Central Balkans for the research of the Early Neolithic and the numerous documented and excavated sites; the archaeobotanical studies are still not at an enviable level. Since the Neolithic is the time when first settlements and permanent dwellings start to appear; the samples obtained from the identified house floors can give important insight into the activities that were taking place indoors and; in that way; researchers can get a chance to better understand the household economy. As is the case with the analysis of fossilized plant remains; the analyses of micro-residues from the house floors (Ullah *et al.* 2015) are rarely performed even when the preservation of architectural features is at a high level.

In this paper we bring preliminary insights into the aforementioned topics which are based on the information gathered through an integrated archaeobotanical and micro-refuse approach (Antolín *et al.* 2020) implemented at two sites in this valley. This approach combines the data provided by the analysis of direct evidence on plant use- the fossilized plant remains; and the data provided by the analysis of small organic and inorganic elements (bone; shell; seeds; chaff; charcoal; daub; pottery; stone flakes; other artifacts etc.) which are also recovered by the processing of the archaeobotanical samples and which represent residues from anthropogenic activities in the past (Ullah *et al.* 2015; Antolín *et al.* 2021).With this approach we got a chance to illuminate knowledge on the crop species which were cultivated; wild plants which were gathered and domestic activities in the Early Neolithic in Pelagonia.



### The sites under study

The focus of this research are two Early Neolithic tell sites located in the Pelagonia valley -Vrbjanska Čuka and Veluška Tumba. Pelagonia is an elongated valley situated in the Southwestern parts of North Macedonia with a small part stretching into Greece (fig. 1). It is surrounded by many mountains (with peaks up to 2600 m) and has continental climate. The largest river in the valley is Crna Reka; which had many tributaries in the past that are now dried out. The topography and fertile soil made this area suitable for agriculture and the foundation of settlements. Throughout the valley there is evidence for Early Neolithic occupation and the most common settlement types are tells; which point to a high level of sedentarism and construction of permanent villages which were in use for many generations (Naumov 2016; Naumov 2020). Vrbjanska Čuka and Veluška Tumba are both large tells which dominate the flatlands and the surrounding smaller sites. The site Vrbjanska Čuka is located in the north of the valley near to the city of Prilep and Veluška Tumba more to the south close to the border with Greece; next to the city of Bitola (fig. 1).

Vrbjanska Čuka was excavated several decades ago; with campaigns starting in 1979 and continuing for several years in the 1980's when the site was systematically studied for the first time (Kitanoski 1989; Kitanoski et al. 1990). The archaeological excavations recommenced in 2016 and are ongoing. In this new set of campaigns; the site and the material has been studied with a more interdisciplinary approach where geomagnetic scanning; digital topography; 3D modeling; use-wear analysis; lipid and isotope analysis; radiocarbon dating; archaeozoology and archaeobotany studies are being implemented (Beneš et al. 2018; Naumov et al. 2018; Naumov et al. 2021). Vrbjanska Čuka is one of the biggest Early Neolithic tell sites in Pelagonia which covers an area of around 2500 m<sup>2</sup>. It has the stratigraphic deposits reaching 3.5 meters in height; with several building phases in the end of the Early Neolithic in terms of Balkan chronology (Naumov et al. 2021). The radiocarbon dates indicate that the Neolithic settlement was first established around 6000 BC and stopped being occupied approximately 3 hundred years later (Naumov et al. 2018). The settlement was enclosed by a ditch and was densely inhabited consisting of more than 20 buildings. A remarkable preservation of architectural object has made it possible to identify many buildings with massive wattle and daub walls where multiple floor levels were documented (Naumov et al. 2021). Apart from buildings; many smaller architectural features and objects were also documented; such as ovens; bins; platforms; pits and so on; as well as numerous small finds; like sickles and grindstones. Many of them seem to have been used for food preparation; crop processing and storing; and are in accordance with the practice of agriculture (Mazzucco et al. 2022; Naumov et al. 2018; Naumov et al. 2021).

Another large tell site in the Pelagonia valley is Veluška Tumba; situated approximately 50 km to the south from Vrbjanska Čuka. The archaeological excavations at Veluška Tumba started in the 1970s and continued in the 1980s mostly focusing on the central part of the tell. Afterwards; no excavations were conducted until 2013 when a small campaign took place; and finally; from 2017 onwards; systematic multi-disciplinary research began. This new ongoing research; apart from excavation and revisions in stratigraphy and material culture; includes geomagnetic scanning; geological examinations; isotope analysis; radiocarbon dating and archaeozoological and archaeobotanical studies (Naumov et al. 2020; Naumov and Gulevska 2020). Veluška Tumba is another large tell with a height of almost 4 meters of cultural layers showing continual occupation in the period of Early Neolithic. The radiocarbon dates place the existence of the settlement between 6000 and 5600 BC which makes it roughly contemporaneous to Vrbjanska Čuka (Naumov et al. 2018). The conditions for the preservation of the architectural features were less favourable than at Vrbjanska Čuka; still it was possible to determine different building phases and architectural features. Remains of plastered floors; daub which was used for the construction of walls; post-holes and several well-preserved architectural objects were documented (Naumov and Gulevska 2020). The numerous artifacts discovered include very fine pottery with white painted patterns; anthropomorphic house models and figurines; but also tools which most probably fig. 2 served for cultivation and processing of the crops (Naumov et al. 2009; Naumov and Gulevska 2020). As a result of such precious finds and impressive material culture Veluška Tumba served as the eponymous site for the Velušinaporodin cultural group; characteristic of Pelagonian Neolithic.

#### Materials and methods

The data presented in this paper was gathered through analysis of archaeobotanical samples gathered in 2019 during excavation campaigns at both sites. At Vrbjanska Čuka; a total number of 43 samples were retrieved from different deposits and buildings. The sampling was carried out systematically and horizontally where different samples were taken from different features in the same occupational phase (fig. 2). The preliminary results presented here originate from 22 samples which come from 18 different stratigraphic units. As far as 2019 campaign at Veluška Tumba is concerned; the excavation included the revision of the profile made by researchers in the previous decades; the opening of a small control trench and coring for geological analysis (Naumov et al. 2020). This kind of excavation enabled the sampling for archaeobotanical analysis to be done vertically. Every stratigraphic unit documented in the profile was sampled and some stratigraphic units were also sampled in the control trench (fig. 3). Apart from this; many smaller samples come from geological cores which were drilled at different locations of the tell. There were a total of 87 samples acquired with very different sizes due to the origin of the samples. The preliminary results in this paper were gathered by analyzing a total of 17 samples from Veluška Tumba.

g. 3

Before any sample processing; the volume of each sample is documented. For retrieving the plant macroremains; the wash-over method (Kenward et al. 1980) was used. Before the procedure begins the whole sample is soaked in water. This technique requires taking a small fraction





of the soaked soil and its gentle disintegration in a bowl by adding more water; which then lets the charred organic components be separated by flotation. The charred contents are decanted over a column of sieves with different mesh sizes. These make up the organic (light) fraction and are divided on sieves with mesh size of 2mm and 0.35 mm. The same procedure is repeated until the remaining sediment in the bowl is barren of all the charred material and only the heavy components at the bottom remain. The bowl is then emptied and the heavy remaining material is subsequently divided into 8 mm; 2 mm; and 1mm fractions making up the inorganic (heavy) fraction. A small amount of soaked soil is again added to the bowl and the same procedure repeated until the whole sample has been processed. After drying and packing each sample is composed of 5 fractions – 0.35 and 2 mm light; and 1; 2 and 8 mm heavy.

The plant remains from all the fractions are sorted and classified if possible. If the 0.35 mm fraction is too large the subsampling is performed. Later the total number of remains for all taxa with 3 or more remains is multiplied to get the estimated number of remains in the whole sample. The 2 mm light fraction is always analyzed entirely. The identification of the plant remains and their taxonomic classification is done with the help of a stereomicroscope with magnification up to 40 times. This is done based on the observation of morphological traits of all the seeds and fruits recovered and with the help of a reference collection and atlases for the identification of plant species (Bojnanský and Fargašová 2007; Cappers *et al.* 2012; Jacomet 2006). All the classified remains are counted and the data is inserted into ArboDat (Kreuz and Schäfer 2002); which is an Access database specified for archaeobotanical analysis. Aside from the information on the sample and the archaeological context (site; date of excavation; date of sieving; stratigraphic unit; type of unit; quadrant; sample number; sample volume) this database contains information on plant taxa and the taphonomy of plant remains (taxon; ecological group; type of remain; way of preservation; number of remains; number of fragments).

The micro-refuse approach (Ullah *et al.* 2015) involves sorting and observation of specific elements in all the five fractions in each sample; and comparing their volumes. First the volume of each fraction is noted. Further; over 30 variables including any recognizable category preserved in the fractions are quantified. The observed and quantified elements are as follows: bone; bone charred/calcined; fish bone; complete shell; shell fragment; microfauna; microfauna charred/calcined; rodent pellets; charred seed/fruit; mineralized seed/fruit; chaff; straw; tuber; charcoal; other organic remains; daub (ml.); daub with spikelet impressions; daub with flat side; stones/pebbles; stones/pebbles (ml.); pebbles/sand (ml.); heavy mineral; other stones; quartz flake; flint flake; pottery; modern roots; other. These small-sized remains become visible due to sample processing by washing; and would otherwise stay unrecovered. The main goal of this method is to observe patterns in their occurrence which can reflect anthropogenic activity in different areas of the houses (for example cereal processing; meat processing; waste disposal) (Antolín *et al.* 2020). This method was so far only applied to the material from Vrbjanska Čuka since the samples were spread in a horizontal manner and because the samples were taken from defined buildings and features.

#### Results

The total volume of the 21 samples from Vrbjanska Čuka before processing was 132 liters; and the 17 samples from Veluška Tumba were made up of 52 liters of soil. Both sites have shown a high number and density of remains per litre of sediment indicating good preservation conditions. In total for both sites; we have recovered almost 9000 carpological remains; that is remains of seeds; fruits and other plant parts in relation to the fruit. The sample with the biggest density of classified carpological remains had over 1,750 remains per litre of sediment;



yet the average density of remains is a little above 100/litre of sediment. Both sites show similar trends when it comes to relative abundances of classified carpological remains; so their relative frequencies will here be considered grouped up. The plant remains were mostly preserved by charring (99.6%) but some remains come in a mineralized state (0.4%).

The majority of plant remains belong to cultivated crop plants (74%); of which most are the remains of cereal chaff (59.5% of total) and grain (13% of total); and a small percentage comes from legume seeds (1.5% of total). Among the plants which were cultivated in the past the dominant species is einkorn (*Triticum monococcum*) at both sites; followed by emmer (*Triticum dicoccum*) (**tab. 1**). Apart from these two; another species from the genus *Triticum; Triticum timopheevi* (sometimes referred to as "new-glume" or "new-type" wheat) is present at both sites; and on Vrbjanska Čuka two-grained einkorn is also documented in somewhat smaller quantities. Among the cereals; barley (*Hordeum vulgare*) also occurs relatively commonly at both sites and it is represented by at least two cultivars; hulled and naked variety. As mentioned above; pulses comprised a less abundant crop group; but two species; lentil (*Lens culinaris*) and pea (*Pisum sativum*); were regularly encountered. Only two specimens of bitter vetch (*Vicia ervilia*) were encountered at Vrbjanska Čuka.

The sampling at Veluška Tumba gave us the opportunity to observe the different stratigraphic layers which were documented in the profile (**fig. 3**). The preliminary results indicate an interesting trend in the occurrence of domesticated plant taxa. The samples which originate from the lowermost layers (correlating to stratigraphic units 10; 7; 6 and 5 – **fig. 4**) had very little or no plant remains originating from crop plants. The crop plant taxa in these samples make up 11% of the total classified carpological remains; and gathered plants make up 40%. The domesticated plant taxa show up in much larger quantities in the upper layers. Among the layers with a higher abundance of domesticated taxa; in the four of the lowest ones (correlating to stratigraphic units 4; 3; 2; 1) barley has a percentage of 13 %; and in the upper layers (57; 58; 21; 12) it is occurring only as a very small proportion of the crop taxa with only 1% (**fig. 4**).



Besides the cultivated plants; the remaining taxa are wild plants of which some are edible and could have been intentionally gathered. They were considerably abundant at both sites (tab. 1) and account for 20% of all the classified carpological remains from both sites. The rest of the wild plants (5.5%) could have been brought to the site accidentally or could be the remains of weeds which were growing on the cultivated fields. Fat-hen (Chenopodium album) is remarkably abundant at Vrbjanska Čuka; and is also the most abundant species among gathered plants at Veluška Tumba. Next; there are several species with edible berry-like fruits which come up in substantial quantities. These are primarily elderberry (Sambucus sp.) and bramble (Rubus fruticosus)

abundant at both sites. Then; sloe (*Prunus spinosa*) and wild strawberry(*Fragaria vesca*); both somewhat abundant at Vrbjanska Čuka and represented by one specimen at Veluška Tumba; and cornelian cherry (*Cornus mas*) with a single find at both sites. Apart from these; hazel (*Corylus avellana*) at both sites; and apple/pear (*Malus/Pyrus*) at Vrbjanska Čuka also fall into the category of gathered plants and were less abundant.

The preliminary results of the micro-refuse analysis conducted at Vrbjanska Čuka show suggestive trends in the occurrence of observable elements of some samples (**fig. 5**; **fig. 6**). Since the samples originate from architectural features; most of them have a large quantity of daub present. 15 out of 20 samples have bone and shell remains present in at least a small amount; and the carpological remains and pottery fragments have the same ubiquity. In several samples (17; 18; 19; 21; 26; 27; 40) the carpological remains make up the about 80% of all the counted elements in the sample (graph 2). Charcoal was present in all samples but one; sometime in smaller amounts and at times being the dominant element (samples 15; 20; 30; 31; 41). The stone flakes were documented in 6 samples; usually in low quantities.

