No. 10 (2014)

ARHEOLOGIJA I PRIRODNE NAUKE

ARCHAEOLOGY AND SCIENCE

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ARCHAEOLOGY
AND SCIENCE

Center for New Technology
Institute of Archaeology Belgrade

ARCHAEOLOGY AND SCIENCE 10 2014

Belgrade 2015

Centar za nove tehnologije
Arheološki institut Beograd

ARHEOLOGIJA I PRIRODNE NAUKE
10
2014

Beograd 2015.

Published:
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Print:
Digital Art Company Beograd

Printed in:
500 copies

ISSN 1452-7448

Izdavači:
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Štampa:
Digital Art Company Beograd

Tiraž:
500 primeraka

ISSN 1452-7448

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904:738.6(497.11)"01/02"
COBISS.SR-ID 219283468

Original research article
Received: September 22nd 2015
Accepted: November 15th 2015

ROMAN POTTERY FROM VIMINACIUM (SERBIA 2ND - 3RD CENTURIES AD): COMPOSITIONAL CHARACTERISTICS, PRODUCTION AND TECHNOLOGICAL ASPECTS

ABSTRACT

This study presents the results of mineralogical, petrographic and chemical analyses of 58 specimens of pottery and eight kiln wastes from the archaeological site of Viminacium and allows the creation of a reference chemical and mineral-petrographic group.

Four representative samples of argillaceous sediment were characterised by mineral-petrographic analysis before and after firing tests at 600 and 900 °C. Comparisons of the characteristics of the pottery, kiln wastes and local clay established the source of the raw materials and production methods. Petrographic analysis enabled the division of the pottery into the following: i) four fabrics characterised by inclusions perfectly consistent both with the lithotype outcroppings in the immediate vicinity of Viminacium and clay and kiln wastes, therefore deemed to be of local origin; ii) seven petrographic "singles", three of which are of uncertain production.

Firing tests conducted at 900 °C on the clay samples showed (by PXRD) the formation of hematite, gehlenite and pyroxene phases (in samples with calcite and dolomite precursors), all of which were also present in the pottery deemed to be of local origin. XRF confirmed the divisions made on a mineral-petrographic basis. The identified textural properties indicate firing temperatures in the range of 700-1050 °C.

KEYWORDS: ARCHAEOMETRY, POTTERY, ROMAN AGE, VIMINACIUM, CLAY SAMPLES

INTRODUCTION[1]

The archaeometric research described here was performed within the framework of collaboration between the Sapienza University of Rome and the Belgrade Institute of Archaeology.

The samples analysed in this work were collected from the archaeological site of Viminacium (VIMINACIVM), 100 km South East of Belgrade, Serbia (Fig. 1).

Viminacium was founded in the first decade of the 1st century AD on the banks of the river Mlava, a tributary of The Danube, during the second part of the reign of Augustus or in the first part of that

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Fig. 1 Geographical map showing Serbia and the location of Viminacium with respect to Belgrade.

of Tiberius. Viminacium was a major city (provincial capital) and military camp of the Roman province of Moesia Superior (today's Serbia) during the period from the 1st to the 4th century AD. Its exceptional strategic importance was a result of its role in the defence of the northern border of the Roman Empire and, in turn, communications and commercial transactions. Also the hinterland of the Mlava valley, which was rich in metal ores and grains, was very attractive to the Romans. In Roman times, the northern side of the town relied directly on a branch of the Danube, while the western side touched the banks of the Mlava River. Viminacium did not spread to the left bank of the Mlava until a later period. Due to its location, land and waterways, in Viminacium, encounters between the cultures of the East and West were inevitable. Although roads primarily served a military and strategic function, they were a place throughout antiquity of lively traffic, and certainly contributed to Viminacium becoming very prosperous and an important trading and business centre. In the 3rd century AD, it was established for a few decades as a city that minted coins, mostly of copper but also silver, for the armies of the Limes Moesicus. Viminacium was destroyed in 441 by Attila the Hun but was rebuilt by Justinian I during Maurice's Balkan campaigns. It suffered destruction by the Avars in 582 but was then home to the crushing defeat of the Avar forces on the northern Danube bank in 599, which destroyed the Avar reputation of invincibility.

Over the last three decades of the 20th century, site excavations were conducted in an increasingly accurate and systematic way (Korać 2006: 7). The excavations have brought to light a number of public structures (Fig. 2), such as an amphitheatre for 12,000 spectators, an aqueduct, baths, and what seems to have been a circus over the ruins of the legionary fortress and canabae, where many veterans of the legions of the area were settled. The surface area for archaeological investigation is exceptional (over 450 hectares for the greater metropolitan area and 220 hectares in the territory of the city). The remains of Viminacium extend over entire cultivated fields and fragments of, and sometimes whole, ancient artefacts lie scattered on the surface.

More than 13,500 graves have also been investigated, from which over 32,000 objects have been recovered. For this reason the city was named the "Pompeii of the Balkans".

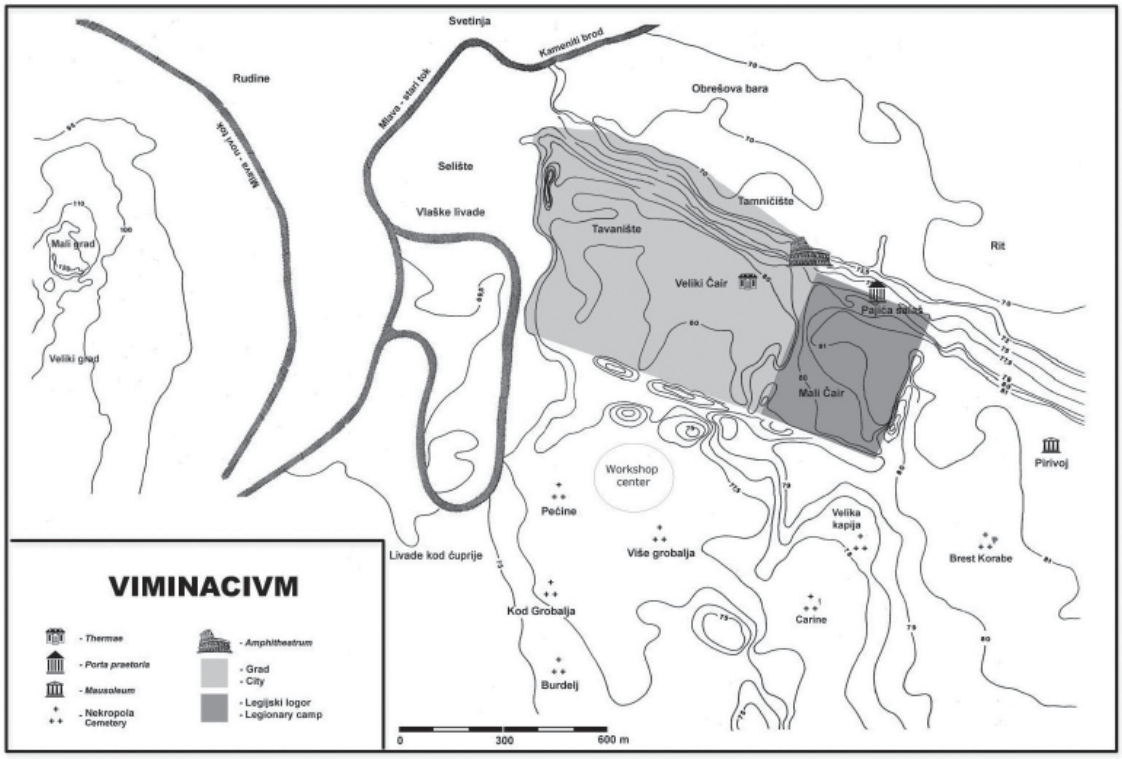


Fig. 2 Map of archaeological site of Viminacium.

During research on the whole area of Viminacium, more than 40 ceramic kilns were discovered, while 13 of them were excavated in the territory of the south necropolises of "Pećine" and "Više Grobalja". A group of kiln wastes (derived from the production of pottery and bricks) were also discovered nearby, and it has, therefore, been assumed that the area served as a workshop centre (Raičković and Redžić 2006a: 82; Raičković and Vuković 2009: 11; Raičković 2007: 55, Fig. 3).

Viminacium produced highly developed crafts (Raičković and Milovanović 2008: 27), with the production of ceramics especially abundant.

Production at this centre was active from the end of the 2nd century AD until the end of the 3rd century AD.

The workshop centre produced ceramic material necessary for the grave inventories of the necropolis, but further research (Raičković 2007: 50.) has shown that only 20% of the forms produced there were used as a grave inventory. The other products of the workshop were vessels that were used in other markets. There is evidence to support such a theory from all localities of Moesia Superior and from other surrounding provinces, such as Pannonia and Dacia *(loc. cit.)*

After macroscopically analysing and typologically classifying more than 16,000 fragments of ceramic vessels from this area, it was suggested that some forms of the vessels were produced in the workshop centre, while some others were imported to Viminacium.

The aims of this work were as follows:

Verify (through the mineralogical-petrographic characterisation and chemical compositions of 58 fragments) the archaeological hypothesis of the local production (Raičković and Redžić 2006a: 87) of most of the samples studied, which represent different functional classes produced at Viminacium (Table 1), a marginal provincial area;

Determine whether the recognised forms, extraneous to local tradition (Raičković 2007: 39), were made with local raw materials (circulation of styles) or were imported (transport of finished goods);

Suggest the source or sources of supply (pot-

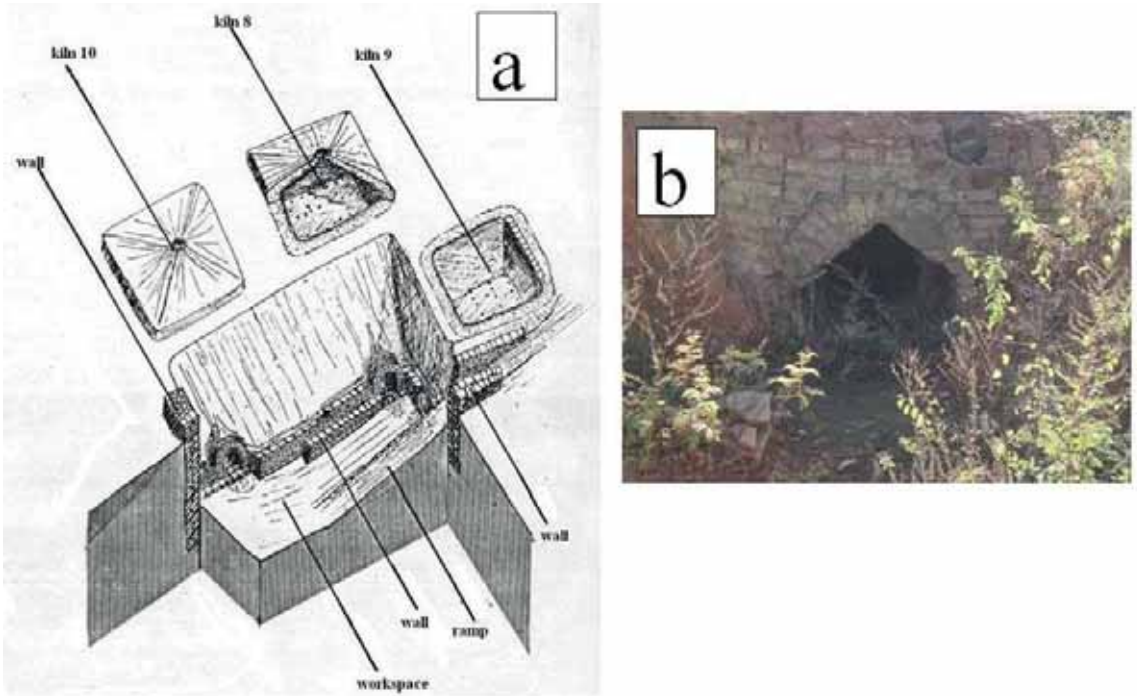


Fig. 3 a) Drawing of Pećine workshop center. b) Photograph of the kiln in Pećine workshop center, near which were taken eight kiln wastes studied.

ters movements and organisation of production) from the study of available lithological data found in literature (Dimitrijević 1997: Fig. 4a-b) and the mineralogical-petrographic study of four clay samples that are representative of clay variability in the immediate vicinity of the site;

Create a chemical and mineralogical-petrographic classification of ceramics produced in Viminacium that will be useful for future comparisons with other pottery from the same period and other Roman provinces.

It is important to emphasise that only a partial chemical analysis of pottery (Walton 2010: 733-759) has been performed in Serbia so far. This is the first time that a chemical analysis has been conducted on Viminacium's pottery and, therefore, it is important for confirming the large production of pottery there and establishing the area across which it was distributed among other Roman provinces.

Several technological and production aspects, such as firing temperatures, production methods, finishing and decoration, were also assessed to determine the skill of the craftsmen at Viminacium.

MATERIALS: CERAMICS, KILN WASTES, GEOLOGICAL SKETCH AND RAW CLAY MATERIALS

In the immediate vicinity of "Pirivoj", a large area (Raičković and Milovanović 2009: 7-29) of red burnt soil was found in the same area where significant amounts of mobile material were also found (Fig. 2). Mobile material that is chronologically sensitive (coins, fibulae and glass vessels) makes chronological dating easier. The space itself was first considered to be a big pyre, but by the end of this study it was considered to be a rubbish heap used for the necropolis's waste (Raičković and Milovanović 2009: 27).

The 58 pottery fragments studied here (dated from the second half of the 2nd century to the end of the 3rd century AD) were collected near "Pirivoj", around the Mausoleum (Fig. 2), during excavation number 29 (Fig. 5), which covered an area of 20 x 20 m to a depth of 3 m.