#### Discussion

The results of archaeobotanical analysis at Vrbjanska Čuka and Veluška Tumba indicate that in Pelagonia agriculture was practiced in the Early Neolithic. Since both sites show a very similar picture; and we have analyzed almost three times more material from Vrbjanska Čuka; we can imply that the results can be sufficiently accurate to characterize the main economic plants already at initial stages of research. The biggest number of recovered plant remains at both sites belongs to crop plants. Certainly; the most important crop at both sites; and in all the phases is einkorn (**tab. 1**; **fig. 4**). Since there are einkorn; emmer; *T. timopheevi*; two varieties of barley; as well as two surely confirmed pulses present; we can say that the crop choice is remarkably diverse; and we cannot exclude a possibility that future investigations may expand the list of cultivated plants in the area. Such a picture points to a big significance of crop husbandry; and henceforth to the principal role of agriculture in the subsistence strategy already in the Early Neolithic times. The crop spectrum is similar to the situation on the Early Neolithic sites in the surrounding regions; like the ones in Greece and Bulgaria where plenty of data has been gathered (Marinova and Valamoti 2014). However; since no oil plants have been discovered yet;

and the cereal and legume spectrum is narrower than in the Near East (i.e. absence of naked wheat and chickpea) from where these crops originate; it is possible that the environmental factors influenced the choice of crops which were cultivated. Further research; which will include investigations of other aspects of crop cultivation; such as sowing and harvesting time; will bring more information needed to conclude on this topic (for some preliminary results in this sense see Mazzucco *et al.* 2022).



fig. 6

The vertical distribution of the samples from Veluška Tumba made it possible to observe temporal changes which were particularly notable when it comes to the relative abundances of crop taxa in the archaeobotanical assemblage (fig. 4). First; the samples coming from stratigraphic units correlating to the earliest phases of occupation at the site (stratigraphic units 10; 7; 6; 5) had a very small percentage of remains of domesticated species among the total number of classified remains in comparison to later phases. If confirmed after more extensive sampling in the near future; this could give a strong indication that at the initial phases of life in this settlement people relied more on the gathered plants in their diet; since their occurrence in these samples had a higher percentage; and that agriculture gained in importance gradually. The next observation concerns the importance of barley in different phases. In the layers where crop plants already have a higher occurrence; the ones correlating to earlier phases (stratigraphic units 4; 3; 2; 1) display a higher significance of barley as a crop; and its importance seems to be diminishing in the later phases of life in this settlement. This might be in connection to the development and mastering of the agricultural practices in the new kind of environmental setting in the later phases of occupation; since barley is a more resilient crop (shorter and earlier growing period; low-demanding in terms of soils) but not as palatable as different species of *Triticum*; and is often used as animal fodder (Zohary and Hopf 2000; 59). Nevertheless; barley has multiple uses (i.e. the production of beverages) that must not be underrated; and only after a more extensive sampling and a context-based taphonomic analysis it will be possible to give a more accurate interpretation of these results. With the available data; it seems that it is possible that one can here follow how through a few generations the villagers started relying fully on agriculture; and through another few generations overcame the environmental constraints and developed their own preferences when it comes to crop husbandry. Nevertheless; our research is at very initial stages and more comprehensive data needs to be collected to confirm such assumptions.

Plenty of wild plants with edible seeds and fruits were present in notable amounts at both sites. They were mostly represented by charred seeds; but on several occasions whole fruits were recovered in a charred state (**fig. 6**). Very often these remains were recovered in contexts related to food preparation or consumption which further confirms their intentional gathering. Their large amount indicates that gathering was an important activity and that harvested goods were plausibly stored within the houses (Antolín *et al.* 2020). These practices are in accordance to the situation in the surrounding areas in the Neolithic period (Marinova *et al.* 2013; Filipović *et al.* 2018; Valamoti 2015). Apart from fleshy fruits and nuts which were commonly gathered in prehistory; a plant which drew the attention of the inhabitants of Vrbjanska Čuka and Veluška

Tumba was fat-hen; which could have been gathered for the consumption of its green; tasty leaves and small; nutritious seeds (**fig. 6**). This plant could occur at archaeological sites due to unintentional gathering in the past since it commonly grows as a weed among cereal crops; but since it was immensely abundant at Vrbjanska Čuka; and was also present at Veluška Tumba in large quantities we excluded this possibility. The interpretation of the charred seeds of fathen at prehistoric sites as a result of gathering and consumption is not uncommon and many researchers agree that prehistoric people did not see it as merely a weed plant (Marinova *et al.* 2013; Mueller-Bieniek *et al.* 2020). The plants with edible; tasty and nutritious fruits and leaves which were available for gathering in the surrounding; were rich in vitamins; minerals and fibers that; together with cereals and legumes rich in carbs and proteins; made the diet of Early Neolithic people well balanced. Of course; this all refers to the plant part of the diet but a big proportion of energy; especially rich in proteins and fats; was introduced through animal products; as indicated by archaeozoological and pottery residue analysis (Naumov *et al.* 2021).

The samples for Vrbjanska Čuka were spread out in a horizontal manner which has provided a chance to observe spatial patterning indicating human activities in the past with the application of micro-refuse approach (fig. 5). Most of the samples consist of building debris mixed with residues of several daily activities. Some of the observed patterns are very obvious and straightforward; as is shown by sample 15. This sample came from a posthole and therefore only charcoal; which represents remains of the post; was recovered. Some other samples give more significant results; such as sample 18 in which almost exclusively cereal grains and chaff were recovered and in large amounts. This sample was collected from a burnt area next to two oval bins which; therefore; probably served as cereal processing installations. The sample 27 contained plenty of carpological remains; and since it is coming from an area near an oven; we can assert that these remains represent food preparation. Also, plenty of unidentified charred objects, which might represent charred remains of food, were also discovered in this sample which is in accordance with such assumptions. Further microscopic analyses need to be conducted on these remains to confirm their nature. The sample number 17 consisted of almost only plant remains; and given the fact that the vast majority of these are chaff and husks; we can assume that it is connected to activities of cereal processing like de-husking. Sample number 40 also has a high number of carpological remains and the cereals are represented mostly by chaff remains which also indicate crop processing; and it is most probably a mixed accumulation of processing by-products. Another rich sample is the sample 41 which has an extremely large concentration of charcoal but also carpological remains. This sample represents a layer of plaster from one of the buildings and is most probably a combustion residue.

Different types of variables; apart from plant remains; also give to noteworthy results (**fig. 5**). The refuse deposits are characterized by a mixture of charcoal; seeds; chaff; bone fragments and potsherds of which the best representative is the sample 11; but some other samples point to the same situation. The sample 11 is coming from a pit and this way we can confirm its role as a place for refuse. Sample 13 is similar but perhaps more indicative of consumption residues; with burned bone fragments; fish remains; shells and so on.

By the observation of the patterns in the occurrences of small remains in the samples; we can say that people at Vrbjanska Čuka used the domestic spaces and architectural installations for conducting tasks like cereal processing. The last phases of crop processing and de-husking which involve activities like fine-sieving and sorting were probably conducted on a daily basis before food preparation. The crop cleaning by-products and food remains could end up in fire installations or refuse pits.

#### Conclusion

Based on the results of an integrated archaeobotanical and micro-residue analysis; even though still at a preliminary level; we can draw first conclusions about several important topics. In the Early Neolithic Pelagonia; communities depended on agriculture as a main subsistence strategy. A broad crop spectrum shows similarities to sites in the surrounding areas; but a small reduction in diversity was observed. This possibly indicates adaptations to the environmental constraints; but might also represent the preferences of the community. Further research will confirm whether the absence of some species is not just due to the preliminary state of the analyses here presented. The assumption that the importance of agriculture is less prominent in the earliest periods of the life at the settlement at Veluška Tumba is notable; but needs further confirmation. As expected in an agricultural community; the plant part of the diet is mainly coming from cultivated species; but a strong input is coming from collected wild fruits and leafy greens as well.

Speaking of the domestic activities; we have evidence that cooking; cereal processing and other alimentary and post-harvest activities were performed in the houses. It was also possible to trace microscopic evidence of rubbish disposal and consumption residues. All the results give important insights and testify that the preservation conditions at these two sites are at an admirable level. This gives a very promising note to the future investigations at Vrbjanska Čuka and Veluška Tumba and the integrated approach presented here will continue to be implemented.

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### **Used Illustrations**

Fig. 1. Map showing the location of the sites. Map: G. Prats.

**Fig. 2.** The excavated area at Vrbjanska Čuka. The red outlined area is indicating where the samples in 2019 campaign were collected from. Photo: Hristijan Talevski.

**Fig. 3.** The profile and the control trench at Veluška Tumba. The red outlined area is indicating where the samples in 2019 campaign were collected from. Photo: Goce Naumov.

**Fig. 4.** Graph representing the amount of remains of each crop (grain and chaff separately) at Veluška Tumba (left) in correlation to the stratigraphic units from 2019 campaign presented on a Harris matrix (right). The numbers on the graph represent the total number of remains per litre of sediment in each sample. Graph: Ferran Antolín; matrix: Goce Naumov.

**Fig. 5.** Two graphs representing the total number (top) and the relative frequencies (bottom) of different variables observed in the micro-refuse analysis in each sample. The numbers for each sample were obtained by dividing the total number of remains in each category by the number of liters of sediment, so the samples of diverse size are comparable. Graphs: Amalia Sabanov.

**Fig. 6.** Charred remains of wild gathered plants which were recovered at Vrbjanska Čuka and Veluška Tumba: a – fruit of sloe (*Prunus spinosa*), b – fruit of elderberry (*Sambucus* sp.), c –seed of bramble (*Rubus fruticosus*), d – fruit stone of hazel (*Corylus avellana*), e – seeds of fat-hen (*Chenopodium album*). Photos: Raül Soteras.

**Tab. 1.** Table with results of the archaeobotanical analysis at Vrbjanska Čuka and Veluška Tumba, with total numbers of classified remains of cultivars and gathered plants presented.

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Cultivated plants	Vrbjanska Čuka	Veluška Tumba
Hulled barley, grain (Hordeum vulgare var. vulgare	39	16
Naked barley, grain (Hordeum vulgare var. nudum)	17	9
Barley, chaff (Hordeum vulgare/distichon )	15	29
Emmer, grain (Triticum dicoccum)	37	7
Emmer, chaff (Triticum dicoccum )	280	148
Einkorn, grain (Triticum monococcum)	112	23
Einkorn, chaff (Triticum monococcum)	1334	773
2-grained einkorn (Triticum monococcum)	24	0
Timopheevi wheat, chaff (Triticum timopheevi)	96	58
Lentil (Lens culinaris)	48	8
Garden Pea (Pisum sativum )	60	4
Bitter vetch (Vicia ervilia)	2	0
Garthered plants		
Fat-Hen (Chenopodium album )	1480	88
Cornelian-Cherry (Cornus mas)	1	1
Hazel (Corylus avellana )	1	2
Wild Strawberry (Fragaria vesca)	5	1
Apple/Pear (Malus/Pyrus)	3	0
Sloe (Prunus spinosa)	7	1
Bramble (Rubus fruticosus)	19	3
Elderberry (Sambucus sp.)	12	14

t. 1

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# Теренско истражување на археолошкиот локалитет Врбјанска Чука (Пелагонија) во 2020 и 2021 година

# Fieldwork Research on the Archeological Site Vrbjanska Čuka (Pelagonia) in 2020 and 2021

На археолошкиот локалитет Врбјанска Чука се вршеа ископувања и во последните две години, така што се продолжи со истражување на неговиот централен дел кое започна во 2016 година. Во рамки на овие две кампањи целта беше да се проучат преостанатите антички и средновековни елементи присутни во овој дел на тумбата, како и да се регистрираат сите појави во последните неолитски хоризонти. Притоа се открија нови доцноантички градежни содржини и средновековни гробови и јами, а се документираа елементи и од последните објекти градени во неолитската населба пред нејзиното напуштање. Во 2021 година, исто така, детално се проучуваа сочуваните остатоци од најраните фази на оваа населба, а кои биле во голема мера оштетени со експлоатацијата на песок во 1970-те години и со вадењето на големиот неолитски амбар од Градба 1 во 1980-те години. Притоа, се направи увид во начинот на кој е извршен упад и оштетување на археолошките слоеви, но, исто така, се истражуваа и малубројните остатоци од повеќе неолитски фази во кои се содржани архитектонски елементи и фрагменти од материјална култура.

Клучни зборови: Пелагонија, тумба, неолит, доцна антика, среден век, архитектура

Excavations have been carried out at the archaeological site Vrbjanska Čuka in the last two years, so that the research of its central part which started in 2016 continued in 2020 and 2022 as well. Within these two campaigns, the goal was to study the remaining Classical and Medieval

elements present in this part of the tell, as well as to register all features in the last Neolithic horizons. New Late Classical building contents and Medieval graves and pits were discovered, and the elements of the last buildings built in the Neolithic settlement before its abandonment were documented. In 2021, the preserved remains from the earliest stages of this settlement were also studied in detail, which were greatly damaged by the exploitation of sand in the 1970s and by the removal of the large Neolithic granary from Building 1 in the 1980s. Thereby, an insight was made in the manner of intrusion and damage of the archaeological layers, but also the small remains of several Neolithic phases were included, which contain architectural elements and fragments of material culture.

Keywords: Pelagonia, tell, Neolithic, Late Antiquity, Middle Age, architecture

The archeological site Vrbjanska Čuka, which is located 1.2 km south of the village Slavej in Pelagonia, is continuously explored from 2016 to 2021 (**fig. 1**). The Center for Prehistory Research, Institute and Museum — Prilep and the Institute for Old Slavic Culture, as well as numerous European institutions that are focused on laboratory analysis, are participating in its fieldwork and cabinet study. The multidisciplinary approach in the research of Vrbjanska Čuka provided a series of new insights that gave a thorough picture of life in this Neolithic settlement, which after its abandonment functioned as an Roman *villa rustica* and Medieval necropolis (HayMoB u dp. 2018; Naumov *et al.* 2021). In that direction, it was continued in 2020 and 2021 when excavations were carried out in the centrally placed archaeological trench, while the archeobotanical analyzes were carried out in the museum. The results of the fieldwork will be presented on this occasion, while the outcome of the latest archaeobotanical analyzes have been elaborated in several publications (Antolin *et al.* 2021; Sabanov *et al.* 2021; Mazzuco *et al.* 2022).