In sampling, all types of vessels produced at Viminacium were represented, including those used to prepare food, such as pots, jugs and bea-

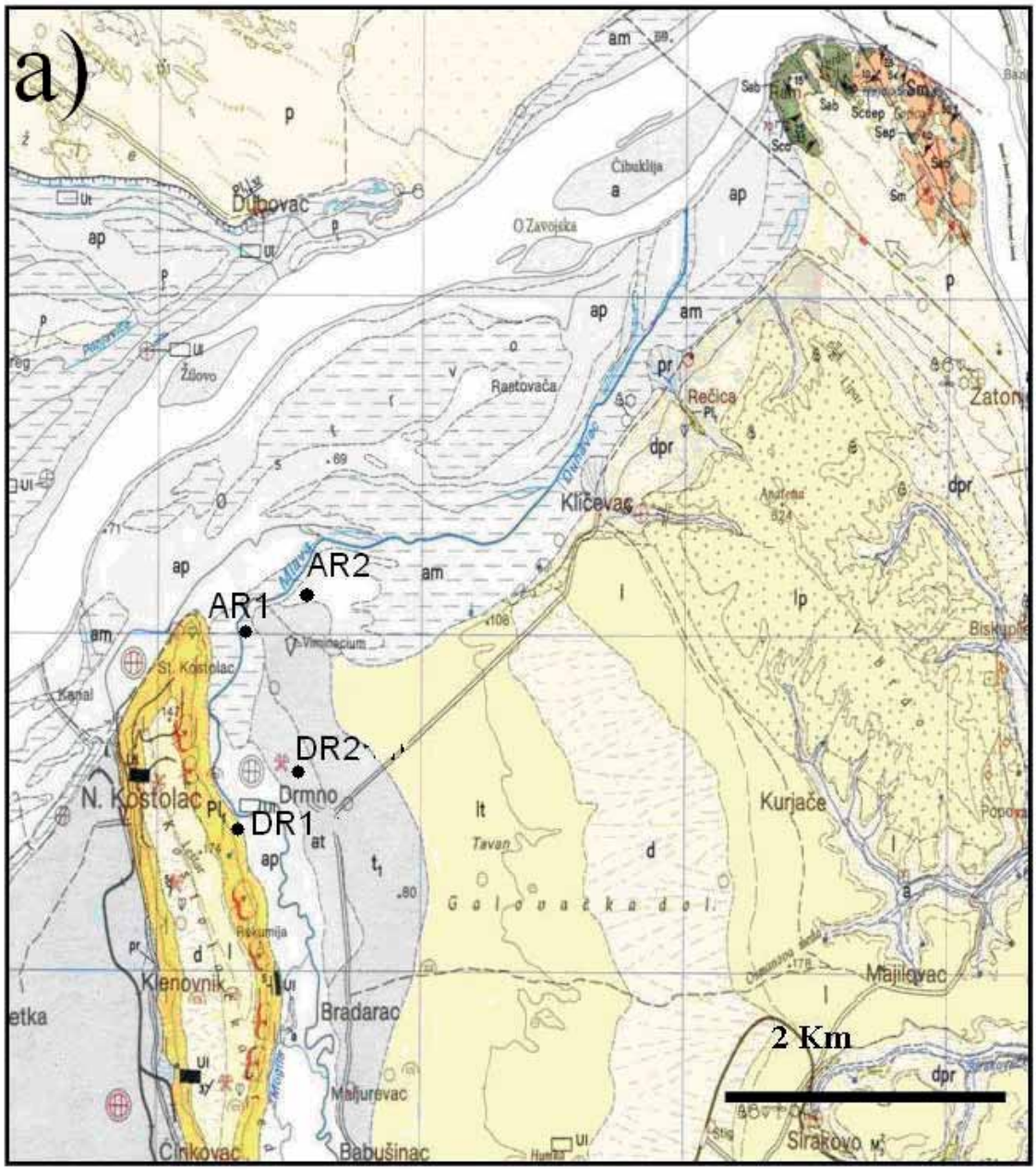


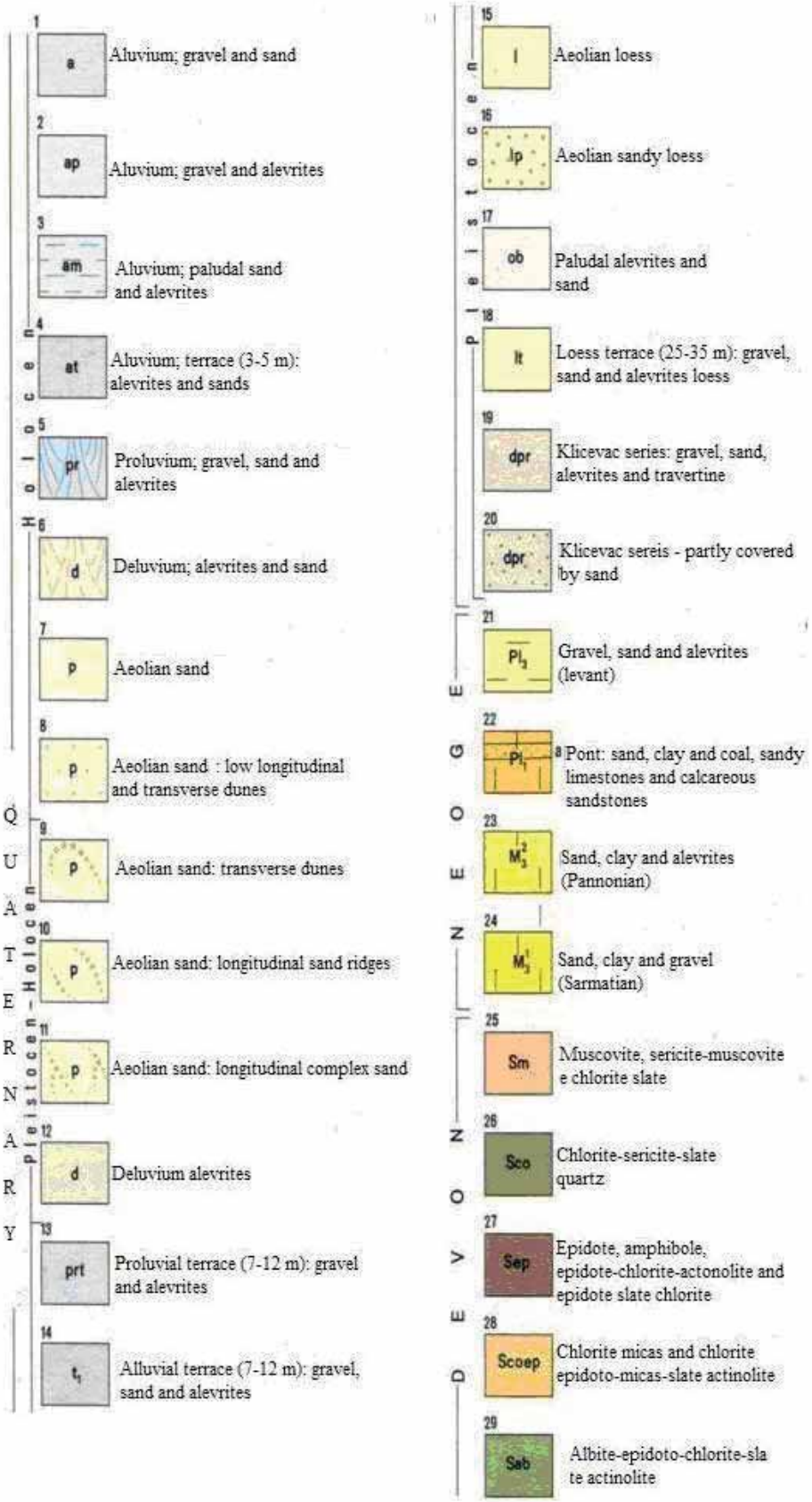
Fig. 4 a) Geological map of Kostolac and Drmno and legend. Sampling point of four clay samples.

kers, and those used for its storage and transport, pithoi and amphorae (Fig. 6). More than 99% of detected pottery was moulded on a lathe.

The analysed fragments were chosen according to several criteria. First, the samples included each vessel type found at Viminacium (bowls, pots, plates); then from them, fragments made of macroscopically different types of clay were chosen.

Among the vessels used for preparing and cooking food, the so-called kitchenware (Table 1), were mainly forms of pots made of grey sandy clay (sample numbers = s. n. 9, 13, 21, 25, 29 and 56 Fig. 6_{8}) or that had red mixtures (s. n. 8, 10, 27, 43, 49, 53 and 57). Some of them (s. n. 22, 50 and 58) contain white fragments, which may be pieces of bioclasts.

As for tableware (Tab. 1), the ceramics were mainly made of partially refined clay that had grey or red mixtures (Fig. 6_{1-2}), and the outer surfaces were often coated with different shades of


QUATERNARY
Holocene
Pleistocene - Holocene
Pleistocene
NEOGENE
Pliocene
Miocene
DEVONIAN
1 a Aluvium; gravel and sand
2 ap Aluvium; gravel and alevrites
3 am Aluvium; paludal sand and alevrites
4 at Aluvium; terrace (3-5 m): alevrites and sands
5 pr Proluvium; gravel, sand and alevrites
6 d Deluvium; alevrites and sand
7 p Aeolian sand
8 p Aeolian sand : low longitudinal and transverse dunes
9 p Aeolian sand: transverse dunes
10 p Aeolian sand: longitudinal sand ridges
11 p Aeolian sand: longitudinal complex sand
12 d Deluvium alevrites
13 prt Proluvial terrace (7-12 m): gravel and alevrites
14 t1 Alluvial terrace (7-12 m): gravel, sand and alevrites
15 l Aeolian loess
16 lp Aeolian sandy loess
17 ob Paludal alevrites and sand
18 lt Loess terrace (25-35 m): gravel, sand and alevrites loess
19 dpr Klicevac series: gravel, sand, alevrites and travertine
20 dpr Klicevac sereis - partly covered by sand
21 Pl2 Gravel, sand and alevrites (levant)
22 Pl1 Pont: sand, clay and coal, sandy limestones and calcareous sandstones
23 M3 2 Sand, clay and alevrites (Pannonian)
24 M3 1 Sand, clay and gravel (Sarmatian)
25 Sm Muscovite, sericite-muscovite e chlorite slate
26 Sco Chlorite-sericite-slate quartz
27 Sep Epidote, amphibole, epidote-chlorite-actonolite and epidote slate chlorite
28 Scoep Chlorite micas and chlorite epidoto-micas-slate actinolite
29 Sab Albite-epidoto-chlorite-sla te actinolite

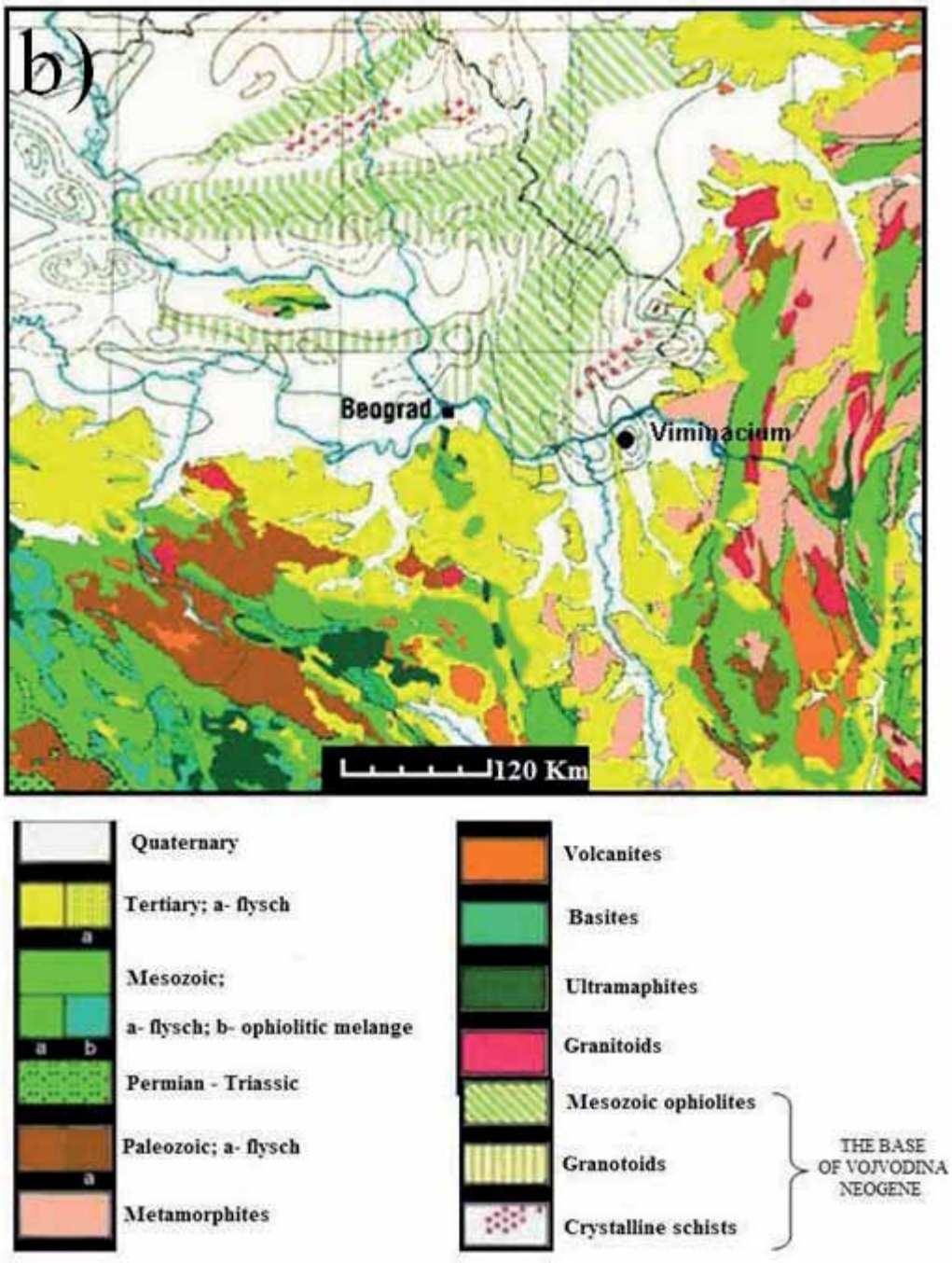


Fig. 4b) Geological map of Serbia and legend.

red (s. n. 11, 12, 24, 31, 36, 37, 51 and 59). In this group, there were a number of forms recognised as imports (Raičković 2007: 43) made of finely refined clay in white (s. n. 23; Fig. 7a), red (s. n. 38; Fig. 7b) and grey (s. n. 41; Fig. 7c) as a result of firing, where the decorations on the outer surfaces were different (stamps and incisions) or the surface was painted with a stable colour or glazed in light green shades (s. n. 20; Fig. 7d).

Among vessels used for the transport and storage of food, the amphorae and pithoi samples made of different macroscopic fabrics were chosen in the range of sandy clay (Fig. 6_{3-7}) with different ingredients (4, 17, 46 and 47). According

Fig. 5 Excavation number 29, Necropolis of Pirivoj.

to archaeologists (*ibid*. 42), the forms of sample numbers 4, 17 and 46 are not of local origin.

The kiln wastes were only broken pieces of mostly unfired ceramics recovered from a kiln dump located in the workshop centre of "Pećine", which was outside the city, near the necropolis. It was impossible to establish the function of the kiln wastes.

Fig. 4a shows that in a radius of 10 km from the archaeological site there is only the presence of sedimentary rocks, mostly alluvial terraces of the river Mlava (Quaternary). In fact Viminacium is located within an alluvial terrace (7-12 m) consisting of gravel, sand and silt. At the edge of this area and to the east lies a terrace of very fine eolic sediment (25-35 m thick) and to the west of the alluvium, a terrace 3-5 m thick composed of silt and sand. To the north of the alluvium, however, are old facies of sandy swamp and silt, alternating with younger facies of sandy alluvials and siltstones. In the area of Stari and Novi Kostolac (about 3 km west and south-west of Viminacium) there is a strip of land consisting of sand, clay and coal, sandy limestone and carbonate sands. Within this area there is different lithology characterised by very thin sandy eolic sediment.

About 10 kilometres north-east of the archaeological site, there is an area of approximately 5 km^2 comprising metamorphic rocks, particularly schists with mineralogical associations such as:

1) Muscovite, Muscovite-sericite-chlorite;

2) quartz, chlorite-sericite;

3) epidote-amphibolite, epidote-Chlorite-Actinolite;

4) Chlorite-Mica and Chlorite-epidote-mica-Actinolite;

5) Albite-Chlorite-epidote-Actinolite.

Fig. 4b (Dimitrievć 1997) instead, shows that Viminacium's area is bordered to the N-NW by an outcrop of crystalline schists and Mesozoic Ophi-

Fig. 6 Kinds of vessels produced at Viminacium and sampled. 1) (Tableware) medium fine texture clay, red fabric; 2) (Tableware) medium fine texture clay red fabric, outer surface colored in different shades of red; 3) (Amphora) medium fine texture clay red fabric with outer surface yellowish white engobe; 4) (Tableware) sandy clay, grey fabric; 5) and 6) (Tableware) sandy clay, white fabric; 7) (Amphora) medium fine texture clay red fabric, outer surface colored red; 8) (Kitchenware) sandy clay, dark fabric.

olites; to the NE by a Tertiary flysch adjacent to granitoid and metamorphic rocks and a Paleozoic flysch; to the E by metamorphic rocks and to the S by Mesozoic alluvial deposits in an area with metamorphic rocks and a small number of granitoid rocks.

Four clay samples were selected from different points around Viminacium for analysis (Fig. 4a): two were near the Mlava River (AR1 and AR2; Fig. 2); two were taken from Drmno, a town 3 km from the old city (DR1 and DR2). The samples were representative of four outcrops of clay in the vicinity of the site *(loc.cit.),* but they were not certain to be likely points for the collection of mate-

Fig. 7 Some forms recognized as imports: a) Sample 23; b) Sample 38; c) Sample 41; d) Sample 20.

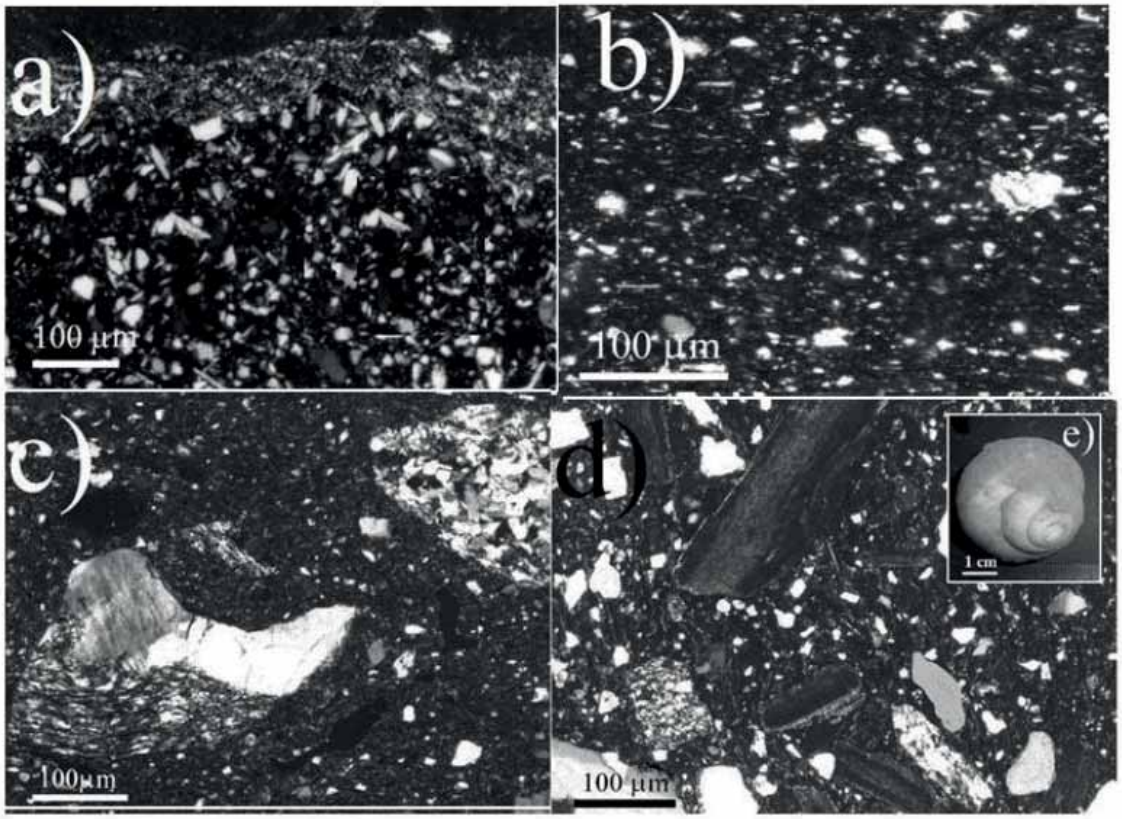


Fig. 8 Thin-section microphotographs by optical microscope of two fabric types and subgroup of coarse-grained group (crossed Nicol prisms): a) Fabric 2; b) Fabric 1 (quartzose component with sharp edges); c) Fabric 3A (hiatal with metamorphic rocks); d) Fabric 3B (fragments of gastropods); 6) One of many shells found on the site, maybe part of the ancient diet.

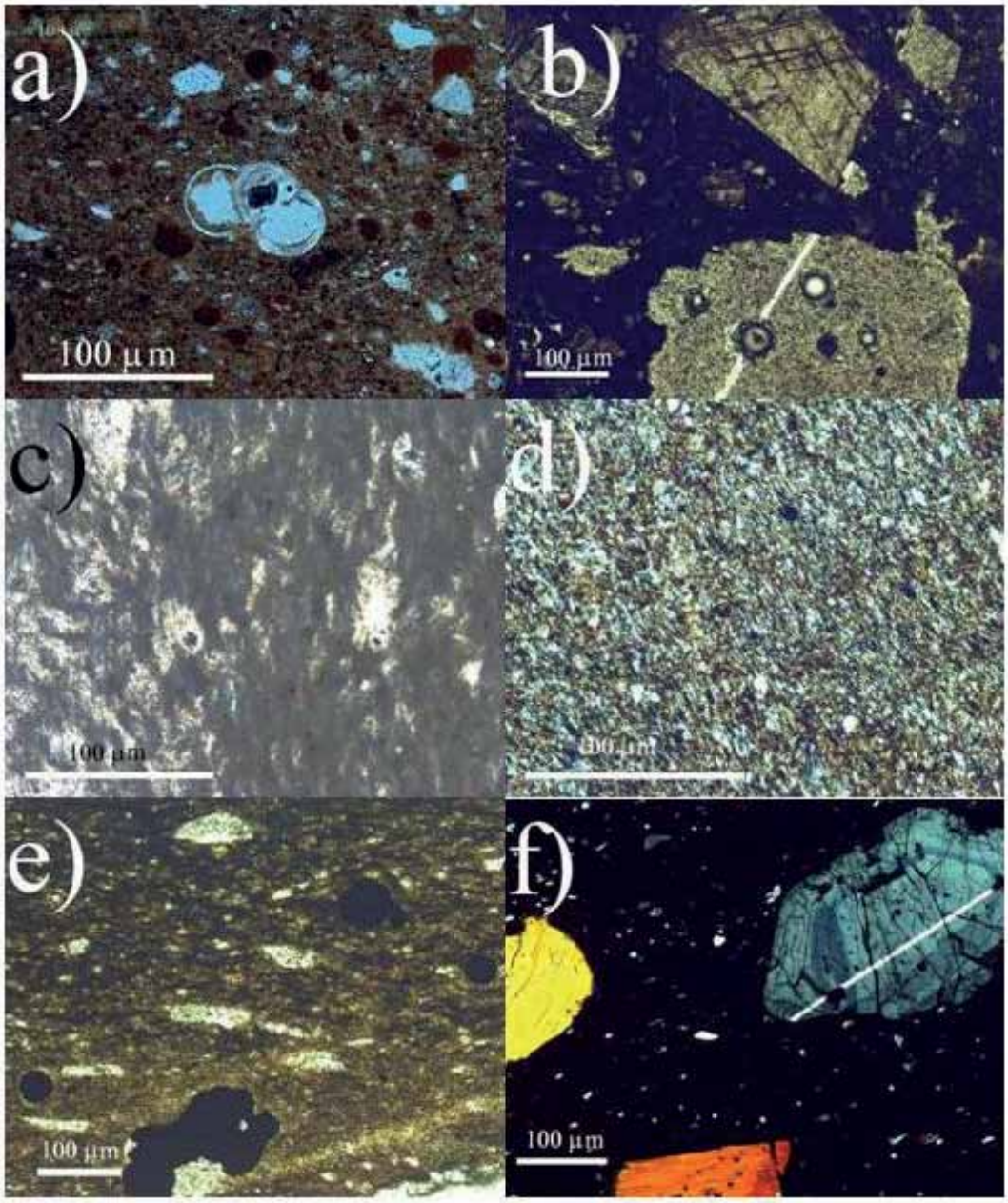


Fig. 9 Thin section microphotographs of petrographic singles: a) Sample 4; b) Sample 9; c) sample 23; d) Sample 38; e) Sample 41; f) Sample 46.

rial for the ancient potters and come from a mine whose depth is unknown. For these reasons, it was not considered appropriate to perform chemical analysis on these samples of clay, so only a mineralogical-petrographic analysis was performed. Samples AR1, AR2 and DR2 come from quaternary alluvial deposits (Holocene); sample DR1 is a Neogene calcareous clay.

ANALYTICAL METHODS

Each sample was powdered in an agate mortar and then subjected to X-ray diffraction (PXRD) and X-ray fluorescence (XRF) analyses.

PXRD was performed using Philips PW 1830 equipment, with filtered CuKα radiation (40 mV, 20 mA), which measures 3-70° 2θ at a velocity of 1°/min and a time step of 2 s, with a 1° divergent

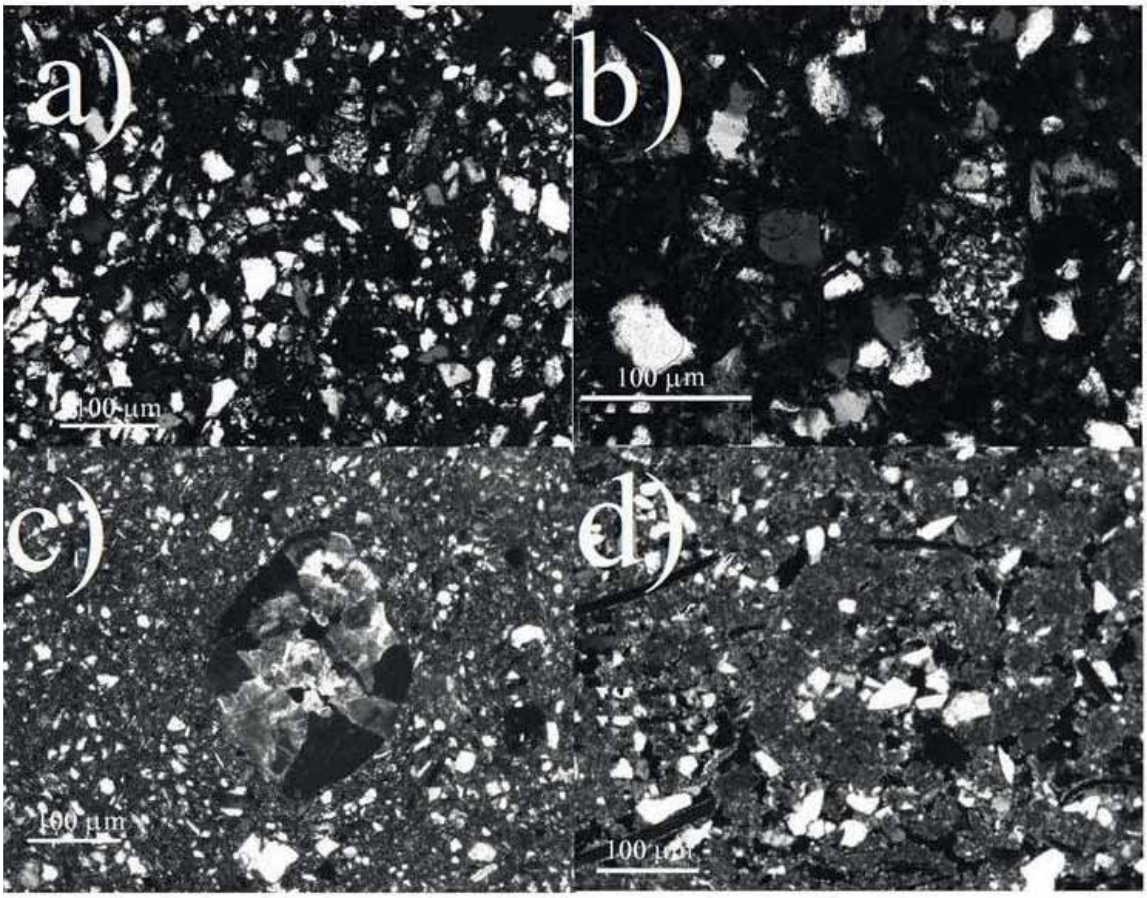


Fig. 10 Thin section microphotographs by optical microscope of clay samples: a) AR1; b) DR25m; c) AR2, in evidence calcareous pellets; d) DR15m.

slit, 0.1 mm detector slit and 2° anti-scatter slit.

Thin-section analyses of the fabric of the archaeological specimens were performed using a Zeiss polarising microscope, which distinguished between inclusions (skeleton), matrix and voids (Maggetti 1982:121-133; Whitbread 1995).

Major and trace element determination was performed by means of XRF on 2g of powder, previously calcined, using glassy pearls (prepared with an automatic *Philips PerlX-2*) with a ratio of ceramic powder and melt of 1:4, and with a RIGAKU ZSX PRIMUS spectrometer (Rigaku International Corp., Osaka, Japan), according to Franzini *et al.* 1975 and Leoni & Saitta 1976.

Calcination by L.O.I. was determined by heating the powder at 1000 °C for 24 hrs. Analytical precision was generally estimated at <3% for major elements and better than 10% for trace elements.

The clay materials were subjected to petrographic analysis and X-ray diffraction (XRD) to define their compatibility, or otherwise, with ceramic materials. To obtain suitable material to study in thin sections and a concrete base for the comparison of pottery considered local, clays were mixed with water and moulded into the form of small bricks measuring 2x3x1 cm. These were first dried at room temperature for 2 days in order to eliminate the mixing water and then cooked, for firing tests, in a muffle kiln, in an oxidising atmosphere (the supposed mode of firing for most samples studied, inferred by fabric analysis) at 600 and 900 °C for 6 hrs.