**Excavations in 2020** 

Given the pandemic nature of 2020, some of the planned multidisciplinary activities were reduced due to the limited preventive measures of the involved international and domestic experts. As a result, research this year has focused solely on excavating and documenting the findings. However, during the fieldwork, samples were taken for geoarchaeological, archaeobotanical, micromorphological and chronological analyzes, which are planned to be performed in the forthcoming period.

The excavations were carried out for one month in the trench started and continuously researched from 2016, which is located in the central part of the tell (**fig. 2**). During the excavation, quadrants 25 and 32 in the upper strata were explored, where the Medieval and Classical layers are present, and also certain research was continued in Building 2 and Building 4 in the quadrants 17 and 26. The work in quadrants 25 and 32 reached the highest Neolithic levels, which was one of the primary tasks for this campaign, in order to open a wider area of the later Neolithic phases of the site and which in future campaigns would be fully explored. This will provide a better insight into the archaeological units and features of the final stages of the Neolithic settlement, which previously could not be registered in detail. As a result of this concentration of Medieval and Classical layers in these quadrants, several graves and new architectural elements were discovered, which provided additional insight into the rituals and structures of the Medieval period. At the same time, in Building 2, the remaining fallen daub on the oven (SE 322) and the area around it were removed, and samples for archaeobotanical and radiocarbon analysis were collected from the floor. In parallel with this work, the dug canals in Building 4, made for the foundations of a later building (Building 16), were also explored.

The Harris Matrix was used to document the archaeological phenomena employing the Stratigraphic Units (SU) model, while all characteristic phenomena were photographed and draw. As previously stated, during the excavations, samples were taken for laboratory analysis, not only from Building 2, but also from the pits and the ground in the dug canals on Building 4. In the last days of the fieldwork, the entire trench and certain structures were photographed by drone, and the resulting illustrations were used to create an orthophotographic survey and a new photogrammetric 3D model of the discovered architectural units.

The research of Vrbjanska Čuka this year was in the domain of the planned directions, which is the definition of the Neolithic settlement, but also a detailed study of the Classical and Medieval phases of the site. Although the primary interest of most researchers and specialists is focused on various segments of the Neolithic period on the site, still the research is equally concentrated on the architectural and material remains of the later stages of this tell. Thus, in 2020, all elements of the Medieval necropolis and Classical remains were fully studied, while the new contents of the Neolithic buildings were documented in parallel. In this sense, this year's fieldwork can be divided into several thematic categories, such as: graves, pits, architecture, photogrammetric modelling and 3D reconstruction.

#### Graves

Medieval graves on Čuka Vrbjanska have been registered during excavations in the 1980s, their numerous and presence has been confirmed in the new archaeological campaign that began in 2016 (Миткоски 2005; Наумов *и др*. 2016; Naumov et al. 2018). In that sense, it was not a surprise the appearance of new graves





fig. 3

during this year's excavation, which are again present in the first cultural layers, i.e. just below the surface humus. Remains of four individuals were registered in quadrant 32, i.e. SU 566, 567, 568 and 603, which are at the same levels as the skeletal remains from previous excavations.

CE 566 is only a part of the individual, as the skull, right humerus and several ribs have been discovered (fig. 3). The remaining bones are not present so it remains to be debated whether they were blown up by later ploughing, decomposed by the effects of the ground, or deliberately removed from the buried individual. All three interpretations are possible given that elements of these phenomena are registered on the site, although there are no specific indications for the particular skeleton.

SU 567 is an almost completely preserved individual, but it lacks the pelvis and both ulna and radius (fig. 3). In this case, it can be assumed that these parts were removed during ploughing, which went deep into the central part of the skeleton and that is certainly difficult to confirm.

CE 568 is detected in the western profile of quadrant 32, with only the tibia, metatarsal

bones, and phalanges of the foot (fig. 3). This individual remains will be studied in one of the next archaeological campaigns when there will be an expansion of the quadrants to the west. It should be noted here that this individual, like the other mentioned above, is laid in the east-west direction and follows the standard Christian traditions of burial, which in turn determines their temporal and cultural character.

SU 603 is a surprise in the domain of Christian funerary rituals. It considers burial, i.e. deposition of a skull in a deep pit - SU 594 (probably for storage of grain, because elements of garbage are not found in it). Although skulls or isolated skeletal bones have been found in previous campaigns, this is the first time it has been carefully placed at the bottom of the pit in a specific way (fig. 4). Namely, this skull is carefully halved into two parts, i.e. the front part (the face) and the back part of the cranium. They are placed next to each other and during the filling of this rather large pit with organic fig. 4



content (grain), their position is not displaced, which indicates a controlled and planned act. This ritual practice is an obvious deviation from the Christian traditions and deserves a more thorough interpretation in the future, as well as an analogy with other similar phenomena.

In the context of the graves, also SU 546 should be mentioned which was discovered in the last campaign, but deserves attention in this report as well, given the phenomena present below it, a situation present in some of the other graves. Yet again, these are the remains of legs that have been found in the western profile of quadrant 32, and under which structures have been registered that require more detailed attention.

#### *Grave structures*

Speaking about the graves in Vrbjanska Čuka, it is interesting to point out that there are no indicators for their presence and position, nor are the grave pits bounded by some material (stones or bricks). Also, despite the careful excavation of the upper levels of the pits, there is no clear separation of their contours, which indicates a relatively shallow digging or laying of dead individuals. In addition, the elements that are characteristic of the coffins, i.e. nails and plates are absence, and they are not detected at all in the graves and their vicinity. The absence of grave goods (jewellery, vessels, crosses, etc.) should also be noted here, although 2 rings have been confirmed as registered material during excavations since the 1980s (but outside the graves) (Миткоски 2005).

In the context of the grave units of Vrbjanska Čuka it is important to point out the area under the graves themselves. Namely, in the last research campaigns on the site, including the one in 2020, paved areas were discovered just below the skeletal remains (Naumov et al. 2018). It is a paving with tiles (SU 591) or stone (SU 592) which is in relation to the grave and that is an area on which the deceased probably were placed (fig. 5). In SU 591 the paving is done with fragments of tiles that are placed in a rectangular unit, while the stones from SU 592 are

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massive and arranged on several levels below the deceased. Pavement with tiles (SU 573) is also registered near the grave SU 568, above the stones SU 592, so it can be considered that such an area was present in several graves. It is interesting that under these structures, i.e. graves there are pits, while the pit SU 594, in which the skull SU 603 was discovered, is located exactly between the individuals SU 546 and 568. In that sense, it can be considered that the pits besides their depositional function also had a ritual character and some of them were related to burials.

#### Pits

It is common for Pelagonian tells to have a Medieval or Classical horizon with a multitude of pits, most likely for grain storage. Such is the situation with Vrbjanska Čuka, where dozens of pits have been discovered, quite densely distributed (HayMOB  $u \ \partial p$ . 2018). Pits were also registered in 2020, a total of 6, several of which were related to burials, while the rest retained their primary function (**fig. 6**). Their diameter varies between 0.7 and 1.4 meters and depth up to 1.8 meters. They do not reveal much material (except for the modest presence of Neolithic and Medieval pottery, as well as massive stones in SU 574), which indicates that they may have contained organic waste or more likely grain that was stored until it was transported to villages and towns near Vrbjanska Čuka. Given the densely distributed pits and the absence of a Medieval settlement on this tell, it can be considered that they primarily had a storage function.





The pits SU 575, 593 and 594 partially deviate from this role, which are in some way related to the burials, i.e. later deceased individuals (un)intentionally laid on them, while at the bottom in SU 594 a carefully placed transversely separated skull was found. Given the symbolic connection between the grain and the burial rituals, this role of the pits should not come as a surprise, although it is unusual for graves to be placed right on top of them, a practice not well known in other sites (perhaps due to lack of research).

It should also be noted that some of the pits identified in 2020, as in previous archaeological campaigns, are so deep that they can even reach the walls and floors of some Neolithic buildings. Thus, for example, at the bottom of the pit SU 579 a daub from the Neolithic Building 3 or Building 12 is registered, while the pits SU 576 and SU 593 reach a clay plaster (probably floor) from a Neolithic structure on Building 15, which is located next to Building 2 i.e. on its western side. This deep digging of the pits also contributed to the large presence of daub in the Medieval and Classical layers, which was actually removed during the penetration into the Neolithic layers. Due to these characteristics of the pits, they are often used as control trenches through which the Neolithic layers can be documented and monitored, which in turn enables consistent reconstruction of the architectural dynamics in this period in many parts of the settlement.

#### Architecture

Vrbjanska Čuka is recognizable for its specific architecture, especially in terms of Neolithic buildings (Миткоски 2005; Naumov 2013; Naumov 2020). As for the Classical and Medieval period, the architectural elements are far more modest, but still they are present and indicate certain building traditions. The same was stated in 2020, when several Medieval and Classical architectural features were discovered, and new elements were also defined in the Neolithic buildings.

### Classical and Medieval architectural features

Architectural remains from Roman era and the Middle Ages are very rare on Vrbjanska Čuka, which indicates that there was no active village in these periods, but only a few buildings probably in function of the economic character of the pits. In this sense, a compacted earth floor (SU 577), elements of unfired daub (SU 587) and several postholes (SU 589) were discovered in quadrant 32, which partly suggested Neolithic features (**fig. 7**). However, after careful exploration of this archaeological unit, Late Classical ceramic material was discovered, which determined the dating of the building. This confirms that prehistoric architectural techniques were maintained in the Classical period as well, which should not be surprising given their presence in the Balkan villages until the 20<sup>th</sup> century (Hammuee 1993).



Apart from these building elements and the above-mentioned grave structures, no other architectural contents were discovered in quadrants 25 and 32 that could be attributed to Classical period or the Middle Ages. This additionally contributes to the economic character of the tell in these periods and its primary use as a space for grain storage after harvesting the fields.

#### Neolithic buildings

Although excavations in 2020 were focused on the upper layers of the tell, several Neolithic structures detected during previous archaeological campaigns were still explored. In the layers just below the Classical horizon in the quadrants 25 and 32 the last Neolithic architectural features were registered. This is SU 609, which is the remain of a wall of unfired daub, typical for the architecture of the Neolithic tells in Pelagonia (HayMOB  $u \partial p$ . 2020; HayMOB  $u \partial p$ . 2021). In this context, the discovered same vessels were as in the lower Neolithic strata, as well as legs of altars and bones, which confirms the complete belonging to this period. In the lower levels of SU 609, more pebbles and grinding stones were registered, which indicates the presence of a floor that was not detected during the research. Given that the remains of this building cannot be related to those that were previously discovered, for the moment it can be conditionally characterized as Building 18, at least until further research to determine its individuality or connection with another building.

In parallel with the work in the upper layers, parts of Building 2 were explored, which due to its massiveness remains to be explored in detail in several more archaeological campaigns. In 2020, parts around SU 322 (the oven in the western part of the building) were explored, where a floor was registered on which this oven was placed (SU 598) (**fig. 8**). It is extended throughout the north-western part of Building 2, i.e. below the platform where this economic unit is placed,



and where also several more pits for piles / columns were discovered (SU 599 and SU 610). Remains of another round bin (SU 600) were found on the floor, which was actually levelled when the floor was being renovated (SU 605) in its second phase. This bin is located between the oven SU 322 and the bin SU 527 so that together they form an economic unit very similar to the one in the eastern part of Building 2, especially if it is considered that here as well a grinding stone was vertically, i.e. laterally placed.

Excavation was also performed on the remains of Building 16, i.e. in the southern part of this construction. Namely, the canals SU 612 and 613 were explored which form the southeast corner of the Building 16 and were dug to make a foundation for its walls. In SU 613 postholes (SU 616) were discovered on which branches were woven and the daub was applied. Canal SU 612 is dug down to the floor of Building 4 (SU 617) which confirms that Building 16 is established on the remains of Building 4. The section of this canal demonstrates the remains of a structure belonging to Building 4, most likely an oven or a bin (SU 618) cut from it, which remains to be explored in one of the following archaeological campaigns.

### 3D animation of the Building 2 and photogrammetric modelling of the trench

In addition to the standard documentation of the site, the archaeological trench usually conducts field and aerial photo research, i.e. it is scanned and modelled in 3D format (HayMOB  $u \partial p$ . 2016; HayMOB  $u \partial p$ . 2018; Naumov *et al.* 2021). This year, with employment of digital software and drones, as well as the application of photogrammetry, orthophotography and digital elevation models, the illustrations were obtained that enable a detailed overview of the architectural contents. On this occasion, the methods and results of the 3D animation of Building 2 and the photogrammetric modelling of the entire trench will be briefly explained. The possibility for their application in the cabinet research will be presented, but also within the presentation of the real cultural heritage.

With the advent of computer technology, the environment in which the first farmers once lived can easily be fully represented. It is a 3D technology through which visual reconstruction is achieved. For the preparation of such a reconstruction, it is primarily to carry out archaeological excavations, through which information necessary for making a 3D model is obtained. It is a set of information related to the construction itself, i.e. from which period it originates; what type of building it represents; what was its function; what were its dimensions; whether it had exterior and interior decorations; what the household was consisted from and everything else that can help to make a consistent visual interpretation of the building, and then the overall ambience in which it was located.

During the preparation of the 3D model of Building 2 in Vrbjanska Čuka, the multi-year field researches and documentation were used, which completely determined the boundaries of the extension of this object and its interior. After the accumulation of this information, the next phase of the visual reconstruction was approached, i.e. the modelling itself. This model is made



with the help of Adobe Maya software, applied for 3D modelling and Lumion software in which the animation and textures of the models are made (**fig. 9**). The procedure itself can be divided into three stages: sketching, modelling (i.e. decorating the objects in order to obtain the desired shape and material texture) and animation of the model.