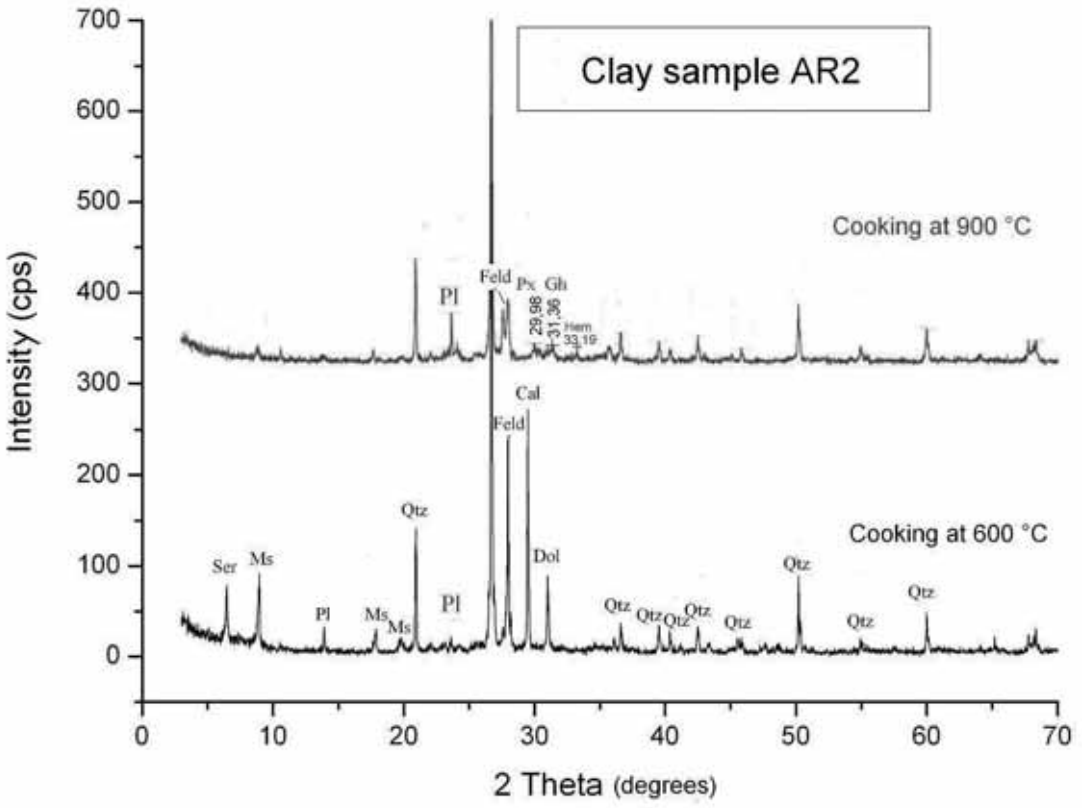


Fig. 11 Diffractograms showing comparison and different mineralogical phases between clay sample AR2 cooked at 600 and 900 °C. Ser, sericite; Ms, muscovite; Pl, plagioclase; Qtz, quartz; Feld, feldspar, Px, pyroxene; Gh, gehlenite, Cal, calcite; Dol, dolomite; Hem, hematite (symbols as in Kretz, 1983).

RESULTS

Optical microscopy

The samples were petrographically observed for functional class using optical microscopy. An accurate comparative examination of the results revealed not only recurrent similarities, but also differences among samples of the same type, which enabled the division of most of the fragments into different fabrics (Fabric 1, 2, 3A and 3B) based on the composition of their aplastic component.

Seven samples (4, 9, 17, 23, 38, 41 and 46) were so unique that it proved impossible to attribute them to any fabric type, and they were therefore regarded as petrographic "singles".

Petrographic observations also allowed the classification of the eight kiln waste samples, as with the pottery, as Fabric 1 (sample II), Fabric 2 (samples I, III, IV, V and VIII) and Fabric 3A (samples VI and VII).

The proposed quantification of the inclusions present in the samples was a semi-quantitative estimation made using comparative tables (Cuomo di Caprio, 2007: 21-40).

Tableware

This group of 27 samples (Table 1) is characterised by 2 fabrics (Fabric 1 and 2) and 3 petrographic "singles" (samples 23, 38 and 41).

The two types of dough differ in the absence (Fabric 1; samples 20, 24, 26, 37, 42, 52, 55 and 60) or occurrence (Fabric 2; samples 1, 3, 7, 11, 12, 15, 28, 31, 32, 34, 36, 39, 40, 49, 51 and 59) of scarce and very fine, rounded fragments of calcareous pellets and calcite (Fig. 8a) and the presence

(Fabric 1) of frequent fine metamorphic-quartzose rock fragments, sometimes with sharp edges (Fig. 8b).

For this type of pottery, the paste had a granulometry from fine to very fine, from homogeneous to serial, with packing that was low to medium ands sorting that was from good to moderate (Fig. 8a). The aplastic component (inclusions ≤20-30 □m; Whitbread 1995) had rounded edges, with the exception of specimens 20, 24, 37, 55, and 59, where the quartzose component had sharp edges (Fig. 8b). The composition of the skeleton was predominantly monocrystalline quartz, plagioclase, variably abundant micas that were often oriented in the direction that the clay was worked and rare K-feldspars with rounded edges. Of the micas, muscovite was more abundant than biotite. Low to very scarce quantities of small iron oxides and hydroxides were present in almost all samples and clay pellets (Whitbread 1986: 79-88) could often be identified.

The entire specimen set was characterised by low porosity and compactness and in specimens 3, 11, 32, 35, 40 and 59, calcite from recrystallisation was frequently observed. In samples 35 and 40 rare and very small crystals of sericite were noted. The matrix content ranged from a minimum of 60% to a maximum of 90% by volume, and the ceramic bodies showed chromatic zoning due to varying degrees of oxidation of the matrix. Most samples presented a matrix without birefringence. Additionally, less of a birefringent black core in comparison to a birefringent brown-orange border was not very common (samples 20, 36, 52 and 55).

Kitchenware

This group of 15 specimens (Table 1) included 2 fabric types very similar to each other (which from here on will be called Fabric 3: A and B) and one petrographic "single" (s. n. 9). Fabric 3B can be considered a subgroup of Fabric 3A.

Fabric 3A (s. n. 8, 10, 13, 21, 25, 27, 29, 43, 53, 56 and 57) and 3B (s. n. 22, 50 and 58) contained coarse-grained samples and had a medium-high concentration of the lithic fraction; it was poorly sorted and had a generally hiatal granulometric distribution. The non-argillaceous fraction was distinguished mainly by two different granulometric classes (Fig. 8c).

The inclusions (the larger component, which were clearly tempered) were for the most part sharp-edged and only in rare cases were rounded. Mineralogical phases in decreasing order of abundance were: polycrystalline quartz with a typically undulose extinction, crystals of micas (mainly muscovite and sericite only in specimen 21) and plagioclases. Subordinates included K-feldspar and granules of monocrystalline quartz; this component belongs to the smallest granulometric class and is often characterised by rounded edges. Lithic inclusions were frequently metamorphic-quartzose and metamorphic-schistose rock fragments, which belong to the largest granulometric class and have a sharp edge. Chamotte (Cuomo di Caprio and Vaughan 1993: 21-40) was frequent in most samples. Porosity was more marked and compactness thereby lower than that of the first group.

Fabric 3B shows fragments of either freshwater or terrestrial gastropods (Fig. 8d) in addition to the bigger inclusions of hiatal granulometric distribution, which, based on the many shells found on the site (Fig. 8e), may have been part of the ancient diet (Raičković, 2007: 44). The fragments were oriented in the direction of the long sides of the sherds. Both macroscopic observation of the samples (blackened walls, coarse grains on fractures and high porosity) and microscopic inspection (a very dark-coloured matrix and the rather coarse granulometry of the fabric) suggested that all three samples were potentially used for firing. In sample 22 rare crystals of sericite were noted.

Amphorae and Pithoi

This group of 16 samples was characterised by 2 fabrics and 3 petrographic "singles" (s. n. 4, 17 and 46).

Samples 2, 5, 14, 30, 33, 47, 48 and 54 were found to be Fabric 1 (similar to part of the tableware), and the remaining samples were Fabric 2 (similar to part of the tableware).

All samples in this group, except for the petrographic "singles", had a quartzose component with sharp edges (Fig. 8b).

Petrographic "singles"

According to their microscopic features, seven samples were deemed to be of different production and were therefore considered to be petrographic "singles" (Fig. 9).

Sample 4 (amphora): The sample was medium to highly packed and had a poorly sorted matrix, coarse granulometry, and a serial structure. Fossils were very abundant in these samples (whole shells and fragments of planktonic foraminifera and Pliocene Globigerinidae) but were not found in other samples. Various oxides together with fragments of quartzose metamorphic rock and mineral components represented by quartz, gypsum, plagioclase and micas also occurred.

Sample 9 (kitchenware): The sample was extremely coarse with a fractured fabric and very high porosity. Large, sharp-edged fragments of carbonate rock, calcite crystals, quartz, and rare plagioclase and micas were clearly visible.

Sample 17 (amphora): The sample was rather coarse with a high-porosity granulometry that was oriented in the direction that the sherd was worked. Inclusions were represented by somewhat round-edged quartz, very sharp calcite, opaque iron oxides and clay clumps.

Sample 23 (tableware): The sample showed almost no packing at all, had a light-coloured purified matrix with only a few minuscule quartzose inclusions which were highly compact. The considerable differences between specimens could be confirmed macroscopically due to the extreme thinness and white colour of the ceramic body.

Sample 38 (tableware): The sample showed very scarce packing and was composed of purified clay, rare, tiny fragments of quartz and sporadic small clay clumps. It was concluded that this sample was surely a different production because quite different techniques seem to have been used. For example, although the coarsest components were completely eliminated from the paste, oxides and clay clumps were scarce, whereas such components were frequent in fine-grained vessels, which were also almost completely free of inclusions.

Sample 41 (tableware): The sample had a very fine-grained matrix and the lithic fraction exhibited slightly greater packing than the two preceding fragments. The lithic granules, mostly quartzose, were oriented and contained large amounts of oxides. Again, a different production is apparent because even at the macroscopic level, the distinguishing features were quite striking: extremely thin walls, external black varnish and interior burnishing and engraved decorations on the rim. According to archaeologists, the piece was certainly not made for everyday use.

Sample 46 (amphora): The sample showed a medium-high concentration of inclusions, low sorting, and hiatal type granule distribution. The fine-grained matrix had embedded quartz and plagioclase crystals, large clinopyroxene crystals, some basalt fragments and subordinate clay clumps. The sherd had an external engobe.

Kiln wastes

As a result of the observations of the ceramic fabric (spatial distribution, size, shape, occurrence and composition of the different components of the paste; Whitbread 1995), it was possible to directly correlate Fabric 1 with sample II; Fabric 2

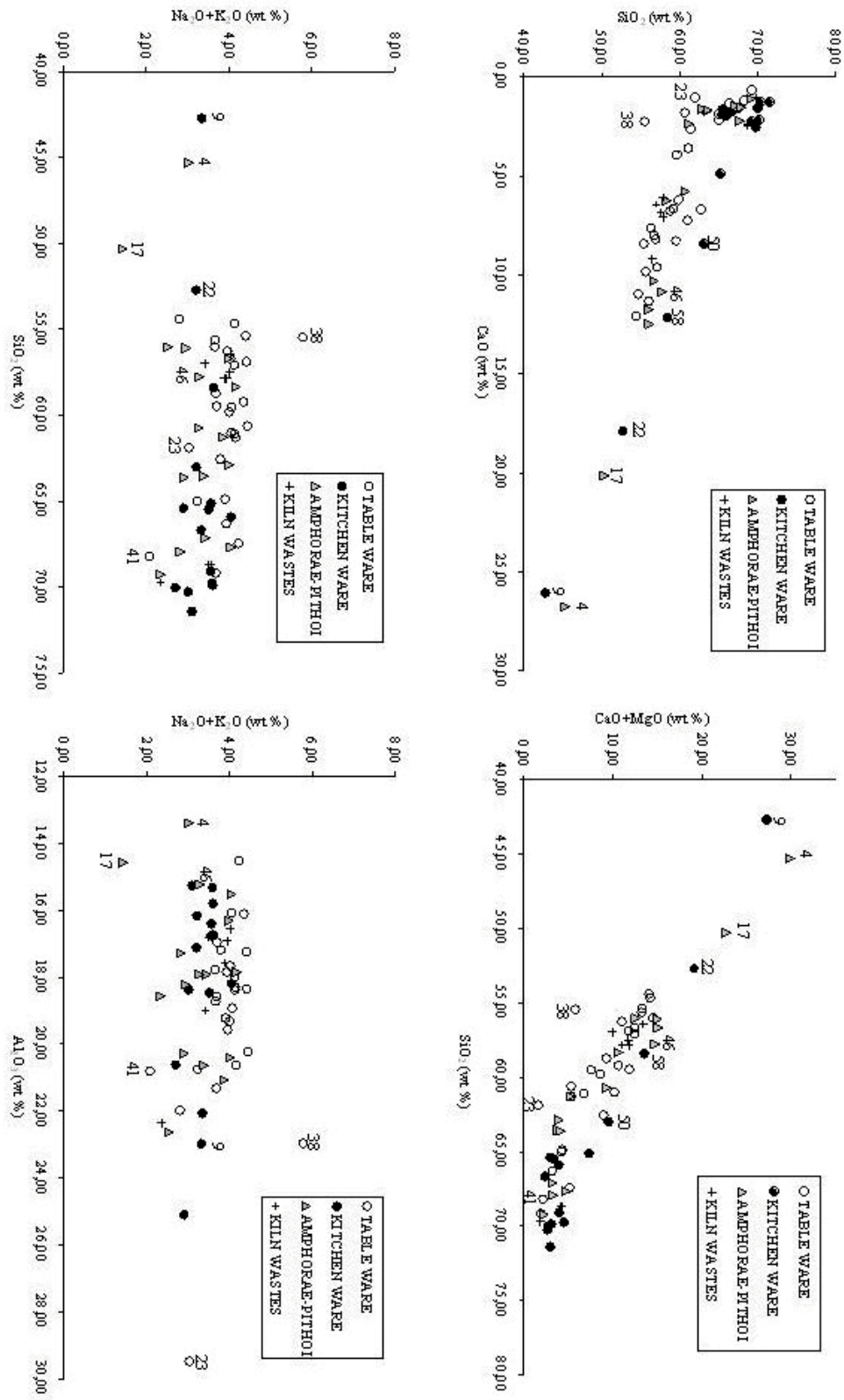


Fig. 12 Binary distribution diagrams showing comparison between some significant oxide.

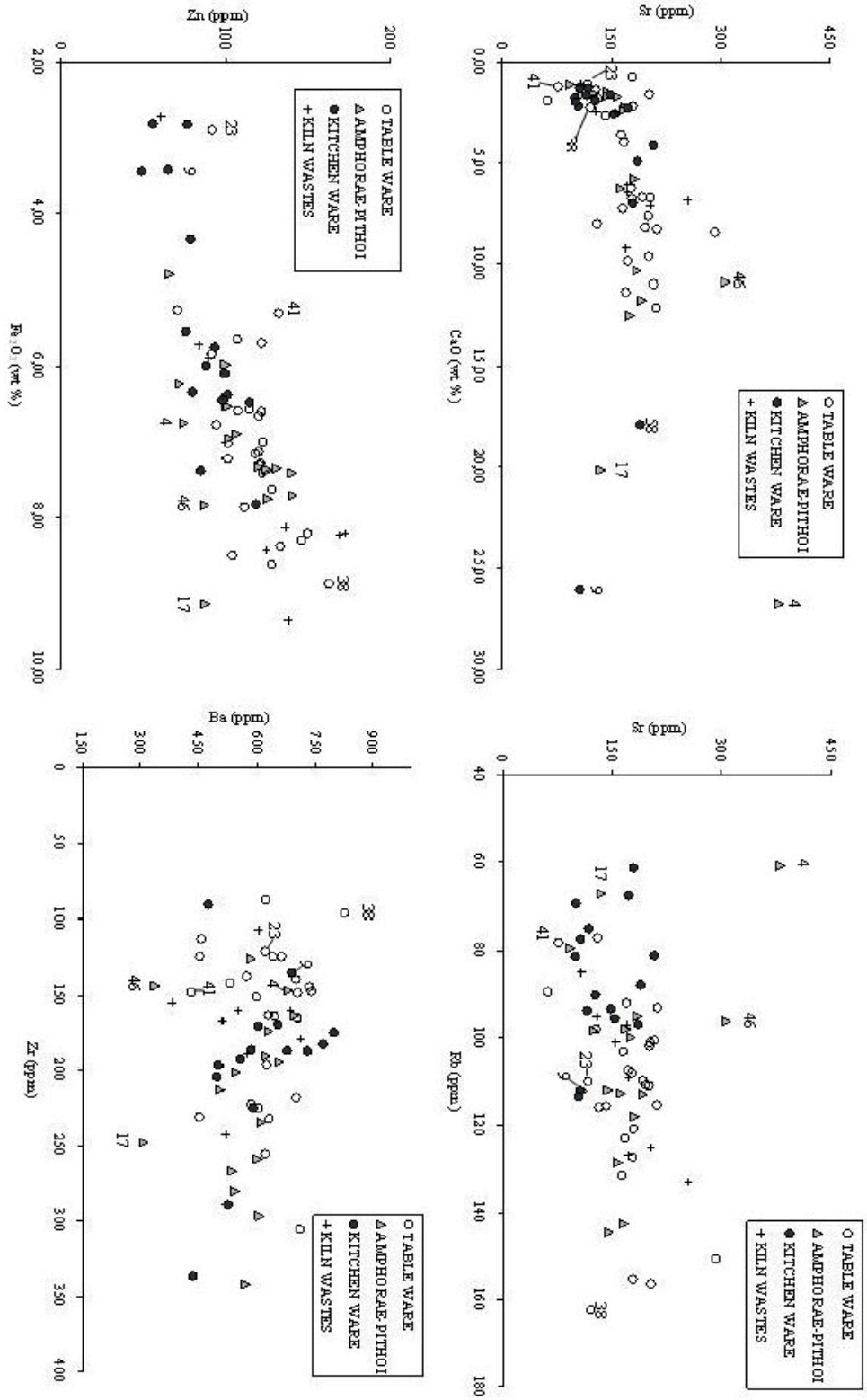


Fig. 13 Binary distribution diagrams showing comparison between some significant oxide/trace elements or trace element/ trace element.

with samples I, III, IV, V and VIII; and Fabric 3A with samples VI and VII. Therefore, it could be concluded that these three fabrics were produced locally. Rare crystals of sericite were present in samples VI and VII.

Clay

The mineralogical composition of three of the four clays (AR1, AR2 and DR2) is homogeneous and consistent with that of most of the analysed samples (quartz, plagioclase, muscovite and K-feldspar; Fig. 10a-b, and rare crystals of sericite). Their granulometry is similar to Fabric 1 and 2, but only in AR2 were there frequent calcite crystals and fine rounded fragments of calcareous pellets (the same as those noted in Fabric 2; Fig. 10c). There were scarce and very small (<20μm) neoformation oxides in the sample fired at 900 °C.

The percentage of muscovite was lower in samples fired at higher temperatures, presumably due to the breakdown of the mineral at temperatures of around 900 °C (Mignucci 2002: 245-252; Rodriguez-Navarro *et al.* 2003: 713-724).

Besides the above-mentioned minerals, sample DR1 with coarser granulometry had inclusions of quartzose and shale metamorphic rocks and sporadic gastropod shells (Fig. 10c) of the same type as those found in the third ceramic group described above (Fabric 3B), but the shells had a finer granulometry (0.3-1 mm in Fabric 3B; max 0.2 mm in the clay sample). Also, this sample fired at 900 °C, revealed neoformation oxides.

PXRD analyses

PXRD data almost always coincides with OM observations, except those cases where this type of analysis is able to detect low percentages of some mineralogical phases not noticeable under OM. The results are a semi-quantitative estimation of peak intensities.

Results (Table 2) indicate the constant presence of quartz, which is predominant in all samples, followed by feldspar, which varies from scarce to abundant.

The presence/absence of certain mineral phases confirmed the divisions made between the fabrics within the functional classes by the petrographic study with MO. For example, in samples characterised by Fabric 2 (tableware, amphorae-pithoi and kiln wastes), calcite was always detected in widely varying percentages, from traces to detectable quantities in 17 samples and from less abundant to abundant in six samples. However, in samples characterised by Fabric 1, this mineralogical phase was detectable in trace amounts at best.

In the kitchenware group, calcite was only detected in three samples (22, 50 and 58) at levels from detectable to abundant, corresponding to Fabric 3B (with gastropods).

The abundance of mica, almost always present in the specimens studied, also varied widely (from absent to abundant) within the different fabrics identified. The authors note, however, a systematically higher frequency of micas in samples that contained more calcite, which reached a maximum firing temperature of 800 °C. In addition, the amount of micas was lower in the kitchenware group than in other categories, with abundances ranging from scarce to absent.

Pyroxene was found in 40 specimens, and gehlenite was found in nine. Neither mineral phase was detected with the optical microscope because of the small grain size of these neoformation crystals. Two neoformation phases only appeared together in s. n. 14 and 59. Pyroxene was generally scarce to slightly abundant; gehlenite, which was generally found in small quantities, was more abundant in specimens 32 and 44 only.

Calcite was absent in 21 of the 40 samples containing pyroxene and gehlenite, while in the remainder it was found only in low quantities.

Gehlenite and pyroxene were often associated with appreciable quantities of iron oxides (hematite and magnetite; see Table 2).

The diffractometric kiln wastes data highlighted the absence of gehlenite and iron oxides and once again confirmed the predominant presence of quartz and feldspar in all samples. Micas and calcite were detectable in those samples classified as Fabric 2 (I, III, IV and V).

In petrographic "singles", quartz was still the dominant phase; feldspar was abundant only in samples 38 and 46 and from poor to slight abundance in the others. Micas were always present in low quantities, except in sample 17, where it was absent. Calcite was the main mineral in samples 4, 9 and 17, while pyroxene was very abundant in sample 46 only. Gehlenite, found in small quantities in most samples, was more abundant in specimen 17.

Diffractometric analyses of clays as received and after firing at 600 and 900 °C (Table 3) confirmed the presence of most of the mineralogical phases revealed in the pottery fragments and kiln wastes (quartz, feldspar, mica, calcite, pyroxene, gehlenite and haematite) via PXRD.

The diffractograms of samples DR2, AR1 and AR2 both as received and after firing at 600 °C, revealed amphibole and sericite in the first two and sericite, calcite and dolomite in the third sample, although they were always found in small quantities. Dolomite was not present in the ceramic fabrics deemed to be of local origin or in kiln wastes, whilst sericite was only present in four pottery samples and two kiln wastes. It should be noted that amphibole, sericite, mica, calcite and dolomite, while present after heating to 600 °C, disappeared after the second firing at 900 °C (Fig. 11).

Gehlenite, pyroxene and hematite were formed on firing at 900 °C only in those samples that originally contained calcite and dolomite (AR2 and DR1; Fig. 11), although these phases appeared in the "embryonic" state (Peter and Iberg 1978: 503). Diffractometry also revealed a considerable reduction in the mica content of samples fired at 900 °C.

XRF analyses

The results of the chemical analysis using XRF are shown in Table 4.

To make the data more comparable with each other, the authors believed it useful to consider each value normalised to 100 wt% without LOI. In other words, each sample was recalculated as a total (100 wt%) without LOI and the corresponding values of the individual oxides.

The data clearly shows that SiO_2, Al_2O_3, Fe_2O_3 and CaO oxides were the major oxides (Table 4). MgO, Na_2O and K_2O were the minor oxides that were highly variable and evidently unrelated, most likely because they are linked to the contributions of metamorphic materials in the mixtures. Chemical data less clearly allows for the same divisions of petrography within ceramic classes. The unclear separation among samples leads us to conclude that, probably, almost all the sherds share the same petrofacies (i.e. the same distinctive petrographical and mineralogical content).

However, as pertaining to petrographics, the presence/absence of $CaCO_3$ showed a distinction between different fabrics in different pottery classes, so the chemical analysis of mainly calcium oxide confirmed that discrimination.

In the chart comparing SiO_2 *vs*. CaO (Fig. 12a), almost all samples (except the four petrographic "singles": 4, 9, 17 and 38, and one kitchenware: 22) fall into two fairly distinct categories: a homogenous and narrow CaO <5 wt% and CaO >5 wt%.

The category of CaO <5 wt% covered most of the findings in the groups of amphorae-pithoi (corresponding to Fabric 1) and kitchenware (Fabric 3A), and was therefore characterised by clay Ca-poor and Si-rich materials (due to the addition of a quartzose component as a temper in the mixture, confirmed by MO).

Most of the samples of tableware (Fabric 2) fall into the category of CaO >5 wt%, suggesting the use of different clay from previous materials, richer in $CaCO_3$. Ten samples from the tableware

group, however, that fall into the CaO <5 wt% category (Fabric 1) have a chemical behaviour obviously very similar to samples from the amphorae-pithoi class of the same fabric (Fabric 1), and also very similar to most of the samples of the class of kitchenware (Fabric 3A), albeit a very different grain size as observed in MO. This finding could suggest the use of the same clay from the same location, treated differently for the production of items that were functionally very different.

Another important fact to note is how the eight pieces that were certainly produced locally (kiln wastes) were distributed perfectly between two areas identified on a petrographic basis: samples I, III, IV, V and VIII have values entirely similar to those of the tableware group (Fabric 2; Table 7), while samples VI and VII show chemical data comparable to those of Fabric 1 (sample II) and the kitchenware group (Fabric 3A; Table 7).

Three of the seven petrographic "singles" (4, 9 and 17) fall far from the main distribution (see Fig. 12), thereby confirming their distinct nature, as already noted. Sample 22 seemed to have a different chemical nature compared with the rest of the group to which it belonged (kitchenware), but its position far from the main distribution solely depended on its high content of gastropods ($CaCO_3$), as noted in OM. The petrographic "singles" 23, 41 and 46 always fell within the compositional fields of the other specimens (Fig. 12a-b-c), while 38 differed slightly from the two main compositional "clouds" (Fig. 12a-b-c). Only in the chart Na_2O+K_2O *vs.* SiO_2, did samples 23 and 38 deviate more from the main compositional "cloud".

The chemical data from samples 4, 9 and 17, in addition to the minero-petrographic observations and archaeological hypothesis (only samples 4 and 17), suggested a different production from what has been referred to as "local", confirming these objects as imports.

However, for samples 23, 38 and 41 (recognised as imports by archaeologists) the petrography suggests a different texture from that observed for most samples, but the lack of inclusions did not allow any assumptions to be made about the origin; thus, the chemical analysis clearly helped to include these samples into the group considered to be locally produced.

Finally, sample 46, which was characterised by a temper that was completely inconsistent with both local and regional geological data (Dimitrievi ć 1997), cannot be considered to have been made locally, although it mainly falls within the compositional groups.

Trace elements showed greater dispersion (Fig. 13) than most of the major oxides, thereby contributing less to the analysis.

DISCUSSION AND CONCLUSIONS

The mineralogical and petrographic data allowed functional classes of 51/58 pottery samples to be classified into four different fabrics (Fabric 1, 2, 3A and 3B).

This division is motivated by the observation of a greater diversity among the samples: the grain size, composition and the shape of the inclusions (Whitbread 1995).

Among the classes, the tableware and amphorae-pithoi were of Fabric 1 and 2. For this type of pottery, because the paste had a granulometry ranging from fine to very fine, the authors can assume the use of two different clays (more likely) or a different treatment during the production of the same functional class.

The first type of clay – Fabric 1 – was devoid of a carbonatic component and was enriched by a fine quartzose and metamorphic-quartzose component; this fabric was found in most of the amphorae-pithoi that were analysed, which were often large objects, requiring the use of coarser materials for their production.

The second type of clay used for Fabric 2 was characterised by the occurrence of scarce and very fine rounded fragments of calcareous pellets and calcite and by the absence of a fine metamor-

phic-quartzose lithic component. With regard to the grain size from homogeneous to serial and the mostly rounded edges of the aplastic component, it indicated that either naturally 'pure' clay with fine granulometry was selected or that the clay was artificially purged of its coarsest component in order to prepare for the overall thin-walled vessels, i.e., tableware (Fig. 6).

For kitchenware production, the hypothesis was that one type of raw material was used, given that in two of the fabrics (3A and 3B), the same mineralogical and lithic component, granulometry and structure were observed, with the only difference being the addition of pieces of gastropod shells evident in Fabric 3B. The finding that these anomalous inclusions were a naturally occurring component in one of the local clay samples (DR1) and were probably used as a raw material confirms the hypothesis of the autochthonous origin of the specimens. However, the granulometry and concentration of shells were much higher in the pottery (Fig. 8d) than in the clay, indicating the addition of extra quantities of this material, widely found at the archaeological site (Fig. 8e), to the paste during fabrication.

In the case of Fabric 3, the clay was enriched with an inert quartzose component with coarse, sharp-edged granulometry (mainly fragments of metamorphic- quartzose and schistose rocks, Fig. 8c) to make the paste more resistant to heat treatment. Many studies of the tempers used in fired ceramics (quartz, shells and calcite) have shown that ceramic pastes with calcareous inclusions are subjected to calcination (T >900 °C) and the formation of new phases that increase the mechanical strength more than those with quartz additives (Tite *et al.*, 2001), which then render the paste more refractory.

Based on their microscopic characteristics, seven of the specimens (4, 9, 17, 23, 38, 41 and 46) could not be assigned to any of the three fabrics.

In particular, three of them (s. n. 23, 38 and 41, recognised as forms unfamiliar to local tradition) showed a number of distinct features in the matrix (highly purified), ascribable to a different method of production and choice of clay (Fig. 9) other than that of a non-local origin, which was confirmed by the chemical data (Fig. 12). In fact, apart from in Fig. 12d, samples 38 and 23 were outside of the uniform cloud. The interpretation of this data suggests the circulation and arrival of non-local styles and technologies to Viminacium, produced using local raw materials.

The remaining four (4, 9, 17 and 46) show a very different composition in both the model (Fig. 8) and chemical composition (Fig. 11). This data corroborates the hypothesis of the non-local origin of the amphorae (4, 17 and 46), which is in agreement with the archaeological data and suggests a non-local origin for the kitchenware sample number 9. Consequently, these objects were imports and were transported to Viminacium as finished goods.

By virtue of their fabric (spatial distribution, size, shape, occurrence and composition of the different components in the paste; Whitbread, 1995), the authors could directly correlate Fabric 1, 2 and 3A of the pottery samples with the kiln waste samples and thus assume local production of most of the pottery. The eight kiln wastes were classified as Fabric 1 (sample II), Fabric 2 (samples I, III, IV, V and VIII) and Fabric 3A (samples VI and VII).

Provenance of raw materials

There is good correspondence between the mineralogical and petrographic data of the inclusions (both naturally occurring and added to the paste) in all specimens (both the 51 pottery fragments and the eight kiln wastes), and those in the matrix of the locally available raw materials, suggesting the local production of most samples. From a petrographic perspective, nearly all the fabrics (1, 3A and 3B) contained metamorphic rock fragments (quartzose and micaceous schists),

polycrystalline quartz, muscovite and, occasionally, sericite. These same components were found in two kiln wastes (VI and VII) and in the local clays (AR1, AR2 and DR2). In addition, two neoformation phases, gehlenite and pyroxene, which appeared in clay samples DR1 and AR2 after firing at 900 °C, were also found in the pottery specimens (Table 2).

Further evidence in favour of the local production of the objects is found in the evaluation (OM and PXRD) of the concentration of micas: they are present in medium amounts in the fine-grained fabrics (1 and 2) and in higher amounts in the coarse-grained fabric (3A) in both the ceramics and kiln wastes, a sign of a different, albeit local, supply.