The first phase consists of cylinders, squares and spheres that gradually develop into walls, ceramic objects and wooden structures. In this phase, attention is paid to the dimensions and positions of the construction according to its real situation in the archaeological trench. After obtaining the initial image of the model, the next phase is approached, which represents the visualization of the previous polygons, i.e. facilities. This phase can be divided into two parts: the first part is modelling the walls, structures, piles and the floor, while the second phase is the production of ceramic materials, i.e. the household. For the first part of the building, the simplest tools offered by the Adobe Maya program were used in order to achieve the material texture of the objects, i.e. the walls, the piles and the floor. The second part is more complex and requires meticulous skills, and archaeological knowledge is necessary for making ceramic vessels and ovens. In consultation with the site explorers, the most distinctive forms of vessels were used to make the ceramic vessels, while drawings from the excavations of sites related to Vrbjanska Čuka were used for the bins and ovens that are not fully preserved and for which there are only technical bases.

The last stage of the modelling is the textures and animation that were made with the Lumion software. Texturing is a process through which the made models get their final outlook. After this procedure, the animation is prepared, i.e. making a video where the camera moves through the outer space and the inner interior (**fig. 10**). Finally, by rendering within the software, the final product is obtained and which is saved as a video.

As part of a complex multidisciplinary research methodology, several field and aerial photographs were taken. Using these data and the data for the grid of the site, three-dimensional models with moderate and high level of detail were generated using photogrammetry. In addition to







#### fig. 11

these results, the possibilities of using the obtained data in advanced spatial analysis were tested (horizontal and vertical cross-sections that intersect at different phenomena at different places and heights, as well as optimal path modelling, visibility analysis and flood modelling). All this was done as an attempt to find an adequate methodological approach that could cover all aspects of the relatively complex archaeological site, from excavations and documentation, to research and conservation, and finally to proper presentation.

#### **Excavations in 2021**

During the fieldwork research at the Vrbjanska Čuka site in 2021, the goal was to expand the archaeological trench to the north. As a result of this strategy, six quadrants were opened, with the trench expanding 10 meters to the north and 15 meters in the east-west direction (**fig. 11**). Thus, the dimensions of the whole trench are now 30 x 20 meters, although the shallow damaged quadrants in its north-eastern part remain to be opened. Given that in the western part the trench covers an area that was partially or largely excavated in the 1980s, the intact and unexplored space was only the squares 15 and 8. In contrast, squares 14 and 9 are partially explored, while 13 and 10 were completely excavated during intensive archaeological campaigns in the 1980s. Therefore, during the excavations in 2021, the projected research area did not have the same chronological and archaeological contents.

Nevertheless, one of the main directions for all quadrants was to be equally explored and documented, with quadrants 15 and 8 providing insight into the Medieval and later Neolithic strata, and quadrants 14 and 9 exploring the earliest Neolithic horizons (unfinished during the excavations in the 1980s), while in quadrants 13 and 10 the previous excavations will be revised and the contours and preserved elements of Building 1 (also registered and documented in



fig. 12

fig. 13

the 1980s) will be determined. In this way, completely new knowledge of the Medieval and Neolithic contexts was obtained, but also the methodology and archaeological approach in the 1980s was revised based on the preserved contents. Therefore, this review will provide insight into the situation, as well as new data on the Neolithic and Medieval elements in the unexplored and partially explored quadrants from previous archaeological campaigns.

#### Quadrant 13

As mentioned above, quadrant 13 is located at the site of the earliest excavation trench on Vrbjanska Čuka, where in 1979 its exploration began as a result of damage to the tell during the exploitation of sand from its central and eastern peripheral part (Μμτκοcκμ 2005). In the first few campaigns, this space was defined and Building 1 (then named House 1) was registered, which after the documentation was largely damaged due to the removal of the massive conservation granary (today exposed in the Institute and Museum – Prilep). Therefore, during the research in 2021, the excavations made for the extraction of the granary were detected in this quadrant, which greatly damaged Building 1 (**fig. 12**). Therefore, only a few elements probably belonging to this structure have been discovered in this quadrant.

Specific for this quadrant is the central deep dug hole made for the extraction of the granary, which partially enters the quadrants 14, 8 and 9. This 1980s excavation was placed in a northwest-southeast direction and probably followed the position of the granary, so that it could be easily and without damage removed from the trench. Therefore, the excavation is quite deep and penetrated far below the archaeological layers, which was detected during the formation of sections in the western part and the southern half of quadrant 13. Although with its formation, Building 1 was significantly damaged, still in the peripheral parts of this quadrant its remains are preserved and which were also documented during this year's archaeological campaign.

In the southern half of quadrant 13 was the virgin soil (SU 626 and 639), i.e. natural Neogene sand, in which pits for columns and piles (SU 630, 634, 636, 637, 638 and 640) were dug, and on which also smaller remains of a plaster floor were discovered (SU 627), common for the Early Neolithic buildings on Vrbjanska Čuka, but also for the other synchronous sites in Pelagonia (**fig. 13**). These column pits have different dimensions, the larger of which could function as waste or ritual pits, also present in other Early Neolithic buildings. According to their position, it can be noticed that they were placed in the northwest-southeast direction, i.e. almost identical to the other buildings in Vrbjanska Čuka, which indicates that Building 1 followed the established architectural tradition of the first inhabitants of this Neolithic settlement (Naumov 2020).

In the context of these pits it is important to note that they do not have a unified character in terms of their bottoms and contents. Namely, in some of the pits a larger amount of soot (SU 641) or reddish intensely fired daub (SU 630) was found, while in others, their bottoms end on compact surfaces of compressed plaster (SU 636 and 638), common for the floors of Neolithic buildings. On the one hand this demonstrates that some of the pits were used for throwing soot or depositing daub, which can be partially treated as a ritual practice recorded in Building 2 at Vrbjanska Čuka as well, but also in some of the earliest constructions of Veluška Tumba near Porodin and Školska Tumba in Mogila (Наумов и Томаж 2015; Наумов и Гулевска 2020). On the other hand, the pits at the bottom of which a surface with compact plaster was found indicate the possible existence of much earlier Neolithic horizons that have not been established in previous research, and which were probably covered with a deep layer of sand as a result of some geological processes. However, these are the initial observations that are formed solely on the basis of the narrow bottoms of several pits, so in order to check or deny their veracity it is necessary to make a deeper probing during future archaeological campaigns.

#### Quadrant 8

This quadrant is located north of quadrant 13 and covers the same area that was excavated in the 1980s. The excavation made for the extraction of the granary continues, which actually occupies most of the space of this quadrant. Therefore, only in the northern half of the quadrant, elements that have an archaeological character have been found. Namely, the virgin soil was registered here as well, i.e. the sand (SU 639) on which the earliest Neolithic buildings were formed. Several pits are dug in it, for a column and a post (SU 672) and one probably for waste (SE 650), so its entity and function cannot be defined because it is registered next to the eastern profile of quadrant 8 (**fig. 12**).

Neolithic layers and remains of plaster are recorded on the virgin soil (SU 654 and 673), which together with the pits may be part of Building 1. Regarding the Neolithic horizons, it should be noted that in the north-western corner of the quadrant, several unexplored Neolithic layers from the 1980s research were detected, which were shaped in the form of a cascade, in order to single out and highlight the separate architectural contents. They contain elements of whitish plaster typical for the floors of Neolithic buildings (SU 658 and 659), as well as soil that resembles the remains of unfired daub, and which is necessary to investigate in subsequent campaigns to determine its character. This cascade with architectural contents, in which the remains of at least two buildings have been found, is an announcement for the units that continue to quadrant 9 and which will also be explored in the forthcoming fieldwork seasons.

The question remains whether any of the floors (for example SU 659) belonged to Building 1 or is part of another building. In any case, the floor SU 658 can be associated with a building that was not recorded in the 1980s and which is further from those found in the research period from 2016 to 2021. In that case the floor would be part of Building 20, which could be a renovation of Building 1 or a new building in this initial horizon, the whole of which has yet to be explored with the future excavation of quadrant 9.

#### Quadrant 9

To the west of quadrant 8 the quadrant 9 is placed, which during the field research in 2021 was cleared only on the surface in order to give a priority to the rest of the trench. This quadrant was cleared at the highest layers to determine the level of its research in the 1980s because this part

was also included in the past archaeological campaigns. Due to that, only the recent layer under which the Neolithic layer was immediately registered was removed, which indicates that the Medieval and Classical horizons were excavated in this part, as well as part of the upper Neolithic horizons. Given that this area remained unfinished in the 1980s, and was not significantly damaged by the excavation of the granary, it was decided to study it more thoroughly during the next year. Thus, the focus in 2021 was on the Medieval and upper Neolithic strata and those of the earliest Neolithic horizons, which were damaged during the removal of the massive granary from Building 1.

#### Quadrant 14

This quadrant also belongs to the area that remained unexplored in the 1980s, and which is located south of quadrant 9. In contrast, quadrant 14 was much more intensively explored because it recorded the remains of the earliest and latest Neolithic horizons, as well as from the Medieval strata. This enabled a stratigraphic section of the tell in this part, in order to understand the life dynamism of this site. This was to some extent made possible by the several Medieval pits, which during the last five campaigns have been constantly used as control profiles of the Neolithic strata.



fig. 14

As for this guadrant, it should be pointed out that it also includes part of the excavation made for the granary, i.e. its western corner. Elements of a building were also discovered near it, which was also established on the virgin soil (SU 680) and was probably placed west of Building 1. These are several pits for pillars and piles (SU 655, 666 and 693), as well as the remains of floor made of whitish plaster (SU 679,681 and 687). As part of it the remains of a wall of unfired daub (SU 688) fallen on the floor SU 687 can be considered, i.e. the floor with ash SU681 which is a renewal of the previous one. As only a small area on the east side of this building has been identified, it will be necessary to explore it in the future after studying the layers above it, which are located in the western half of this quadrant, as well as in quadrant 15. At this moment, it is difficult to confirm whether this building is part of Building 11, detected in 2018, or it is a completely new structure.

A layer of soot plaster (SU 686) and massive pieces of fired daub (SU 674, 677 and 685) were discovered on it, which are probably part of Building 4 or a neighbouring building north of it, the size of which cannot be clearly determined due to unexplored top Neolithic strata. Above the fired daub of this building a layer of sand (SU 678) was detected which may be part of the substructure or the result of a geological phenomenon between the two building phases, so far would be the only such recorded case in Vrbjanska Čuka (fig. 14). Above this sand again a plaster floor (SU 679) is present which would belong to an object established on the same level with Building 16, i.e. east of it, and from which also the remains of walls of unfired daub (SU 705) are detected. In that case it would be a separate object that can be defined as Building 21.

Given that this south-western half of quadrant 14 was part of the unexplored space in the 1980s, only the lower layers can be seen, while the space in its southwest corner was not excavated at the time. This part was explored in 2021 and only the Medieval horizon, i.e. the upper layers of the site, where 4 storage pits were discovered (SU 632, 671, 676 and 683). In one of these pits (SU 683) a narrow canal was found in the northwest-southeast direction (SU 695), which is probably the base of a Neolithic building wall. Because this canal continues into quadrant 9, which has not been excavated, and its continuity is not clearly traced in the southern half of quadrant 14, it cannot be confirmed to which object it would belong.

#### Quadrant 15

Next to quadrant 14, i.e. on its western side, is quadrant 15. It belongs to a space that has never been explored so the intact layers were being excavated starting from the last Medieval phases. Below the recent layer, the highest Medieval features were discovered, i.e. the top cultural layer with the presence of mixed material dominated by tegulae (SU 623). Several pieces of compact daub were discovered (SU 625 and 628), which also in this campaign was confirmed to have been taken out of the Neolithic horizons, and in which Medieval pits were dug (SU 629, 631, 632, 644, 645 and 646). Some of these pits were registered with a large quantity of daub (SU 629 and 646), thus confirming that it belongs to the Neolithic buildings and by digging the pits it was taken out and scattered through the space which at that time was no longer used for grain storage (that was in fact the primary function of these pits).

The Medieval storage pits in Vrbjanska Čuka are mostly large, with approximate dimensions of about 1 m, and especially deep, so that they often penetrate the Neolithic layers even to the earliest stages. Despite their primary function, tegulae (SU 631), scattered daub (SU 629) and





even human remains (SU 632) were thrown into some of them. Regarding the burials, it should be noted that these skeletal remains (part of the skull, ribs and humerus – SU 670), are the only ones discovered in 2021 (**fig. 15**). This is unusual for the Medieval strata of Vrbjanska Čuka because buried individuals are often found between and above the pits (Наумов  $u \partial p$ . 2018; Naumov *et al.* 2018).

In the case of the pit SU 629 and the daub in it, it should be pointed out that it is different from the usual Neolithic daub, i.e. it is quite calcined, non-porous and brown in colour, so the question arises whether it was taken from the Neolithic layers of this site either belonged to another settlement, having in mind that the Neolithic daub on Vrbjanska Čuka is fragile and mostly orange-red in colour. It is possible that the daub found in this pit was taken out of the site and left for a long time to external influences (rain, snow and dust), after which it was thrown into the pit. Of course, in order to confirm this, detailed analyzes of the structure of the daub and its comparison with that of the Neolithic layers of this site are necessary.

It should also be noted that a larger piece of Neolithic mudbrick was found in pit SU 653, an adobe made of well-fired compact clay, which is not a common technical element in the Balkan Neolithic settlements (**fig. 16**). Such a mudbrick, with smaller dimensions was discovered in the upper Neolithic layer (SU 655), that is a quite surprise, because their presence is also very rare in the previous archaeological seasons. This brick-building technology is generally rare for the Neolithic in the Balkans and is more characteristic of Anatolia, so that their presence on the Vrbjanska Čuka causes great attention (Anvari 2021).