The types of inclusions observed in the pottery and clay specimens were in complete conformity with the outcropping lithotypes in the area surrounding the archaeological site. Metamorphic rocks appeared both on and below the surface approximately 10 km NE of Viminacium near the settlement of Ram, with their mineralogical associations being similar to those of the samples that were studied (muscovite, sericite and quartz; Fig. 12). Their break-up would lead to the formation of the lithic inclusions constituting the clay of the sedimentary basin of the rivers Mlava and Danube. A second hypothesis concerns the direct provisioning by potters of such non-carbonate materials, which were used as temper and were most easily obtainable in terms of distance from the site, as there was an exclusive source of sedimentary rock within 10 km of Viminacium (Fig. 4a). Metamorphic quartzose boulders (Micaschist) were also found as part of amphitheatre in Viminacium, further indicating that this material was known and exploited at the time.

Data on major and trace elements confirmed the subdivisions defined according to petrographic evidence. The bivariate diagrams showed a main homogeneous group that contained most of the analyzed specimens, suggesting that they came from a single production area that was very probably local. The samples outside this "cloud" corresponded to three of the seven identified petrographic "singles" (4, 9, and 17), confirming observations regarding their distinctive characteristics. For these samples, the authors can assume a non-local production (movement of finished goods), taking into account not only the chemical data, but also the composition of the skeleton observed microscopically (fossils for sample 4, and large sharp edged calcite and carbonate rocks fragments for samples 9 and 17).

It is worth noting that although petrographic "single" 46 does not fall sharply outside the main chemical group in the bivariate distribution, a local source of raw materials with volcanic fragments similar to those observed by microscopy is presently unknown, but it can't be excluded. This pottery could have been imported.

Instead, the technological and minero-petrographic characteristics of the three petrographic "singles" (23, 38 and 41) point to an uncertain production, but chemical data for these samples generally fell just within the borders of the main "cloud" (Fig. 12). These samples were simply assumed to have undergone a different processing of local raw materials, which shows remarkable experience on the part of the workers responsible for a particular product (circulation of styles).

Technological aspects

Observations of the techniques used in the production of the ceramic paste also lent support to the same subdivision by composition.

All samples belonging to the fine-grained group (Fabric 1-2), except three amphorae (14, 35 and 47), a pithos (48) and five pieces of tableware (26, 28, 34, 42 and 55), have a surface coating. The type of finish varied and may have been present on either one or both surfaces of the object. Where it was external, the layer had aesthetic and waterproofing functions (varnish, engobe, and burnishing). However, where it was

internal, its main function was to conserve its contents (food), since this type of inner coating was found on objects of everyday use. Objects with an inner and an outer coating were generally important or valuable and probably had some particular significance apart from their everyday usefulness.

Most samples in the coarse-grained group (Fabric 3A-B) did not have external coatings (Table 1), as they were mainly articles used for cooking.

Technologically it is important to note the peculiarity in the cases of the amphorae (2, 5, 6, 14, 16, 18, 35, 44, 45 and 47) and the pithoi (30, 54 and 48), and was evident in the results of local production from the intersection of all analytical data. Their production was unusual because of the use of purified clay, with the addition of a small amount of a coarser quartzose component. Normally, objects of this type, given their size, have fabrics with a richer temper (Guerrini and Mancini 2007: 197-234).

Some of the samples referred to as petrographic "singles" by OM observation (23, 38 and 41) provided evidence of a clearly different method of execution and a high level of technical skill and craftsmanship. Sample 38, the most finely worked and best preserved fragment (Fig. 7c), was a "terra sigillata" of red paste fired in a highly oxidising environment and then painted bright red. It was fashioned from highly purified clay containing rare, small clumps (Fig. 8d). The border bears a beautiful impressed decoration that is evidence of the most advanced technical level of any of the specimens. Also sample 41, which has highly refined technical and production characteristics – thin walls, internal and external coatings, extreme purification of the paste (Fig. 7d) and a high neoformation oxide content – was quite different from the remaining pottery studied here that was mostly for everyday use. A hypothesis can be advanced about their origin: the manufacturing might belong to a reproduction of forms and technologies imported into Viminacium, whereas their production, on the basis of chemical data, could be considered local.

The examined specimens include examples of ceramic firing in reducing or oxidising environments and those of simultaneous reduction and oxidisation. The choice of firing atmosphere, which is well-documented in literature, was linked not only to aesthetic function but also, in particular, to technical requirements. To maintain high temperatures in the kilns, which often burned for days on end, fuel had to be added occasionally (at any time during the firing). This produced smoke, thereby leading to a reduced amount of oxygen in the kiln, which gave rise to the black surface colour of the pottery (Cuomo Di Caprio 2007). It seems that only for articles of a certain value did the potters pay careful attention to controlling the firing atmosphere in order to obtain homogeneous colours in the bisque.

The firing temperatures for most of the fragments believed to be of local origin, especially the fine-grained ones (Fabric 1-2), must have reached at least 850-900 °C and up to 1,050 °C, as neoformation mineralogical phases, such as gehlenite, pyroxene and iron oxides were generated (Capel *et al.* 1985:563-575; Duminuco *et al.* 1996: 281-288; Ricciardi *et al.* 1999:393-409; Cultrone *et al.* 2001:621-634).

The sericite, amphibole, dolomite and calcite in the clays fired at 600 °C were not present in the pottery specimens (see Table 2) or kiln discards, probably because they were fired at a temperature exceeding 600 °C; in fact, these phases disappeared in the cooking tests on clays at 900 °C.

Another aspect that suggests very high firing temperatures is the absence of birefringence in the specimen matrices, indicating the complete decomposition of clay minerals and further attesting to firing temperatures well above 800 °C (Brisbane, 1981). There are few cases in which the ceramics were low-fired, as evidenced by the finding of a less birefringent black core in comparison to a more birefringent brown-orange border.

However, for the kitchenware group, the firing temperatures were estimated to be slightly lower. The almost total absence of gehlenite assumes a

firing temperatures not exceeding 850 °C; the absence of iron oxides, the medium-high presence of muscovite, the high presence of gastropods (Fabric 3B) and the low presence of pyroxene suggest a temperature reaching around 900 °C (Cultrone *et al*. 2001; Rodriguez-Navarro *et al.* 2003: 713-724).

Comparing the results of the firing tests of raw materials, it may be concluded that pyroxene and gehlenite were formed by the complete thermal decomposition of calcite and the reaction of calcium oxide with the molecular fractions of clay or quartzose minerals. Calcite was absent in most samples (27 out of 43) containing pyroxene and gehlenite, which provides evidence for the formation of these two phases at the expense of calcite and silicate phases as precursors.

When calcite was present contemporaneously with neoformation phases, it was predominantly secondary and due to contamination during burial as evidenced by microscopic observations (Cau *et al.* 2002: 9-18). Sericite, present in three of the four clay samples fired at 600 °C (AR1, AR2 and DR2), four of the 58 pottery specimens (21, 22, 35 and 40), and two of the eight kiln wastes (VI and VII) indicated lower firing temperatures (no higher than 700 °C; Mignucci 2002: 245). This mineral probably originates from the breakdown of the nucleus of metamorphic rocks occurring a few kilometres from Viminacium (see geological sketch-map, Fig. 4a-b). It was not found in any of the other samples believed to be local because the firing temperatures were evidently above 700 °C.

Lastly, the structural characteristics found in most of the specimen fabrics indicated a high degree of sintering; the use of non-calcareous temper, despite the wide availability of such materials in the old city, indicates a good knowledge of local sources by ancient potters. Both of these aspects constitute a good technological choice for preventing the breakdown of CaO and enhancing the thermal resistance of the pottery (Heimann 1989: 123-148; Tite *et al.* 2001: 301-324).

A future comparison of this archaeometric data with those of studies made on pottery of the same historical period (from the second half of the 2nd century to the end of the 3rd century), reproduced at various sites of the Roman Empire, will help to define the extent of expertise within the context of a very large Empire, and will provide the ability to render a vast territory that, from a technological viewpoint, extended from Gibraltar to the borders with Mesopotamia, homogenous.

ACKNOWLEDGEMENTS

Special thanks to Prof. G. Montana for his availability, invaluable advice and the time he gave whenever asked for his expert opinion. Further thanks go to Dr. Snezana Nikolic for allowing us to sample materials, Prof. E. M. Azzaro for conducting chemical analyses, Prof. J. Pignatti for paleontological recognition, Prof. L. Lezzerini for providing language assistance and Mr. S. Stellino for his assistance in the XRD laboratory.

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REZIME

RIMSKA KERAMIKA IZ VIMINACIJUMA (SRBIJA II-III VEK NOVE ERE): KARAKTERISTIKE MINEROLOŠKOG SASTAVA, PROIZVODNJA I TEHNOLOŠKI ASPEKT

KLJUČNE REČI: ARHEOMETRIJA, KERAMIKA, RIMSKI PERIOD, VIMINACIJUM.

Rad je rezultat više analiza koje su izvršene nad šezdesetak uzoraka fragmenata keramičkih posuda, sirove gline, kao i gline od koje su napravljene opekarske peći iz zanatskog centra na Viminacijumu.

Cilj je bio stvaranje referentne hemijske i mineološko petrografske celine sa kojom bi se potom mogli porediti ostali keramički uzorci. Dobijeni rezultati su nam dali informacije ne samo o tome na kojoj temperaturi su posude pečene (koja je temperatura dostizana u opekarskim pećima) nego i o tome kakav je kvalitet korišćene gline, koji su najčešći dodaci glini i u kojim odnosima korišćeni. Izdvaja se nekoliko grupa posuda u odnosu na to na kojoj su temperaturi pečene, a samim tim i njihova čvrstoća je različita. Sve se nalaze u rasponu od 650 do 1050 C°.

Mineološko petrografska analiza omogućila je podelu keramike na četiri grupe različitih struktura. Izvršena je na osnovu različitosti u veličini i izgledu čestica koji čine gline uzorka. Rezultat je, da iako su istog osnovnog sastava (glina istog porekla) u nekima je koncentracija granulata tolika da se ne može smatrati slučajnom, nego se radi o namernom obogaćivanju inertnim kvar-

toznim komponentama, u ovom slučaju škriljcima. Kada se pogledaju uzorci kod kojih je ovo primećeno jasno se izdvajaju posude koje su korišćene za pripremu hrane i kao takve izlagane većim temperaturama. Eksperimenti su pokazali da se dodavanjem ove primese dobijaju posude koje bolje podnose i zadržavaju temperaturu.

Iste analize su otkrile i fragmente čije je poreklo sasvim sigurno van šireg areala Viminacijuma, a to ukazuje na trgovinu i import keramičkim materijalom.

Rezultati hemijskih analiza dati su na tabli br. 4. Oni pokazuju da su najčeši oksidi SiO2, Al2O3 i FeO3, te da skoro svi fragmenti imaju taj isti petrografski i mineraloški sadržaj, a da se veliko odstupanje vidi po pitanju CaCO3 što je prikazano na grafikonima. Ovo dokazuje da iako su u osnovi korišćene iste gline, one su predtretirane kako bi se od njih napravile funkcionalno različite posude. Isto tako, iskočili su i singlovi (fragmenti koji ne odgovaraju regionalnim geološkim podacima) koji pokazuju posude za koje se i inače smatralo da su stigle putem importa.

Ono što je bitno je da se ovi arheometrijski podaci mogu upoređivati sa drugima uzorcima na keramici istog perioda širom Rimskog Carstva i time proširiti dosadašnja saznanja o samoj tehnologiji izrade kao i o distribuciji posuda.

Table 1

Sample	*Type*	*Fabric*	*Coating*	*Sample*	*Type*	*Fabric*	*Coating*
20	tableware	1	glaze	**29**	kitchenware	3A	absent
24	tableware	1	painting	**43**	kitchenware	3A	absent
26	tableware	1	absent	**53**	kitchenware	3A	absent
37	tableware	1	painting	**56**	kitchenware	3A	absent
42	tableware	1	absent	**57**	kitchenware	3A	absent
52	tableware	1	engobe	**22**	kitchenware	3B	absent
55	tableware	1	absent	**50**	kitchenware	3B	absent
60	tableware	1	painting	**58**	kitchenware	3B	absent
1	tableware	2	engobe	**9**	kitchenware	single	absent
3	tableware	2	varnish	**2**	amphora	1	burnishing
7	tableware	2	engobe	**5**	amphora	1	engobe
11	tableware	2	painting	**14**	amphora	1	absent
12	tableware	2	varnish	**47**	amphora	1	absent
15	tableware	2	absent	**30**	pithos	1	engobe
28	tableware	2	absent	**33**	pithos	1	absent
31	tableware	2	painting	**48**	pithos	1	absent
32	tableware	2	engobe	**54**	pithos	1	bunrishing
34	tableware	2	absent	**6**	amphora	2	painting
36	tableware	2	painting	**16**	amphora	2	engobe
39	tableware	2	painting	**18**	amphora	2	engobe
40	tableware	2	painting	**35**	amphora	2	absent
49	tableware	2	painting	**44**	amphora	2	engobe
51	tableware	2	varnish	**4**	amphora	single	absent
59	tableware	2	painting	**17**	amphora	single	absent
23	tableware	single	absent	**46**	amphora	single	engobe
38	tableware	single	painting	**II**	kiln waste	1	engobe
41	tableware	single	varnish	**I**	kiln waste	2	engobe
8	kitchenware	3A	absent	**III**	kiln waste	2	engobe
10	kitchenware	3A	absent	**IV**	kiln waste	2	painting
13	kitchenware	3A	absent	**V**	kiln waste	2	absent
21	kitchenware	3A	burnishing	**VIII**	kiln waste	2	engobe
25	kitchenware	3A	engobe	**VI**	kiln waste	3A	engobe
27	kitchenware	3A	absent	**VII**	kiln waste	3A	engobe

Table 1 The type, fabric and coating of the ceramic artefacts analysed.

Table 2

Legend: Qtz, quartz; Feld, feldspar; Mca, mica; Cal calcite; Px pyroxene; Gh gehlenite; Ox haematite-magnetite; Ser sericite. (symbols as in Kretz, 1983). / absent; tr traces; + detectable; ++ not much abundant; +++ abundant; ++++ predominant. T tablewares; A/P amphorae/pithos; K kitchenwares; W kiln wastes.

Samples			*Qtz*	*Feld*	*Mca*	*Cal*	*Px*	*Gh*	*Ox*	*Ser*
FABRIC 1	T	20	++++	+	/	/	tr	/	/	/
		24	++++	++	++	tr	/	/	/	/
		26	++++	++	/	/	tr	/	+	/
		37	++++	++	+	+	+	/	tr	/
		42	++++	+	tr	/	tr	/	+	/
		52	++++	++	+	/	+	/	+	/
		55	++++	++	+	/	tr	/	tr	/
		60	++++	++	/	/	++	/	+	/
	A/P	2	++++	++	tr	/	tr	/	/	/
		5	++++	+	+	/	tr	tr	tr	/
		14	++++	+	/	/	tr	tr	tr	/
		30	++++	++	+	/	tr	/	tr	/
		33	++++	++	/	/	+	tr	tr	/
		47	++++	++	+	/	tr	/	/	/
		48	++++	+	tr	tr	/	tr	tr	/
		54	++++	++	++	tr	/	/	/	/
	W	II	+++	++	/	/	+	/	/	/
FABRIC 2	T	1	++++	++	+	tr	+	/	tr	/
		3	++++	++	++	+++	/	/	/	/
		7	++++	+++	+++	tr	++	/	+	/
		11	++++	++	++	++	tr	/	/	/
		12	++++	++	tr	tr	++	/	/	/
		15	++++	++	++	+++	+	/	/	/
		28	++++	++	++	+	/	/	/	/
		31	++++	+	+	tr	tr	/	/	/
		32	++++	+	tr	++	/	++	+	/
		34	++++	+++	+	+	/	/	tr	/
		36	++++	++	+	tr	++	/	tr	/
		39	++++	++	tr	+	+	/	+	/
		40	++++	++	++	+++	/	/	+	tr
		49	++++	++	+	++	/	/	tr	/
		51	++++	+++	/	tr	+	/	tr	/
		59	++++	+++	tr	++	+	+	tr	/

Table 2 Mineralogical composition of archaeological specimens, by PXRD analysis.

Samples			Qtz	Feld	Mca	Cal	Px	Gh	Ox	Ser
FABRIC 2	A/P	6	++++	++	+	+	+	/	tr	/
		16	++++	++	tr	+	+	/	/	/
		18	++++	++	tr	+	+	/	/	/
		35	++++	++	+	++	+	/	/	+
		44	++++	++	+	++	/	++	+	/
	W	I	++++	+++	+	+	/	/	/	/
		III	+++	+	+	+	/	/	/	/
		IV	++++	+++	+	+	tr	/	/	/
		V	+++	+	+	+	/	/	/	/
		VIII	+++	+	/	+	tr	/	/	/
FABRIC 3A	K	8	++++	++	/	/	+	/	/	/
		10	++++	tr	/	/	tr	/	/	/
		13	++++	+	tr	/	tr	/	/	/
		21	++++	+++	tr	/	/	/	/	tr
		25	++++	+	/	/	/	/	/	/
		27	++++	++	tr	/	tr	/	/	/
		29	++++	++	/	/	tr	/	/	/
		43	++++	+++	tr	/	tr	/	/	/
		53	++++	+++	tr	tr	+	/	/	/
		56	++++	++	/	/	tr	/	/	/
		57	++++	+	+	/	/	/	/	/
	W	VI	++++	+++	/	/	/	/	/	tr
		VII	+++	+++	/	/	+	/	/	tr
3B	K	22	++++	++	+	+++	/	tr	/	tr
		50	++++	++	tr	+	/	/	/	/
		58	++++	++	+	+++	/	/	/	/
SINGLES	T	23	++++	tr	tr	/	/	/	/	/
		38	++++	+++	+	tr	+	/	++	/
		41	++++	tr	tr	/	/	tr	/	/
	K	9	+++	tr	+	++++	/	tr	/	/
	A/P	4	+++	+	tr	++++	/	/	tr	/
		17	++++	+	/	+++	/	++	/	/
		46	++++	+++	tr	/	+++	/	+	/

Table 2 Mineralogical composition of archaeological specimens, by PXRD analysis.

Legend: Qtz, quartz; Feld, feldspar; Mca, mica; Cal calcite; Px pyroxene; Gh gehlenite; Ox haematite-magnetite; Ser sericite, Am Amphibole, Dol Dolomite (symbols as in Kretz, 1983). / absent; tr traces; + detectable; ++ not much abundant; +++ abundant; ++++ predominant.

Cooking T	*SAMPLE*	*MINERALOGIC PHASES*									
		Qtz	*Feld*	*Mca*	*Cal*	*Px*	*Gh*	*Ox*	*Ser*	*Am*	*Dol*
as received		++++	+++	++	/	/	/	/	++	+	/
600 °C	**AR1**	++++	+++	++	/	/	/	/	+	+	/
900 °C		++++	+++	tr	/	/	/	/	/	tr	/
as received		++++	+++	++	+++	/	/	/	++	/	++
600 °C	**AR2**	++++	+++	++	+++	/	/	/	+	/	++
900 °C		++++	++	tr	/	+	tr	tr	/	/	/
as received		++++	+++	tr	+++	/	/	/	/	/	/
600 °C	**DR1**	++++	+++	tr	+++	/	/	/	/	/	/
900 °C		++++	++	/	/	tr	tr	tr	/	/	/
as received		++++	++	+	/	/	/	/	+	tr	/
600 °C	**DR2**	++++	++	+	/	/	/	/	+	tr	/
900 °C		++++	++	/	/	/	/	/	/	/	/

Table 3 Mineralogical composition of specimens of clay.

TABLEWARE	1	3	7	11	12	15	20	23	24	26	28	31	32	34	36	37	38	39	40	41	42	49	51	52	55	59	60	χ	σ
SiO_2	61.00	57.07	55.37	56.70	55.63	67.43	64.98	61.88	61.29	66.29	56.26	58.72	54.40	59.80	56.89	61.07	55.45	59.21	54.67	68.20	69.16	56.01	62.55	60.62	64.87	59.46	59.51	60.17	4.34
TiO_2	0.87	0.88	0.80	0.89	0.85	0.86	0.86	1.02	0.91	1.08	0.91	0.79	1.05	0.86	0.85	0.95	0.96	0.87	0.86	1.27	0.75	0.82	0.80	0.94	0.92	0.81	0.93	0.90	0.11
Al_2O_3	16.07	18.01	17.24	17.66	18.72	14.51	20.75	29.48	20.62	17.84	19.58	21.31	21.97	19.31	18.34	18.38	22.96	16.11	18.30	20.80	18.57	17.77	17.18	20.23	19.22	16.95	18.92	19.14	2.81
Fe_2O_3*	7.30	6.66	8.50	7.87	7.15	7.22	5.64	2.89	7.28	7.41	7.63	5.69	5.26	7.01	7.00	8.38	8.88	8.31	7.13	5.30	5.85	6.78	6.57	8.21	6.59	6.60	8.62	6.95	1.29
MnO	0.13	0.15	0.13	0.18	0.16	0.16	0.03	0.01	0.14	0.13	0.18	0.06	0.05	0.15	0.17	0.08	0.07	0.14	0.23	0.04	0.02	0.14	0.05	0.13	0.06	0.15	0.14	0.11	0.06
MgO	2.92	2.77	4.85	4.38	3.33	3.53	2.31	0.56	2.65	1.79	3.39	2.48	1.94	2.32	3.57	3.12	3.52	3.92	3.18	0.93	1.19	3.13	2.25	3.49	2.11	3.55	3.57	2.84	1.01
CaO	7.23	9.62	8.42	8.01	9.84	1.58	1.91	1.06	2.65	1.36	7.61	6.76	12.09	6.22	8.19	3.60	2.24	6.66	10.97	1.20	0.70	11.33	6.69	1.79	2.18	8.27	3.94	5.63	3.62
Na_2O	1.28	1.29	1.20	0.83	0.25	0.91	0.70	0.39	0.89	1.79	0.99	0.94	0.50	0.87	1.37	1.37	1.21	1.52	1.17	0.43	0.54	0.88	0.81	1.31	1.23	1.13	1.13	1.00	0.37
K_2O	2.76	2.83	3.20	3.20	3.42	3.32	2.53	2.64	3.27	2.15	2.97	2.73	2.30	3.14	3.04	2.76	4.57	2.82	2.96	1.65	3.14	2.76	2.98	3.14	2.67	2.57	2.93	2.91	0.51
P_2O_5	0.43	0.72	0.28	0.28	0.66	0.49	0.29	0.07	0.29	0.17	0.47	0.49	0.44	0.32	0.56	0.30	0.13	0.44	0.53	0.17	0.08	0.38	0.11	0.16	0.15	0.51	0.29	0.34	0.18
Total	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100	100		
LOI	4.34	9.84	1.55	7.86	7.50	11.63	2.05	2.38	4.76	1.11	7.94	4.81	6.11	6.89	6.00	2.41	1.77	0.00	10.78	1.15	1.34	8.27	8.21	2.38	1.52	5.99	2.54	4.86	3.337
Ba	597	704	644	622	700	572	454	620	702	620	704	603	453	700	740	630	826	640	736	432	710	528	457	662	584	624	628	625.63	96.94
Sr	165	201	292	130	172	202	61	117	142	128	201	178	211	177	196	163	121	192	208	77	178	169	203	132	179	212	167	169.41	46.67
Zr	151	165	164	88	139	138	124	121	165	256	148	225	231	218	147	232	96	124	144	148	306	142	113	124	222	196	163	166.30	52.42
V	111	125	121	131	105	111	109	139	138	157	139	127	133	112	130	152	163	132	109	148	109	110	140	179	129	98	138	129.44	19.57
Rb	103	102	151	77	107	101	89	110	116	98	111	127	115	108	111	132	162	110	101	78	155	92	156	116	121	93	123	113.52	22.32
Zn	120	120	103	111	118	101	106	92	121	122	128	121	71	101	122	133	163	146	119	132	92	94	114	149	107	121	127	116.81	19.29
Ce	117	65	164	108	98	70	62	33	109	122	93	85	44	82	69	123	155	163	72	88	202	91	84	170	110	95	137	104.11	40.62
Cu	47	41	38	43	35	43	154	87	47	37	50	42	44	35	40	43	51	55	43	41	30	35	36	41	46	39	43	47.63	23.6
La	32	26	45	35	33	25	33	29	30	49	28	36	25	32	32	45	48	42	32	53	114	29	35	49	30	29	40	38.37	17.13
Y	19	23	28	18	22	22	0	22	27	31	26	28	22	29	26	30	28	19	22	17	27	19	23	24	27	24	23	23.19	5.994
Co	14	36	18	18	35	14	22	2	13	30	25	11	10	9	39	33	18	43	39	29	21	9	7	41	5	15	21	21.37	12.09
Nb	11	12	18	7	11	12	7	9	14	15	14	16	21	17	13	20	14	11	12	10	17	9	15	12	16	14	15	13.41	3.555
Pb	178	35	31	25	38	28	98	51	39	29	39	38	81	27	86	133	35	161	145	41	38	27	29	32	59	54	264	68.19	59.19

Table 4 Major oxides (wt %) and trace element (ppm) contents of tableware group by XRF analysis.
Values normalized to 100 wt% without LOI. LOI=loss of ignition. Fe2O3*=Fe tot.

AMPHORAE PITHOI	2	4	5	6	14	16	17	18	30	33	35	44	46	47	48	54	χ	σ
SiO_2	67.12	45.3	69.23	58.33	67.66	60.73	50.3	56.68	63.54	67.93	56.09	56.03	57.77	62.88	63.61	61.27	60.28	6.59
TiO_2	1.01	0.88	1.26	0.87	0.88	0.88	1.23	0.82	0.97	0.97	0.82	1.00	0.79	1.00	0.98	0.97	0.96	0.13
Al_2O_3	17.91	13.39	18.56	17.85	15.52	17.92	14.57	16.3	20.64	17.29	18.23	22.62	15.22	20.4	20.27	21.07	17.99	2.57
Fe_2O_3*	6.9	6.76	6.23	7.76	6.96	7.38	9.15	6.53	7.36	7.33	5.98	4.79	7.84	7.41	7.71	7.35	7.09	0.96
MnO	0.11	0.21	0.03	0.15	0.09	0.11	0.15	0.15	0.08	0.11	0.13	0.03	0.11	0.07	0.11	0.08	0.11	0.05
MgO	1.78	3.11	1.12	4.37	2.52	3.53	2.57	4.74	2.1	1.8	2.5	0.82	3.89	2.32	2.53	2.87	2.66	1.08
CaO	1.45	26.79	1.1	6.26	2.22	5.78	20.15	10.32	1.7	1.52	12.49	11.75	10.85	1.61	1.65	2.36	7.38	7.61
Na_2O	0.98	0.45	0.61	0.89	1.59	0.59	0.22	1.02	1.11	0.54	0.2	0.56	1.08	1.31	0.25	1.06	0.78	0.41
K_2O	2.47	2.58	1.74	3.28	2.46	2.7	1.21	2.98	2.29	2.29	2.77	1.98	2.21	2.7	2.66	2.81	2.45	0.50
P_2O_5	0.27	0.54	0.11	0.24	0.1	0.39	0.44	0.47	0.21	0.22	0.8	0.41	0.25	0.3	0.22	0.16	0.32	0.18
Total	100	100	100	100	100	100	100	100	99.99	100	100	100	100	100	100	100		
LOI	1.15	18.6	3.24	4.29	1.31	2.13	9.21	6.31	1.12	0.96	12.63	4.79	1.18	2.94	2.01	1.75	4.60	4.97
Ba	570	680	543	584	535	623	309	629	606	544	657	505	338	696	601	611	564.44	107.79
Sr	144	381	93	163	169	181	135	185	158	125	176	192	307	110	145	166	176.88	71.97
Zr	342	147	280	126	267	190	248	174	297	201	194	213	144	163	259	234	217.44	61.27
V	132	97	120	130	104	108	140	100	147	124	100	107	127	170	138	148	124.50	21.01
Rb	112	61	79	113	98	118	67	95	129	98	100	113	96	112	145	143	104.94	23.63
Zn	106	75	73	126	102	125	88	101	124	120	100	66	88	140	141	131	106.63	24.02
Ce	101	31	81	125	107	133	74	99	116	125	43	51	114	134	137	126	99.81	34.15
Cu	42	29	35	42	34	42	35	34	43	46	47	41	44	42	41	44	40.06	5.08
La	39	21	51	35	37	37	34	34	43	47	25	30	23	54	63	45	38.63	11.52
Y	34	23	23	23	28	25	23	24	33	28	23	19	19	24	34	33	26.00	5.07
Co	12	14	9	15	10	34	19	14	14	30	31	22	7	39	34	17	20.06	10.25
Nb	20	14	15	11	18	14	22	13	21	14	14	18	13	12	21	19	16.19	3.60
Pb	33	18	36	34	29	51	33	23	38	63	37	25	46	40	34	40	36.25	10.89

Table 5 Major oxides (wt %) and trace element (ppm) contents of amphorae-pithoi group by XRF analysis.
Values normalized to 100 wt% without LOI. LOI=loss of ignition. Fe2O3*=Fe tot.