As for the upper Neolithic layer, it continues in other parts of quadrant 15 (SU 655) and is in a slightly higher position than the uppermost layers in the quadrants excavated in previous years. This is due to the fact that in this part the tell is highest, and therefore the elevation of the Neolithic layers is higher (approximately 1.3 m). In these stratigraphic units of quadrant 15 only the



fig. 17

Neolithic finds are discovered for the first time, without the presence of later material, except of course in Medieval pits. Therefore, it can be considered that they represent the last stages of the Neolithic life in Vrbjanska Čuka.

In this last Neolithic layer, elements of a building were found, i.e. Building 19. In the northern half of the quadrant, a base of a wall made of whitish compact plaster (SU 696) was discovered, which continues in quadrant 8 (**fig. 17**). The use of whitish clay plaster is rare when the walls of Neolithic buildings in Vrbjanska Čuka were established and is only confirmed in Building 2 and Building 9. In this wall several postholes (SU 660-664, 697-699) are detected, as well as few outside it (SU 666-669, 692, 700 and 701), while the remains of supporting pillars were not discovered. The wall also borders a space paved with plaster (SU 690), which represents the floor of Building 19 and in the southern edge of which no wall was discovered. In that case, this floor, its earlier phase (SU 702) and the remains of walls falling on it (SU 655) make up the components of this building, which is also placed in the same direction as the other Neolithic buildings in the settlement. Only a small area of the eastern part was discovered from it, while the rest continues towards the western profile of quadrant 15 and 8, i.e. towards the central part of the tell. Outside this building, i.e. south of it, a soil with a different character from the plaster was discovered, which indicates that it is part of a space that belonged outside it and was probably used for walking (SU 691), particularly in a longer period (SU 703 and 704).

#### Quadrant 8

This quadrant is north of quadrant 15 and generally has the same contents because this area was not explored in the 1980s. Several storage Medieval pits have been found in it as well, one of which is double, i.e. with a smaller pit in it (SU 651). As for the upper Neolithic layer, the wall from Building 19 continues in it, as well as the plaster (SU 690/702) and pieces of unfired daub from the wall (SU 655), but to a lesser extent than in quadrant 15 (**Fig. 17**). Therefore, the work





fig. 19

(SU 611 and 614) in this space composed of several similar structures. These two small bins are located between the oven (SU 322) and the circular grain grinding structure (SU 600) that were placed next to each other, but due to the damage done by the renovations and the Medieval pit, they are barely visible and only small parts from their walls are preserved (**fig. 18**). Pits for load-bearing columns (SU 610, 619 and 624) were discovered near them, which held the upper platform in the western part of Building 2.

in these two adjacent quadrants

ended at the same position, i.e.

at the level of the last Neolithic

horizon, so that they will con-

tinue to be explored in the next

In addition to the quadrants in the northern part of the trench,

contexts were also further ex-

plored in Building 2, which in its

western area falls within quad-

rant 26. It defined new situa-

tions near the complex of ovens

and bins, and where more con-

tents were discovered. Namely,

this considers two more bins

fieldwork season.

**Ouadrant 26** 

In the context of the bin SU 614 it is interesting to note that its bottom (SU 615) is placed on the floor (SU 616) which unfortunately cannot be traced elsewhere throughout this complex of structures. But it is remarkable that above some parts of this bin the remains of the floor (SU 617) were found, which during the renewal of this part of the building damaged the bin and then functioned as a new base for movement. These constituent elements of this set of structures further emphasize the complexity of Building 2 and its function as an object primarily intended for processing grain and food.

#### Photogrammetric trench modelling and Building 2

As part of Vrbjanska Čuka research conducted in 2021 also a photogrammetric (IBM - image-based modelling), three-dimensional model of the trench was generated, as well as the textured surfaces, a point cloud, a digital height model and a mosaic of orthophotographs, for the first time georeferenced in the exact spatial frames (**fig. 19**). For that purpose, 253 photographs taken with a drone and 51 points were used (43 used for reference, and 8 as control points) taken with a total station in the Macedonian coordinate system (EPSG: 6316). Although the purpose was to document Building 2, the data cover the entire excavated area of the settlement so far. The total covered area is 728 m<sup>2</sup>.

The average deviation of the points used for spatial reference is X (0.00905019 m); Y (0.00759449 m); Z (0.0040006 m); XY (0.0118145 m) Total (0.0124735 m). The average deviation of the control points is X (0.0250604 m); Y (0.0349699 m); Z (0.0077822 m); XY (0.0430223 m) Total

(0.0437205 m). Spatial alignment and creation of spatial maps is performed on the basis of 133,776 points, with calculated spatial deviation ranging between 0.00058–0.015 m. During the processing, a total of 245 spatial maps were created, so that the point cloud is 163,688,860 points, and the three-dimensional model is 1,468,831 points. The point cloud and the three-dimensional surface model show an extremely high level of spatial reliability of the points (**fig. 20**), which apparently decreases in proportion to the distance from the surface covered by points for spatial reference. The resolution of the reconstructed surface is 2.62 mm / pix.

From all this it can be concluded that a solid basis has been created for monitoring the changes that have occurred during the previous and will occur during the upcoming research. The exact spatial determination of the buildings will be the basis for the exact spatial determination of the movable finds and human activities, and of course, the remains of animal and plant origin, as well as the integration of the data for them in the GIS. Additionally, the results of the application of this technique enable exact spatial determination of the samples taken so far for analysis, and the collection of samples from the remains on the walking levels and other features located inside and outside the Neolithic buildings can be done within a network, determined in very precise spatial outlines. Surely, all this is in favour of leaving as relevant record as possible for the results of research on Vrbjanska Čuka, as well as the potential for complex spatial analysis of the remains of past activities in particular space.

### Conclusion

The excavations of Vrbjanska Čuka in 2020 and 2021 were a continuation of the previous archaeological field-working, in which the central part of the tell was excavated. The continuous excavation in this part of the Neolithic settlement, the Classical economic area and the Medieval necropolis, provides a more detailed understanding of the activities and life in the three chronological stages recorded on this tell. It will significantly contribute to the understanding of this archaeological entity as a whole, as well as to the separate study of each of the periods recorded on it.



In 2020, the fieldwork continued in the same quadrants in which research was conducted in 2019, without expanding the trench with new quadrants (which was the case in 2021). In this way, the research in Building 2, 4 and 16 was employed, and also some of the upper Neolithic layers in several quadrants were studied. Regarding the Neolithic buildings, new features were discovered around the oven SU 322, i.e. several pillars and another circular bin, which increases the number of contents in this part of the building and also confirms its complex character. In Building 16, the canals that were dug for walls during its establishment were monitored, and postholes were found. Considering that this building was built onto Building 4, in the profiles of its canals the remains of an oven belonging to this building were detected, which is in relation to the other structures in it (Наумов  $u \, \partial p$ . 2018). In that sense, Buildings 2 and 4 contain the elements common for architecture in Pelagonia, but also in Macedonia and in the Balkans in general (Симоска и Санев 1975; Garašanin 1979; Санев 1994; Толевски 2009, Naumov 2013).

In addition to the Neolithic contexts, in 2020 the research was performed on the uppermost archaeological layers, in which Classical and Medieval elements were found. Compared to the Classical contents, a compact floor of clay, daub and pits for piles were discovered, which are common for the Neolithic horizons, but in this case, the presence of fragments of Late Classical tegulae and vessels was detected next and below them. Such architectural features are unusual in the Classical archaeology in Macedonia, but it should not be surprising because in that period buildings were made from these elements, which could have an economic function. Architectural contents from this period have been discovered in the previous archaeological campaigns of Vrbjanska Čuka, so that this construction of clay floor, daub and piles only complements their variety (Haymob u dp. 2018; Naumov *et al.* 2018).

The usual Medieval funerary features were discovered above the Classical layers, but in this year's case there were additional contents that are a novelty in the Macedonian archaeology. Among the 4 graves discovered few contained paving stones and stones under the remains of individuals. Their placement in the east-west direction confirms the Christian character, which in turn is related to the graves discovered in the past years on this site (MMTKOCKM 2005; Haymob  $u \, \partial p$ . 2016; Haymob  $u \, \partial p$ . 2018; Naumov *et al.* 2018). In the Medieval horizon 6 storage pits were detected, common for this tell in many cases penetrate even to the Neolithic layers. A halved skull was found at the bottom of one of them, deliberately placed there, which further indicates the complexity of the Medieval burial rituals, which in the case of Vrbjanska Čuka were never accompanied by grave goods.

As for the research of Vrbjanska Čuka in 2021, the trench was expanded to the north and considered six quadrants (8–10 and 13–15), so that the size of the entire trench is now 30x20 meters, with the exception of the quadrants in its north-eastern part which remain to be excavated in the future. This year's research was partly focused on determining the space, contents and methods of excavations in the 1980s, i.e. in the eastern half of the trench, while in another part, the Medieval and upper Neolithic strata were identified.

In the quadrants that cover the space explored in the 1980s (9, 10, 13 and 14), the hole was found that was dug for the extraction of the massive granary in Building 1 for its better conservation and display in the Institute and Museum – Prilep (Kitanoski *et al.* 1990). During these interventions, necessary damage was done to Building 1, from which several pits for pillars, piles and deposition of a daub were registered. During the determination of the layout of the pits for pillars, it was concluded that they are in the northwest-southeast direction, which

indicates the standard position of placing Neolithic buildings in this settlement. In relation to these pits, the remains of layered clay plaster were detected, which was used as a floor for this building. In some of the quadrants, elements of other buildings from the earliest phases of the Neolithic settlement were discovered (Building 20 and Building 21), which contain the same architectural features as the other structures from this period of the site.

In the quadrants of the western half of this year's trench (8 and 15, and partially 14) the remains of the highest Neolithic layers were studied, and in which a wall, floor and unfired daub from Building 19 were found. It is currently one of the last buildings built during the end of Neolithic life on this site. It is interesting that the base of the walls and the floor are made of whitish clay plaster, which is a rare practice in Vrbjanska Čuka and in Macedonia in general. Only in Building 2 and Building 9 of this site such walls were discovered, and they are partially present in the Neolithic settlements of Veluška Tumba and Vlaho (Наумов  $u \partial p$ . 2020; Наумов  $u \partial p$ . 2021). This type of building technology using clay plaster is common for the Early Neolithic settlements in Anatolia, so their presence in Pelagonia can be considered one of the last reflections of these Near Easter architectural traditions (Anvari 2021).

In this context, the few clay mudbricks (adobe) should be noted, discovered in the upper Neolithic layers and in the Medieval pits, which are also remnants of the Anatolian building practices. Although such a structure in Vrbjanska Čuka with walls made entirely of adobe is not recorded, the presence of several intensively fired mudbricks again indicates the Anatolian reminiscences, which are also present in the early Neolithic phases of Amzabegovo and partly in Tumba Madjari (Gimbutas 1976; Commenge 2009). Regarding the Neolithic architecture, the new structures (bins) discovered in the western part of Building 2 should also be noted, which fit into this architectonic complex intended for processing cereals and food preparation. Near them, new pillars were discovered that held the upper platform in this part of the building, emphasizing the specific role of this imposing Neolithic building, which is also one of the largest in Macedonia.

Unlike the Neolithic contents that were recorded in most quadrants, partially or completely open during excavations in the 1980s, Medieval horizons were explored only in quadrants 8 and 15, and to a lesser extent in quadrant 14. Several storage pits were detected in them, positioned in the northwest-southeast direction. According to this established order in this part of the trench, it can be considered that it was applied through the central space of the tell. So far, no systematic documentation of the Medieval pits on other tells and sites in Macedonia has been made, so it can not be confirmed whether such a layout is a common practice or is the case only for Vrbjanska Čuka. However, this type of storage pits on tells initiates special interest and points to their organized distribution, which in turn indicates their primary economic character (Китаноски  $u \, dp$ . 1983; Симоска и Кузман 1990).

What was particularly surprising concerning the Medieval horizon was the absence of graves in the quadrants. Unlike previous research, which considers approximately twenty graves, during the excavations in 2021, no element was found that indicates this ritual activity. Only in one of the storage pits were disarticulated remains of an individual found, and only a skull, ribs and humerus, indicating that they had been left there. The possibility of dismantling the eventual grave with later agricultural activities is debatable, as these bone remains were found in the pit, although this hypothesis should not be completely ignored since the skeleton was found in the upper part of the pit. This placement of the dead on the pits has been recorded in the excavations from previous archaeological campaigns, so the partial presence of bones in this pit

should not come as a surprise. On the other hand, laying only certain parts of the human body in the Medieval pits of Vrbjanska Čuka is also not an unknown ritual practice. But this ritual took place at the bottom of the pits, which is not the case with this year's context.

The absence of graves in an area of 10x15 meters, which is to some extent equal to that of some previous campaigns and in which several graves were discovered, indicates that no burial was performed in this part of the tell and that was probably a practice for its central part. Regarding the unusual archaeological situations during the research of the trench, the absence of layers from the Classical period should be noted, which in the past years were usually present during the excavation of the upper layers. Although Classical tiles and ceramic fragments were discovered in some quadrants, the absence of architecture in this northernmost part of the trench indicates that there were no building structures in that part of the tell. In any case, it remains to further explore the area north and west of the current trench, in order to register the layout of architectural, economic and ritual elements from the Classical and Medieval period. Of course, the same applies to the Neolithic horizons that also need to be studied in the future, to encompass the entire contours of the buildings and to understand their layout and ratio in regard to the household and social activities.

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#### **Used Illustrations**

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Сè поблиску до бакарот: доцнонеолитската населба Бојковци кај село Дамјан и околните мајдани со бакар

**Getting Closer to Copper:** The Late Neolithic settlement Bojkovci near the village Damjan and the surrounding copper sources

#### Апстракт

Неколкуте сондажни и заштитни археолошки кампањи на поширокиот ареал на Радовишкото село Дамјан, поточно на локалитетите Канли Чаир, Бојковци и Тополничка Река донесоа на светлината на денот голем број артефакти со извонредни податоци за праисторијата во Радовишкиот Регион. Локалитетите се протегаат на десниот брег на малата Тополничка Река и се разделени од магистралниот и брз современ пат Штип-Радовиш-Струмица. Позицијата на Бојковци се наоѓа јужно од патот во обработливите и плодни парцели на кои се одгледуваат градинарски и индустриски култури. На парцелите 126/1 и 128/1 се позиционираа 18 квадрати, каде што се открија последните фази од опстојувањето на неолитската населба.

Откриените архитектонски објекти, како и големиот и разновиден археолошки материјал, овозможува да се продре во населбинското живеење, откривајќи аспекти од социјалниот, културниот и духовниот живот на населбата. Одредени артефакти откриени во подоцнежната фаза на опстојување на населбата дозволуваат таа да се поврзе со синхрони култури на поширокиот простор од Балканскиот Полуостров. Овие култури ги преживувале последните неолитски денови, постепено преоѓајќи кон новите текови поврзани со ресурсите на бакарот.

Клучни зборови: локалитет Бојковци, доцен неолит, керамика, архитектонски објекти.

#### Abstract

The few sondage and protective archaeological campaigns in the wider area of village Damjan in Radoviš, more precisely at the sites Kanli Čair, Bojkovci and Topolnička Reka brought to light a number of artefacts providing valuable data of the prehistory in the region of Radoviš. The sites extend on the right bank of the small Topolnička River and are separated from the expressway and fast modern road Štip-Radoviš-Strumica. The position of Bojkovci is located south of the road

in the arable and fruitful plots on which garden and industrial crops are grown. On Cadastre lots 126/1 and 128/1, 18 squares were positioned, where the last stages of the Neolithic settlement were revealed.

The discovered architectural objects, as well as the large and diverse archaeological material, provide the image of the settlement, revealing aspects of the social, cultural and ritual life of the settlement. Certain artefacts discovered in the later phase of the settlement's existence, allows association with synchronous cultures in the wider area of the Balkan Peninsula. These cultures survived the last Neolithic days, gradually shifting to new trends related to copper resources.

Keywords: Bojkovci site, Late Neolithic, ceramics, architectural objects.

#### Geological and geographical data

During the spring months of March until May 2018, on the easternmost part of the site Bojkovci protective archaeological excavations were realized – which were part of the extensive project of the Bučim mine and the Institute for protection of monuments and museum Štip.<sup>1</sup>

The toponym Bojkovci belongs to a larger geographical-cultural-historical entity which integrates the three archaeological sites: Kanli Čair, Bojkovci and Topolnička Reka, thus creating an archaeological ambient space that extends to about 15 hectares, with rich vertical and horizontal stratigraphy. This small neo-tectonic valley intersected by several small watercourses allowed several Neolithic and many other prehistoric cultures, ancient and medieval, to intertwine. All of them are interconnected with the main artery<sup>2</sup> (Garašanin 1975, 9; Санев и др. 1978, 12; Sanev 2006а, 149) or with the copper deposits which are abundant in the surrounding area.<sup>3</sup>

From a geographical point of view for the most part the valley was additionally shaped by the small Topolnička River. The river springs from the south-western slopes of Plačkovica near the village Topolnica and in its upper course it has a north-south direction. Topolnička Reka in its middle course forms a larger arch and turns to the west, where on its short watercourse, now as Mademska Reka, cuts the two striking volcanic vents at Pilav Tepe and Ploča (today Derven gorge), and then flows into Kriva Lakavica river – as a right tributary (Петровъ 1896, 319; Цвијић 217-218).



fig. 1

The first data about the archaeological sites of Bojkovci and Kanli Čair are given by Sanev in 1976 (figs. 1, 2). Both sites were discovered during reconnaissance and recorded under the toponym Kozluk (Санев и др. 1978, 69)<sup>4</sup>. And then in 1987–1988, Sanev also conducts test archaeological excavations (Санев 1989, 36; Санев 1996, 325). The archaeological sites are located on the right bank of the small Topolnička River, where the river widely turns, thus forming a large arch covering the marked area on the east and south sides. On the west side it is surrounded by a stream that flows from the village of Bučim. The first two trenches are located on Bojkovci in the plots just below the road at the junction to the mine (Cadastre lot 134 and Cadastre lot 142, Damjan),<sup>5</sup> and the others on the toponym Kanli Čair. On the basis of the test trenches' disposition it was expected to obtain more data on the vertical and horizontal stratigraphy, as well as insight into the cultural and chronological character of the Neolithic settlement. In doing so, two horizons of living were identified that belonged to the Middle and Late Neolithic.

The next archaeological excavations on Kanli Čair were realized in 2015 by Stojanova-Kanzurova. The explored area was positioned near the trenches excavated by Saney. These excavations showed that the Neolithic settlement had a horizon with two phases of existence, in the Early and Middle Neolithic (Stojanova-Kanzurova 2017, 192). Geomagnetic scans were also performed on a part of Kanli Čair during 2016 which enabled us to see the spatial distribution of the Neolithic settlement and the layout of a large number of architectural units (Рујак и др. 2019, 97–98).

The previous explorations on Bojkovci and Kanli Čair provided with different methodological approaches to obtain more data on the development of the settlement. Thereby, Early and Mid-

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4 For the preparation of the state's archeological map on the territory of Radoviš, in 1976 archeological reconnaissance

<sup>1</sup> The project Protective archaeological excavations at the sites Bojkovci and Topolnička Reka endangered by the construction works of the infrastructure project, transport line from the concession area for exploitation of copper ore Borov Dol to Bučim mine. On this occasion I thank the organizers of the archaeological excavations Dr. Mitko Šterjov, archaeologist, director of the Institute for protection of monuments and museum Štip and Nikolajčo Nikolov, deputy general director of Bučim mine, Vane Sekulov, archaeologist, project manager, Institute for protection of monuments and museum Strumica, as well as my participation as a member of the research team and part manager. Also, the results of the protective archaeological research of Bojkovci were presented at the International Symposium Mining and Archaeology organized by the above institutions, held in Štip on 12–15 September 2019.

<sup>2</sup> One of the natural communications through which the cultural Neolithic impulses circulated was the eastern path which connected the river valleys of Struma, Strumica, Lakavica, parallel to Mademska River or Topolnička River, Bregalnica – through Ovče Pole and Pčinja, as far as to Morava and Danube valleys to the north.

<sup>3</sup> The northwestern part of the Radoviš valley is a small neo-tectonic unit with characteristic relief forms created during the periods of large local volcanic activity beginning in the Eocene-Oligocene (20-15 million years ago), with the greatest intensity during the Miocene and Pliocene (14-10 million years). During that period, a number of fault dislocations were formed which served as channels through which lava flowed during the catastrophic volcanic activities – forming the Borov Dol-Damjan-Bučim stretch which is 25 square kilometres (Колчаковски 2004, 43).

fig. 2

was realized by the then institutions Archaeological Museum of Macedonia and Republic Institute for Protection of Cultural Monuments (Ž. Vinčić and M. Ivanovski), when there were discovered three Neolithic settlements, one of them was Kozluk near the village Bučim.

<sup>5</sup> An old cadastral plan with the positions of Sanev's excavations trenches in 1987. On this occasion I thank Elena Stojanova-Kanzurova for the cadastre remarks and collegial support.

dle Neolithic phases in Kanli Čair and Late Neolithic in Bojkovci were detected as cultural zones of two Neolithic cores. Also, the permanent space increase of the Late Neolithic settlement Bojkovci at the peak of its cultural development was attested.

# Methodology and stratigraphy of the excavated sector Bojkovci (Cadastre lot 126–1 and 128–1, Damjan\*)

The designated area for archaeological excavations has a south-north direction and intersects the Topolnička River valley from the hills of Borov Dol to Bučim mine. Within the Cadastre lots 126/1 and 128/1, Damjan, the research sector which is 45 m long, 10 m wide, and at distance of ca 35 m from the highway was marked. And from the bridge on Topolnička Reka it is about 100 m – in the direction to the southwest. A square grid was set up in the sector and 18 squares were opened, marking an area of 10x45 m. The dimensions of the squares were 5x5 m with control cross-sections between them of 1 m width, whereby squares with dimensions 4x4 m were obtained (**fig. 3**).<sup>6</sup>



The excavation in square 3 and the situation of the northern cross-section provided the stratigraphic sequence of the researched sector.<sup>7</sup> For objective reasons, for the most part, the excavation focused only on the north-eastern quarter of square 3, where a layer of dense dark brown soil filled with small lumps of white limestone and no archaeological finds was reached. Probably that layer was the original humus on which the first Late Neolithic settlement of Bojkovci was built.

The first or surface layer is the plough field with 442.36 m above sea level consists of light brown colour, soft soil consistency and fine river sand (fig. 4). The surface layer is covered with thick grass intertwined with trees' roots ('Stanley' type plums) of the garden in which square 3 was positioned and a part of the researched sector, i.e. Cadastre lot 128/1. The layer depth varied from 0.17 to 0.25 m. In this layer, fragments of ceramic vessels were discovered that belong to the transitional period between the Late



Bronze Age and Early Iron Age. Due to the long-term use of this area as agricultural land, no significant architectural objects were discovered in this layer that would be related to the discovered pottery fragments. A good portion of the fragments belong to the so-called plates with an indented and thickened inwards rim or the so-called 'Turban dish', typical of this period, in which a large number of settlements along Vardar were abandoned in the Early Iron Age (**Pl. 8: 1–5**).

The second layer was a brown soil with medium consistency (elevation point 442.13). In the upper part of the layer, along the entire length of the cross-section, there was a minor deposit of fine river sand with thickness between 0.05 m and 0.1 m (442.05 upper elevation point), sediment that probably accumulated during a natural disaster causing a possible overflow of the Topolnička River, flooding and settlement's destruction. Today the river is located at a distance of about 150 m to the east. The thickness of layer 2 was 0.53–0.61 m; it was filled with crushed lumps of house daub as well as small and medium stones. Pottery fragments were also discovered of which the ones with dark gray and brown colour typical of the Late Neolithic assemblages predominate.

The third layer was dark brown, compact, greasy soil with a soft structure (elevation point 441.61). This layer, like the previous one, contained destroyed lumps of house daub and fragments of ceramic vessels – typical of the Late Neolithic. At the bottom of the third layer there were several massive lumps of house daub (one of them has dimensions 23x31x17 cm) which probably belonged to an architectural object that was located in the immediate vicinity – probably House 2. The thickness of this layer varied from 0.4 to 0.6 m.

The fourth layer was compact, greasy and hard brown soil composed of small lumps of white limestone (elevation point 441.04). No archaeological artefacts were discovered in this layer. Due to the hardness of the layer the excavation was interrupted at the level of elevation 440.51, and did not proceed to the level of yellowish clay soil from the Neogene period. This layer was thick between 0.42 and 0.67 m.

<sup>6 \*</sup> New number is present in the state cadastral map available online (https://ossp.katastar.gov.mk) – Cadastre lot 128/3, Damjan instead of 128/1.

The squares were marked with Arabic numerals (from square 1 to square 18) and were arranged in two rows, odd (1, 3, 5, 7, 9, 11, 13, 15 and 17) and even (2, 4, 6, 8, 10, 12, 14, 16 and 18) numbers in the south-north direction. Only squares 4, 6 and 8 were extended eastwards and thus formed the extensions: 4A, 6A and 8A. In the immediate vicinity under the slope of the expressway there was a larger stone on which the absolute elevation point (443.32 m above sea level) was marked, from which all elevation occurrences, changes, situations and contexts in the excavated sector were measured.

<sup>7</sup> The northern cross-section of square 3, including the ground plans of the other squares together with the foundations of the architectural objects were drawn by Ljubica Kljonkova, Institute for protection of monuments and museum Štip and Vesna Jankovska, Museum of North Macedonia. The photos were made by Kire Spasov, Institute for protection of monuments and museum Štip and the author of the text. Actively participated: Marina Spirova, Archaeological Museum of North Macedonia, Ana Jordanova-Dubrovska, archaeologist, Marinela Serafimova, archaeologist, as well as workers from Radoviš, the villages of Damjan and Brest, and others.



#### **Remains of architectural objects**

Within layers 2 and 3, two architectural construction phases belonging to the Late Neolithic were discovered. They are characterized by different approaches of houses' construction, the use of materials and the shape of the dwellings' foundations. The discovered two dwellings (houses) in the earlier layer follow the old tradition of house construction, while in the later layer there are new elements in the construction in this area. The presence and use of stones in the formation of a stable and solid foundation is frequent.

fig. 5

*House with circular-elliptical base, construction horizon 2 (layer 2)* 

In squares 6 and 8 a larger structure of densely arranged stones (elevation point 441,92) was discovered which extended in the south-north direction with a length of 6.7 m, and width that varied from 1–2.2 m (fig. 5).8 The western side of this stone base had approximately a semicircular shape, while the eastern one was flat. At several positions from the edge of the semicircular west side circular positions were noticed between the stones. These circular positions had dimensions of 0.5–0.6 m, and probably were the positions where wooden vertical poles were founded, thus supporting the roof construction of this architectural object. This circular-ellipsoid object extends in the square extensions - 6A and 8A, where several stone groups were also discovered which probably were supporting the vertical posts on the east side of the wall structure.

The pits for the vertical poles could not be detected due to the dark coloured layer soil, although the grouped stones themselves (amorphous stones of medium and larger size), which as groups were revealed at approximately equal distances from each other, suggest to such possibility. On the northwest side of the building in the shape of a horseshoe was the entrance, which most probably was created as a small slope from the surface, thus making possible the entrance to the semi-subterranean dwelling.

In the inner space of the dwelling at a distance of about 0.6 m from the stone base – in trench 6, there was a circular object composed of a large number of pottery fragments, small stones and daub lumps in a deposit of with clayish soil (upper elevation point 441.7). The diameter of this circular object was 0.9 m and the thickness was 0.2–0.25 m. This construction, built of various building materials, was the basis on which the domed oven was located. If one looks at the technical drawing of this dwelling with a circular-elliptical shape, it can be concluded that the oven had a central position in the household, right next to the raised platform made of arranged stones, intended for a pleasant stay of its inhabitants.

In the immediate vicinity of the oven there was another circular formation built of large stones - in trench 6 and 6A. The diameter of this stone base was 1.05-1.1 m and the thickness was 0.25-0.3 m. The stones were roughly arranged in several irregular rows. On the east side of the stone circular base there was a larger piece of grinding stone (elevation point 441.8) of local volcanic origin - coarsegrained andesite. Given the presence of the grinding stone, this area can be functionally named as a 'table' for food preparation and cereals grinding. This circular formation built of large amorphous rocks was probably coated with several clay layers in its primary form. On the north side of the stones there was a flat slightly burnt clay surface (elevation point 441.65). The dimensions of this area were 0.4x0.3x0.02-0.03 m, and it was preserved in a small extent. This burnt area could be defined as the floor level of the dwelling and was located thirty centimetres lower than the fig. 6 stone platform at the west side.

Due to the dark colour of the soil in layer 2, there was no solid evidence that this building truly represents semi-subterranean dwelling - the most common form of habitat in the Late Neolithic. In the southern part, under the stone construction (the platform), remains of a rectangular oven from the older phase were discovered. Therefore, the circular-elliptical dwelling is thought to have been dug into the space of the earlier layer occupying a small area on the north side of House 2.

#### *Houses 1 and 2, living horizon 1 (layer 3)*

In the lower layer 3 the investigated space in square 2, 4, 4A and 8A remains of an earlier settlement horizon were discovered. The extension made east of square 8 i.e. square 8A, enabled partial discovery of the remains of House 1. Whilst in square 2, 4 and the extension of square 4A remains of House 2 were registered. That is, two objects-houses were discovered and partially explored, which provided much needed data on the spatial organization of the Late Neolithic settlement of the earlier living horizon.

#### House 1

The extension that was made in square 8A made it possible to find the remains of House 1 (fig. 6). The outline of the southwest corner of the house was precisely established i.e. crumbed lumps of daub were found that most probably were remains of the walls. At certain points there were small groups of several stones which highlight the pits where the wooden vertical roof supporting piles were positioned. One such position is the northeast angle of square 8A where one of the pits for the internal wooden structure (which has a diameter of 0.08 m) was located. Samples of charred wood were taken from this position for further



<sup>8</sup> Saney discovered a similar situation with 2 m long arranged stones during the excavation of trench 1 in 1987 (Санев 1989, 36).



laboratory analyses. Remains of a red-fired thin floor layer were also found nearby (elevation point 441.4). The wall on the south side was 2.5 m long and on the west side – 5 m. Both walls extend further towards the cross-sections, so that the total size of the house was probably larger. According to the walls' directions it could be assumed that House 1 had an approximately rectangular-trapezoidal shape.

In the house's interior next to the south wall an architectural construction was discovered – with a flat surface of yellowish fired clay (elevation point 441.82). The dimensions of this construction were 0,6x0.5 m and it was consisted of two separate rectangular or trapezoidal recipients, 0.4x0.2 m, incompletely preserved and elevated by 0.42 m – in relation to the floor (**fig.** 7). Around the fired structure were the remains of larger carinated vessels and several fully preserved or fragmented beakers and bowls.

#### House 2

The remains of House 2 (with a base that was about 8.x5.6 m) were located in square 2, 4 and 4A. (**fig. 8**). Initially a layer of house daub destructions mixed with pottery fragments was discovered as well as architectural elements characterised by straight and arched outlines. The south-western corner of the house was recognizable with a concentration of daub fragments and larger stones. The wall on the south side was followed in a length of 3.1 m, Reinforced with three larger stones which were located near the eastern cross-section of square 2.

Debris from a house wall's edge and a 0.11 m diameter wooden beam's pit were discovered at the west side. Next to the section line dividing the squares 2 and 4, a circular clay shaped structure with edges pointed towards the interior was discovered (**fig. 9**). The diameter of the opening was 0.2–0.22 m and it had a yellowish-ochre colour, and its position was horizontal (elevation point 441.54). Initially it was thought that the clay structure with dimensions 0.53x0.53 m shaped with a plastic prominent circular opening was a space intended for a wooden vertical beam of the roof structure. However, further in the course of the research it was realized that this circular element could also be a specially shaped opening on the upper part of the wall or a possible window opening. This conclusion was made later due to the

absence of a wooden beam pit, as well as the deposits of destructed house daub which was located under this structure. $^{9}$ 

At the section line between squares 4 and 6 a rectangular structure consisted of daub fragments, fragments of ceramic vessels with thicker walls, animal bones as well as small stones was discovered (**fig. 10**). This base composed of various materials had dimensions of 1.2x1 m, and an east-west direction. The rectangular base belonged to the domestic domed oven, which was destroyed by the construction works during the later settlement horizon – during the construction of the dwelling with a circular-elliptical base.

Next to the above-mentioned 'circular opening' of daub – at its north side several fragmented ceramic vessels were found, which were located directly on the floor level of House 2. The house floor was preserved on a small area with red-burnt clay soil (elevation point 441.25). Also, in square 4 groups of stones were discovered that were probably placed directly to strengthen the wooden beams of the north and the east house walls supporting the roof construction.

A large number of large stones were discovered on the south side, which probably secured the house 'yard'. Numerous fragments of pottery, symbolic objects as well as flints and animal bones were also discovered.

### Movable archaeological finds

From the large number of archaeological finds that were discovered on the researched sector of Bojkovci most numerous were objects made of ceramics, flint and stone.

The entire pottery was handmade, of which the most characteristic vessels are the fully or par-

9 Regarding the second statement about the circular structural element of House 2 from Bojkovci, it more closely resembles the openings in some of the anthropomorphic house models. There are two fragments of anthropomorphic models-houses, one from Govrlevo and the other from Madžhari (Sanev 2006b, 187–189, Fig. 30; Чаусидис и Наумов 2011, 28, T. XVII: 2, T. XIII: 8), which are well known, with similar small circular openings, which are the only possible analogy for this architectural phenomenon in Bojkovci. Namely, just below the upper edge of the cubus – towards the side walls' corners circular openings were executed. According to the authors, due to the small size of the fragments they were interpreted as openings with unclear characteristics. Similarly, there are house models from Veluška Tumba – Porodin (Vasileva 2005, 26; Tolevski 2007, 75–76, Fig 9; Толевски 2009, 63, Сл. 6.7; Толевски 2017, 57).



fig. 10

tially preserved vessels and objects as well as those suitable for graphic reconstruction on the basis of their profile line.<sup>10</sup> There are several variants of bowls, conical and carinated vessels, vertical amphoroid vessels, shallow and deep plates with conical or carinated profile, spherical vessels, large carinated storage vessels, conical strainers, small vessels with thick walls, vessels with tall legs, spouted vessels, lid with vertical handles and jug with spindle-like body. Of course, we should also mention the miniature ware resembling the shape and profile of the pottery for everyday use.

Horizontal and vertical handles appear commonly on many vessels. The most characteristic are the vertical handles with button-like application on the highest part, vertical handle with triangular extension on its upper part, vertical handle with horn-like application on its upper part, vertical 'angular' horn-like handle, vertical ribbon-like handle with stressed groove, etc. Also, the following handles appear in the collection: handle with small horn-like application tongue-like handle, characteristic handle imitations or so-called 'pinched' plastic shaped handles, 'wishbone' handles, etc.

The decorative motifs that most often appear on the vessels are (narrow and shallow) channelled grooves - side-long or vertical; (wide and shallow) horizontal channelled grooves; semicircular channelled grooves around the plastic application, etc. Fragments with vertical zigzag channelled grooves are also present. Then, on a small number of fragments light barbotine appears as recurrence - in organized or unorganized form. The characteristic impresso decoration from the Middle Neolithic is absent, but there is an impresso decoration on the most prominent edge on some of the carinated vessels. There are also plastic applications, engraved and stabbed ornaments filled with red or white pasty colour as well as 'black topped' vessels.

Few, but of great importance for the cultural and religious aspects of the Late Neolithic settlement Bojkovci is the group of ceramic objects with symbolic use. Several fragmented anthropomorphic female figurines were discovered; one fragmented zoomorphic figurine; and fragment of a cult table with a triangular shape. Also, fragments of tall legs belonging to the typical symbolic vessels-rhyta (with four tall legs). Then, there is a fully preserved stamp with engraved ornaments as well as fragments of a house model and an oven model. All of these symbolic objects are decorated with stabbing, engraving, incrusted and painted decorations.

Other ceramic objects that were found in the research sector - used in everyday life are: a sling projectile, spindles whorls, etc.

Stone and flint tools were discovered in all layers, the most characteristic of which were flakes, flint blades, guartz, grindstones and spherical guartzite pounders.

### Relative chronological and cultural analysis of the typical vessels' forms

According to the current information obtained from these protective archaeological excavations at Bojkovci in Damjan village, Radoviš region, confirmed that the Late Neolithic horizon of habitation is dominant at the site. However, it should be noted that in the first i.e. surface layer, fragmented vessels from the Late Bronze and Early Iron Age were discovered. The Late Neolithic cultural horizon according to the stratigraphic features and relative chronology confirmed by the typical pottery forms can be divided into two phases.

From the later Late Neolithic phase stand out – the partially preserved jug with a vertically elongated, spindle-like body and a vertical handle with an elliptical section which connects the vessel's neck with the shoulder part (Pl. 4: 8). Characteristic is the outer side of the vessel which has a intermediate fabric and thin walls reaching up to 5 mm. Only the upper part of the neck is preserved from the jug. This vessels' form is unique from the Late Neolithic in Eastern Macedonia, and as an analogy could be compared with the jug of Crnokalačka Bara (phases Gradac II or Vinča-Pločnik I according to the chronologies of Jovanović and Garašanin).<sup>11</sup> The second characteristic form is the amphoroid vessels (Pl. 2: 1; Pl. 4: 1, 2, 4, 7) which are already present in some of the Late Neolithic settlements located in the river valleys of Struma,<sup>12</sup> Strumica,<sup>13</sup> Bregalnica (Корошец и Корошец 1973, 58–59, Т. XXVII, 5; Гарашанин и Гарашанин 2009, 97; Гарашанин 2009, 254–256) and Pčinja (Георгиев и др. во подготовка). The most typical feature of the specimens from Bojkovci are the rounded carination of the vessel's belly, the highly curved neck, the smoothened outer surface and the black colour, as well as the plastic applications or the small tongue-like handles applied to the most prominent part of the belly. A narrow bottom is also observed on one specimen (Pl. 4: 7). In some less preserved specimens on the upper part of the amphoroid vessel's neck, bundles of 'fishbone' channelled grooves combined with horizontal wider grooves are also observed (Pl. 4: 2, 4). The following forms that are more common are the smaller plates in several variants, such as: conical shallow plates, carinated rather deep and semi-circular round plates (Pl. 4: 3, 5, 6; Pl. 4: 4, 5). For this construction horizon, the carinated vessels are chronologically sensitive with the plastic-shaped handle imitations or the so-called 'pinched' handles that are most often found on 'black-topped' carinated vessels – on the belly's widest part (Pl. 5: 3; Pl. 7: 7). According to Garašanin, these plastic-shaped handles are synchronous to Vinča-Pločnik I (Garašanin 1973, 92; Garašanin 1979, 176). Whereas, the characteristic vertical handles with triangular extension of the upper part (Amzabegovo, Angelci, Zelenikovo, Rakle) (Pl. 7: 6),<sup>14</sup> are synchronized with the sites (Balgarčevo III, etc.) along the middle course of Struma (Pernicheva 1995, 116, 119, Figs. 9, 293).

Concerning symbolic objects the presence of a oven models fragment is expected (Pl. 5: 1). A part of the plastic-shaped edge of the model's opening and a small part of the body with an outer side decorated with an engraved ribbon field filled with a stabbed ornamentation are preserved. On the fragment the arch of the opening is noticeable which may suggest that the oven model's form had a domed shape on the front. This miniature oven model with a symbolic purpose most probably accentuate the importance of fire and heat, but in this context as an object that emphasizes

11 Fragments of the jug were discovered on the southern periphery of the circular-elliptical house. Garašanin also

13 Vessels' forms characteristic of the Late Neolithic settlement Stranata, Angelci, phase II (Санев и Стаменова

<sup>10</sup> The drawings of the ceramic material were mostly drawn by the author of this text, together with the participation of Ana Jordanova-Dubrovska (Pl. 5: 3-5).

emphasizes that the appearance of such and similar jugs discovered in several Late Neolithic sites in Serbia (Pločnik, Crnokalačka Bara, Rudna Glava) were directly related to the period of mining activities already started in a wider geographical area of the Balkans (Garašanin 1979, 188, T. XXVIII, 3; Jovanović 2006, 229, Fig. 4, 1).

<sup>12</sup> Amphoroid vessels included in phases II-III from the Late Neolithic in Struma valley (Commenge-Pellerin 2004, 40, Pl. 8, 1; Чохаџиев 2007, Обр. 22. 67. 3).

<sup>1989, 22, 24).</sup> 

<sup>14</sup> This form of handles appeared at the transition between Vinča-Tordoš I and Vinča-Tordoš II, which continued to be practiced in the later Late Neolithic phases (Гарашанин и Спасовска 1976, 111). Also, Sanev includes this type of handles in the phase Angelci I based on direct analogies with layer 1 and the chronologically corresponding pits in Amzabegovo, Lower Struma, and in less extent in Zelenikovo II (Санев и Стаменова 1989, 24). There are similarities with horizon I from the Late Neolithic settlement Rakle (Темелкоски и Миткоски 2008, 98, 103, Т. III, 3).
the new economic branch related to heat within the copper processing activities. The ovens are rare examples discovered in the last stages of Neolithic sites' existence in the wider Balkans area.<sup>15</sup> This can be supplemented with a fragment of a small ceramic vessel (cup) with very thick walls, which may have been used for crushing small amounts of ore (Pl. 3: 3).

From the earlier construction phase the pottery is characterized by an intense red colour, thin walls, flat or polished sides as well as visible use of mineral temper in the fabric. In this phase, the vessels discovered in House 1 and House 2, which were located *in situ* around the building with trapezoidal-rectangular recipients i.e. in the southwest corner or the houses' floor. The most striking is the large carinated storage vessel with vertical ribbon handles executed on the upper part of the neck (Pl. 1: 6). For the most part, the upper cone (neck) is preserved, which has an outward extended rim edge. The vessel was decorated with plastic applications, with bundles of side-long, zigzag and semicircular channelled grooves. The lower part is characterized by a small and narrow bottom. Similar storage vessels, although with a narrower and taller body were found in the Neolithic settlements of Struma.<sup>16</sup> Three beakers and a bowl with a characteristic reddish colour were also discovered here (Pl. 1: 1–5). A profound difference was noticed in the manner of the rim's execution on the beakers. One of them was thickened on the outside (Pl. 1: 1), the second has a flattened upper surface and a slightly thicker edge on both sides – inwards and outwards (Pl. 1: 2) and the third is rounded, so that at the top the width of the wall is reduced (Pl. 1: 3). The most common decorative technique in beakers was the execution of plastic applications located on the middle part of the body as well as additionally decorated with bundles of converse shallow channelled grooves forming an ornament in the middle, in the form of the Latin letter V (Pl. 1: 1, 3).<sup>17</sup> One of the beakers is characterized by a sharp edge in the middle of the body as well as a shallow recipient (**Pl. 1: 4**).

There are also a large number of plates' fragments with different sizes and types found within the houses. Also, there are minimal numbers of vessels that were decorated with the still practiced barbotine technique, a larger fragment is characteristic belonging to the group of storage vessels with vertical ribbon handles, decorated with the barbotine technique (Pl. 2: 4). Carinated and conical plates, then hemispherical ones as well as plates with a slightly indented rims predominate (Pl. 2: 2, 3, 5; Pl. 3: 1, 2, 4–6). Some of the carinated plates were decorated with a characteristic ornament consisted of a plastic application on the refraction edge and semicircular shallow channelled grooves above it (Pl. 2: 5; Pl. 3: 1, 6). Some of the conical plates with a smooth and dark gray outer surface were decorated with meandering engraved lines filled with pasteous red colour. Plastic applications were also placed on the conical plates - on the body (Pl. 1: 5; Pl. 3: 1, 6) or on the rim's edge inwards (Pl. 2: 3). These plastic applications on the rim's edge inwards can be small as in this case or larger overhanging the rim - characteristic of some of the specimens in Mlaka, Šupli Kamen (Георгиев и др. во подготовка). They are found in a wider part of the catchment area of Vardar, Bregalnica, Pčinja and all the way to the Pannonian Plain (Корошец и Корошец 1973, Т. XXVIII, 9; Гарашанин и Гарашанин 2009, 149, 205, T. XXXVIII, 12).18

## Conclusion

The Late Neolithic in the area of the eastern Macedonian valleys is characterized by the emergence and development of Zelenikovo II-Angelci culture as well as certain Vinča elements in the upper layers of Amzabegovo. The upper layers of a large number of Neolithic settlements are greatly damaged due to the permanent deep agricultural cultivation of the areas. Therefore, at some of the Late Neolithic settlements, in the upper layers (plough land, layer 1 or layer 2) sol-



itary fragments of ceramic vessels stand out which are usually without context or were mixed with fragments that originate from the lower layers, for example, such as in the settlements near Vršnik, Čaška, Mrševci and others. (Гарашанин и Гарашанин 1961, 17, 18; Гарашанин 1984, 59; Jовчевска 1990, 56). To a large extent, the ceramic material of these upper layers is heterogeneous and often is difficult for their cultural and chronological determination with the (most probable) destructed construction horizons of the upper layers. Therefore, the Late Neolithic settlements where the construction horizons are preserved, such as Bojkovci and Angelci, should be treated as benchmark for further cultural determination of these characteristic vessels' forms.

The protective archaeological excavations that were carried out on Boikovci and Topolnička Reka enabled more detailed observations and new insights about the prehistory and part of the historical flows about this especially important mining area. Although the older data for Bojkovci as a Late Neolithic settlement were almost insufficient, the new explorations following the previous ones supplemented and enriched the data for the last periods of the Late Neolithic settlement existence (fig. 11). The location of Bojkovci positioned on the river bank of the small Topolnička River and/or near the pathway near it, played a major role in terms of preserving the traditions of the Middle Neolithic as well as cultural influences that acted within its final stages. Those were, most probably populations that already started with an intensive search for new mineral raw materials of copper oxides (Vinča-Pločnik phase) and stimulated the process of gradual demise of the Neolithic society. During the archaeological excavations of Bojkovci no copper remains were found, but in several Late Neolithic settlements in Macedonia (Barutnica, Amzabegovo and Dzuniver, Izvor) a presence of miniature objects made of copper oxides was registered (Mitovski 2018, 188–189, Figs. 1, 2). The discovery of several exceptional ceramic vessels and symbolic objects in Bojkovci, suggests that their direct users can be associated with the period of already started pri-



18 A characteristic fragment of a similar plate was discovered in layer 3 of Zelenikovo (Гарашанин и Спасовска

<sup>15</sup> A similar model of oven was discovered in Valač, Kosovo, synchronized with Predionica IIIb phase, Vinča-Pločnik II and a similar model from Vinča at a depth of 4 m (Гарашанин 1973, 105). Also it has parallels with a horseshoe-shaped oven model from Slatino, Bulgaria from the Early Chalcolithic (Гарашанин 1998, 86; Чохаджиев 2006, 36, Обр. 191). According to Čohadžhiev, the appearance of oven models increased significantly in the Early Chalcolithic in contrast to the Neolithic period (Чохаджиев 2007, 128-129). A group of three horseshoe-shaped models were found in Rakotinci and belong to the Early Chalcolithic settlement (Orlovica 2) in Skopje region (Mitrevski 2017, 89, 94, Fig. 17).

<sup>16</sup> Storage vessel classified in the Late Neolithic phase I (Чохаджиев 2007, lix, Обр. 55); similar vessels were defined as Vinča material from Amzabegovo (Гарашанин и Гарашанин 2009, 148, 206, Т. XXXIX, 11).

<sup>17</sup> A fragment of a smaller beaker (rim diameter of 10 cm), with a characteristically executed rim and a hemispherical body, with a similar decoration was discovered next to House 1 on the south side in square 6 - similar to the beakers of Vinča-Tordoš II phase.

<sup>1976, 105,</sup> T. VIII, 4). Typologically, these ceramic vessels in Pannonia were defined as plates with a 'horned' rim and chonologically determined in the phase Starčevo-Çriş IV/Vinča A - typical for the culture of the new settlers (Drasovean 2006, 96, T. VII, 5, 7,). According to Horvat, these plates were unknown at the eponymous site Vinča, and were found at the sites in South Banat in phases A-B1 (Horváth 2006, 117, Pl. II, Fig. 6-10, Pl. VII, Fig. 1-2). Similar fragments of conical plates were discovered in the Neolithic settlement Gjeramidi, village Čanište, Mariovo region (Mitkoski 2017, 140, 148, T. IV, 14, 15, T. XII, 5, 11).

mary mining activity confirmed in the neighbourhood, Serbia (Pločnik, Crnokalačka Bara, Rudna Glava), Southwest Bulgaria and Greece (Dimitra and Sitagroi II) (Garašanin 1979, 188; Тодорова и Вайсов 1993, 242; Jovanović 2006, 229; Perić 2006, 238, 242; Чохаджиев 2007, 141).

Bojkovci I (layer 3) is presented by ceramic forms with traditional features, but also new conical and carinated shapes and their variants. It abounds in quality and monochrome vessels (reddish, orange, ochre and brown), but vessels with an unequal colour are also common i.e. dark browndark ochre, brown-orange and other brown hues. The most noticeable are the beakers' variants – with reddish hues, decorated with shallow channelled grooves on the upper cone or without them, with characteristic plastic applications shaped on the refraction of both cones. Also, of interest is the vessel in the form of a small cup with a flat bottom, mild carinated profile with plastic applications, intermediate, predominately mineral temper in the fabric (Pl. 1: 5). Earlier traditional decoration techniques such as organized and unorganized light barbotine were still used on larger storage vessels. The most common handles' shapes that were recovered in this layer are the ribbon handles executed on the upper cone, then the ribbon handles with deep and wide groove in the middle and various shapes of 'tongue' handles (Pl. 7: 8, 9). Concerning other objects there are fragments or fully preserved specimens of anthropomorphic figurines (Pl. 6: 1-3, 5), a fragment of a robust anthropomorphic figurine with stabbed ornaments (Pl. 6: 3), a fragment of a zoomorphic figurine (Pl. 6: 9), legs of ceramic vessels-rhyta, stamp (Pl. 6: 7) and a fragment of a cult table (Pl. 5: 2). The ceramic forms belonging to layer 3 are chronologically similar to Zelenikovo II, Angelci I, Vinča-Tordoš I–II as well as the settlements of Middle and Lower Struma (Гарашанин 1973, 83-89; Санев 1989, 24; Pernicheva 1995, 114-126; Гребска-Кулова 2004, 135-136; Митревски 2013, 109–111; Rujak 2017, 41).

Bojkovci II (layer 2) belongs to the later phase of the settlement's development and there is a visible change: both in the ways of dwellings' construction and in the ceramic production increase as well as the appearance of certain new vessels' forms. A characteristic new form of vessels are the tall jugs with a spindle neck, then several variants of amphoroid vessels as well as the appearance of carinated black topped vessels decorated with oblique and vertical shallow channelled grooves and a intermediate fabric. The handles' shapes are increasing in number, of which the most commonly used is a handle with triangular extension on the upper side, then: ribbon 'horned' handle, imitation handles, handles with a protuberance on the upper side, 'wishbone', 'tongue' handles, cylindrical, oblique handles, 'pinched' handles, etc. Although, not very common in this layer the conical vessel-strainers appear. The other objects are fragments of massive legs of vessels-rhyta (Pl. 6: 10), cylindrical anthropomorphic figurines (Pl. 6: 4), fragments of anthropomorphic figurines' legs (Pl. 6: 6), a fragment of a oven model (Pl. 5: 1) and a fragment of a house model's cubus corner decorated with engraved motifs filled with red pasteous colour (Pl. 6: 8). These finds are similar with the material from Zelenikovo II and Angelci II, analogous to the end of the phase Vinča-Tordoš II, Gradac II/Vinča-Pločnik I, then the settlements in Southwest Bulgaria and Middle Struma, Karanovo IV as well as Northern Greece – which are all part of the Balkan-Anatolian Late Neolithic cultural complex (Garašanin 1979, 188; Санев и Стаменова 1989, 24; Pernicheva 1995, 116, 119; Jovanović 2006, 229; Commenge-Pellerin 2004, 40; Чохаџиев 2007).

Due to the relatively complex morphology of the Macedonian relief which consisted of number of plains and river valleys the Late Neolithic settlements east of Vardar developed independently, with their own internal phases, but also with some mutual influences with the synchronous neighbourhoods. One of the probable reasons for this is the frequent mobility of the same populations in that period such as: climate change and the search for new resources - arable land and geological deposits (Гарашанин 1973, 124–125; Здравковски 2018, 33). The Neolithic settlement of Bojkovci reached its cultural peak at the end of the Late Neolithic when in the north there were active Late

<sup>19</sup> The climate maximum has contributed to the occurrence of long-term droughts: deforestation around settlements (excessive felling of trees or forest fires), rising groundwater and the creation of swampy areas in places with fertile agricultural land, possible local catastrophic torrential landslides, and probable abandonment of important economic and cultural values, such as permanent living in one place (Тодорова и Вайсов 1993, 245; Commenge 2007, 16; Митревски 2013, 108-109; Abazi and Tolevski 2017, 114).

## **Used Illustrations**

**Fig. 1.** Position of the research sector of the Late Neolithic settlement Bojkovci near the village Damjan (2018).

**Fig. 2.** Cadastral plan of Bojkovci and Kanli Čair – the old research sectors shown (according to V. Sanev).

- Fig. 3. The research Sector in 2018.
- **Fig. 4.** The north cross-section of square 3 and the stratigraphy of the research sector.
- **Fig. 5.** Groundplan of the dwelling with circular-elliptical shape.
- Fig. 6. Groundplan of the southwest corner of House 1.
- Fig. 7. Construction with rectangular-trapezoidal recipients of House 1.
- Fig. 8. The foundation of House 2.
- Fig. 9. Circular opening on the wall of House 2.
- Fig. 10. Remnants of a rectangular domed oven in House 2.

Fig. 11. The researched sector of Bojkovci, view from the southern side.

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This is the 6<sup>th</sup> volume of the edited book that is related to already traditional conference of the Center for Prehistoric Research, particularly focused on the Neolithic of Macedonia and the Balkans. Same as the conference this publication also brings together various specialists exploring different modes of life of the first farmers inhabiting the Balkans, thus promoting new perspectives in research methods and proposing a variety of possibilities in the understanding of the agricultural societies. This edition of 'Neolithic in Macedonia' gives an extensive elaboration of the latest knowledge in terms of technology, economy and habitation of the first farmers. All these papers provide thorough examination of the material culture, architecture and organic remains in order to demonstrate the modes of everyday life of the agricultural societies from the beginning until the end of the Neolithic period. Furthermore the authors promote novel research approaches and state of the art methods in order to reach a consistent notion of the world in which these farmers lived. That is moreover the substantial principle of the Center for Prehistoric Research which intends to encourage the implementation of the advanced multidisciplinary methods in prehistory and to present their outcome in this volume that has been continuously published since 2016.