KITCHENWARE	8	9	10	13	21	22	25	27	29	43	50	53	56	57	58	χ	σ
SiO_2	69.86	42.73	70.02	66.67	65.9	52.71	65.39	69.75	71.4	69.08	63	65.11	65.48	70.25	58.4	64.38	7.79
TiO_2	0.96	0.83	1.06	1.06	1.02	0.76	0.76	0.75	0.88	0.84	0.8	0.8	1.01	0.93	0.81	0.88	0.11
Al_2O_3	15.79	22.06	20.62	22.98	18.19	16.16	25.1	15.32	15.26	16.76	17.11	16.4	18.47	18.37	16.75	18.36	3.01
Fe_2O_3*	6.38	3.42	2.81	3.44	6.48	7.38	2.82	5.75	6.1	5.54	6	6.45	7.82	4.34	6.34	5.40	1.63
MnO	0.14	0.03	0.01	0.02	0.14	0.12	0.01	0.08	0.12	0.08	0.09	0.12	0.12	0.02	0.1	0.08	0.05
MgO	1.49	1.14	0.51	0.58	1.96	1.14	1.06	1.95	1.67	1.66	1.04	2.39	1.71	1.35	1.31	1.40	0.51
CaO	1.59	26.08	2.18	1.76	1.95	17.9	1.89	2.54	1.28	2.28	8.44	4.9	1.63	1.28	12.16	5.86	7.39
Na_2O	1.35	1.04	0.43	0.63	1.76	1.02	0.73	1.26	1.04	1.38	1.31	1.28	1.12	0.79	1.08	1.08	0.34
K_2O	2.25	2.3	2.27	2.69	2.29	2.19	2.17	2.33	2.06	2.17	1.89	2.28	2.39	2.22	2.54	2.27	0.19
P_2O_5	0.19	0.37	0.08	0.16	0.3	0.63	0.06	0.27	0.21	0.22	0.31	0.26	0.25	0.45	0.5	0.28	0.15
Total	100	100	99.99	99.99	99.99	100	99.99	100	100	100	100	99.99	100	100	100		
LOI	1	16.25	3.12	3.84	5.47	13.43	1.79	2.28	1.01	3.97	8.95	2.7	1.34	6.18	11.25	5.51	4.81
Ba	524	689	436	589	653	729	476	498	501	798	770	583	602	677	555	605.33	110.73
Sr	148	106	104	99	100	208	127	154	118	172	179	186	115	106	189	140.73	37.90
Zr	289	135	336	225	169	187	91	204	197	175	182	186	171	187	193	195.13	57.42
V	122	130	105	110	141	112	108	110	105	96	95	112	154	140	104	116.27	17.47
Rb	93	112	113	81	69	81	90	96	75	68	61	97	94	77	88	86.33	15.23
Zn	101	65	56	49	114	85	77	94	99	76	88	98	118	79	80	85.27	19.61
Ce	94	0	25	42	97	37	55	94	112	76	54	106	122	52	46	67.47	35.62
Cu	35	39	48	48	52	40	61	52	38	36	54	36	44	64	33	45.33	9.74
La	35	27	27	37	45	20	24	31	39	27	25	30	38	39	22	31.07	7.37
Y	32	19	28	24	22	17	15	23	22	17	17	23	22	11	20	20.80	5.20
Co	7	17	0	3	35	30	5	9	25	10	28	10	9	7	16	14.07	10.71
Nb	17	11	22	13	9	12	7	12	10	8	8	11	12	10	10	11.47	3.80
Pb	26	29	98	31	30	37	28	29	24	20	32	30	332	668	35	96.60	176.59

Table 6 Major oxides (wt %) and trace element (ppm) contents of kitchenware group by XRF analysis.
Values normalized to 100 wt% without LOI. LOI=loss of ignition. Fe2O3*=Fe tot.

KILN WASTE	I	II	III	IV	V	VI	VII	VIII	χ	σ
SiO_2	56.97	68.67	57.85	56.46	57.86	68.67	69.71	57.5	61.71	5.68
TiO_2	1.01	0.8	0.95	0.85	0.89	0.81	0.98	0.89	0.90	0.07
Al_2O_3	18.99	16.79	17.55	16.53	16.92	16.67	22.36	16.56	17.80	1.89
Fe_2O_3*	9.37	5.88	8.43	8.22	8.13	5.72	2.72	8.24	7.09	2.03
MnO	0.18	0.11	0.15	0.17	0.15	0.1	0.02	0.15	0.13	0.05
MgO	3.48	1.7	4.91	4.15	4.68	1.87	0.75	4.9	3.31	1.54
CaO	6.42	2.42	6.09	9.21	7.09	2.45	1.05	6.83	5.20	2.67
Na_2O	0.78	1.24	1.04	0.79	1.09	1.4	0.79	0.97	1.01	0.21
K_2O	2.64	2.27	2.84	3.24	2.85	2.18	1.57	3.05	2.58	0.51
P_2O_5	0.18	0.12	0.18	0.39	0.34	0.11	0.05	0.91	0.29	0.26
Total	100	100	100	100	100	100	100	100		
LOI	9.27	2.84	4.25	9.21	2.91	1.56	2.14	5.02	4.65	2.84
Ba	685	573	511	603	551	519	382	713	567.13	97.78
Sr	172	129	172	170	203	155	108	255	170.50	41.94
Zr	160	189	167	107	160	242	155	179	169.88	35.41
V	145	98	124	132	118	99	113	110	117.38	15.03
Rb	127	95	109	97	125	101	85	133	109.00	16.34
Zn	138	90	124	173	136	84	61	169	121.88	37.84
Cu	64	37	51	69	52	37	33	79	52.75	15.69
Y	33	31	34	40	35	32	22	34	32.63	4.74
Co	34	19	26	24	26	17	12	24	22.75	6.26
Nb	13	11	14	10	14	13	11	14	12.50	1.50
Pb	50	41	42	93	49	33	25	67	50.00	19.99

Table 7 Major oxides (wt %) and trace element (ppm) contents of kiln wastes group by XRF analysis.
Values normalized to 100 wt% without LOI. LOI=loss of ignition. Fe2O3*=Fe tot.

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903/904(497.11)
904:725.963(497.11)
902.2(497.11)"2009/..."
COBISS.SR-ID 219284236

Original research article
Received: August 19th 2015
Accepted: November 15th 2015

THE ARCHAEOLOGICAL SITES OF UKOSA AND KUĆIŠTE IN GRAD STALAĆ

ABSTRACT

Ever since 2009, the multi-level sites of Ukosa and Kućište have systematically been excavated within the multidisciplinary research project Ukosa, sponsored by the Ministry of Culture and Information of the Republic of Serbia. They are situated within the area of Grad Stalać, on the left bank of the South Morava. The site at Ukosa was inhabited during the Early Iron Age as well as in the Late Iron Age. It was also inhabited during the Roman period. It is important to note that 6th century fortified settlements have also been found at Ukosa. Additionally there have been finds from the period from the 8th to the 11th century. At the site of Kućište there is a necropolis.

KEYWORDS: UKOSA, KUĆIŠTE, MOJSINJSKO-POSLONSKE MOUNTAINS, FORTIFICATION, EARLY IRON AGE, LATE IRON AGE, ANTIQUITY, EARLY BYZANTINE PERIOD.

Within the multidisciplinary research project of the Mojsinje-Poslon complex, supported by the Ministry of Culture and Information of the Republic of Serbia, the National museum in Kruševac has conducted archaeological research of the sites Ukosa and Kućište, in the area of the settlement of Grad Stalać, in the municipality of Ćićevac.

The area of the Mojsinje and Poslon ranges consists of mountains situated in the West Morava, South Morava and Velika Morava valleys. It mostly includes the Ćićevac municipality, while its smaller parts also include parts of the municipalities of Kruševac and Ražanj. The lower mountain peaks reach heights of 501, 490, 404 and 377 meters a.s.l. The Mojsinje Mountains reach from Grad Stalać in the north to the Gaglovska river in the south. They extend to the West Morava in the west, while in the east, the border includes the South Morava valley along the Stalać gorge, continuing along the Ribarska river. The Poslon mountain range includes the area from the Ražanjska valley in the west to the Stalać gorge in the east, more precisely between the villages of Mađere in the north and Praskovče in the south. The Stalać gorge is 24 km long, with an average width of 300 metres. Situated between the Niš and Aleksinac basins in the southeast, the Ražanj valley in the east, the Great Morava valley in the north and the Kruševac ter-

[1] This paper came out as a result of the work on the project The Processes of the Urbanization and Development of the Medieval Society, supported by the *Ministry of Education, Science and Technological Development of the Republic of Serbia.* (No. 177021).

Fig. 1 Remains of the rectangular building (photo: Ljubiša Vasiljević)

tiary basin in the southwest, the Mojsinje-Poslon complex has always represented a crossroad on the routes leading from the north to the south of Europe and is, therefore, often called "the Gates of Serbia" (Трифуновић 2003: 101 – 111).

The strategic importance and natural potential of the complex resulted in the fact that this area was inhabited since prehistory, testified to by numerous archaeological sites, including those of Ukosa and Kućište.

The sites of Ukosa and Kućište are situated in the area of the village of Grad Stalać, some 2 km to the south of the famous mediaeval fort. They are located on a broad mountain ridge of the Mojsinje mountains, on the left bank of the South Morava. The mountain ridge stretches along the river, running steeply down towards it. This side of the ridge is called Vrletija and the opposite side, on which most of the archaeological excavations have been conducted, is called Gloždak.

During the middle of the 1990s, as part of the project "Mediaeval Stalać", a field prospection and a smaller probe excavation of the site Ukosa were performed by the Institute of Archaeology in Belgrade and the Institute for the Protection of cultural Monuments of Kraljevo. During this research, a probe was opened in the northernmost part of the site. The finds from the probe, material found on the surface and other indications showed that there was a fortification from Late Antiquity – the early byzantine period, but there were also finds from prehistory and the Middle Ages (9th to 10th century) (Вукадин 1988: 281-282).

In 2009, systematic archaeological research of the sites of Ukosa and Kućište began, conducted by the National Museum in Kruševac. Ever since then, with the exception of 2013, they have been conducted every year.

The results gained after five years of archaeological research showed that the site at Ukosa

Fig. 2 Trap hole number 6 (photo: Ljubiša Vasiljević)

represents a multi level site, inhabited in the Early Iron Age, more precisely in the 8th century B.C. It is most likely that back then a smaller fortification was built at this place. Traces of it have yet to be detected, probably due to the long period of habitation on this same spot. Among the small finds from this period, there is pottery (urns with channelled decoration on their rims and necks, bowls with facetted rims, vessels with strainers..) and stone axes (Чађеновић 2007: 14-15; Рашковић 2011: 2).

Ukosa was used as a refugium until the Roman conquest, at the beginning of the New Era. There have also been finds that give testimony to a Celtic presence at this place; a hearth with an ellipsoidal ground plan, measuring 98 x 50 cm, with Late Iron Age pottery shards discovered in the vicinity and dated to the 1st century B.C. (Tapavički et al. 2015: 33).

The strategic advantages of Ukosa were used again in Antiquity, during the turbulent times of the 3rd and 4th centuries, when safe havens high in the inaccessible mountains were needed, where it was possible to organise protection and defence. A hoard of 115 bronze Roman coins from the 4th-5th century gives testimony to the Roman presence (Vasiljević, Rutić 2014: 80).

Several other finds indicate Roman habitation in the vicinity of Ukosa. In 1912, M. M. Vasić wrote about the find of "37 pieces of Roman coinage from grad Stalać" (Васић 1912: 200). In the vicinity of the church of the Holy Spirit (Sveti Duh), close to the mediaeval fortification of Stalać, two brick kilns were discovered, while a third one was most likely destroyed during the reparation of the modern road leading to the church (Миић 1988-1990: 312-313). Field surveys, conducted by the National Museum in Kruševac, revealed that next to the kiln, there are skeletal burials with the deceased laid on ancient tegulae. The archaeological

Fig. 3 Roman brick kiln from Stalać (photo: Ljubiša Vasiljević)

material discovered close to the graves (pottery, a fragment of a lead mirror and a round plate fibula) indicates that the necropolis can be dated from the 3rd to the 4th century (Рашковић 2002: 50-51).

A solidus of the Byzantine emperor Romanos (921-927), discovered during conservation works, gives testimony to continued habitation of the area. Inside a tomb, "a gold coin and two earrings made in a special shape of silver" (Ризнић 1891: 86-87) were discovered. A find of a Roman bronze statuette, which, before the Second World War, was kept at the National Museum in Niš, can also be possibly connected to this area, however, it has now been lost. Its appearance is not known, while the only information about it is that it was a find discovered between Stalać and Mrzenica (Гарашанин М., Гарашанин Д. 1951: 201; Рашковић 1998: 181).

There is reason to believe that the original late antique fortification of Ukosa was established in the 4th century, when the weakening of the central rule led to a decline in security. This, in turn, resulted in an attempt to move a huge number of settlements into the naturally protected hilly places. This fort played its most important role during the 6th century, when it was certainly included into the renovation and additional construction of fortifications conducted by Justinian, who hoped to maintain his rule over these areas.

According to the area it covered, Ukosa represents one of the largest Late Antique/Early Byzantine fortifications in this part of Serbia. The fortification measures almost 300 meters in length, while its width varies between 80 and 100 meters. The whole area is naturally divided into four plateaus. The fortification lines follow the natural terrain configuration. The smaller part of the fortification, which was discovered at the western side of the site, was positioned in a logically chosen position, where the slope becomes very steep. It

Fig. 4 Roman brick kiln from Grad Stalać (photo: Ljubiša Vasiljević)

was constructed of bigger, carved stones secured with mortar. The preserved wall measures 1.10 m in height. Since it enters the western sondage profile, its width could not be determined. This part of the will receive more detailed attention during future of the site excavations.

The building technique applied to the walls was also applied to buildings discovered at the western part of the site, where most of the excavations have so far taken place. Among the objects built of solid materials, there is a rectangular building, orientated east-west, which has not been fully examined. In its vicinity, damaged skeletal burials were discovered.

During the excavation, seven pits were discovered, originally intended as food storages and then, after that, as rubbish pits. Apart from a huge amount of pottery and animal bones, fragments of glass vessels, metal tools, coins, fibulas etc. were discovered in the pits (Васиљевић, Рутић 2014a: 55-56).

Numerous small finds provide evidence of life in Ukosa in the past. It was not only a strategic point, but also an important economic point. Apart from pottery (amphorae, jugs...) typical for the Late Antique and Early Byzantine periods,

Fig. 5 Ukosa – part of town walls (photo: Dušan Rašković)

there have also been finds made of metal, bone and stone, as evidence of different handicrafts (leather working, carpentry, stone cutting, etc.). Among the tools found there were axes, knives (the most interesting of which is a knife used for leather working), a stone cutters tool, shearing scissors, a bell, plough parts etc. A millstone is also worth mentioning, consisting of two stones and discovered in situ, directly on top of a rock. Metal and glass slag indicate the existence of metal and glass production. Finds of spearheads with long flat tops and arrow points of different types indicate a military presence.

A number of finds that can be described as decorative were also found at Ukosa. These include parts of glass vessels with thin walls and glass lamps, bone combs and decorated applications, an exquisitely decorated bone button for a bag, a bone flute, a pottery whistle and jewellery (fibulae and finger-rings). They all indicate the aesthetic taste of the local inhabitants, tending to follow the trends of their times.

Special attention shall be paid to the find of an “S”-shaped fibula, typical for the Langobards, who were possibly part of a military unit. This is actually an isolated find of this type in the territory of Serbia (Рашковић 2011: 4).

At the southern and south-western part of the site of Ukosa there is a necropolis. Apart from skeletal burials, placed in the Christian manner and orientated west-east, there was a skeleton orientated south-north, with a huge stone placed upon its chest.

The second necropolis is situated at the site of Kućište, positioned on a slope next to Ukosa. Part of the northern slope of Kućište has been archaeologically examined. The motive for this archaeological excavation was the word of the locals, who claimed to have found graves in this area. One skeletal burial was discovered in a rect-

Fig. 6 Ukosa – skeletal graves (photo: Sanja Rutić)

angular pit plastered with stone, without grave-goods. Anthropological analysis revealed that it was a woman aged about 25 years. Her relative height was between 163 and 170 cm. The exact cause of death could not be determined, but it is certain that she suffered from bone tuberculosis, however, it can't be determined whether this was the direct cause of death (Џомба 2011: 281-289).

Archaeological finds give testimony to the habitation of Ukosa in the period from the 7th to the 11th century. Slavic pottery decorated with a typical waved line, bone and metal finds (finger-rings, and a fine carved knife, probably used for cult purposes), traces of fire-places and other finds indicate the strategic importance of Ukosa, which did not cease to exist as a settlement in the period mentioned above. During that period, Serbian, Bulgarian and Byzantine forces fought over this area. A find of a small cross also dates from this period and was discovered in the first excavation layer, at the western part of Ukosa.

The connection between Ukosa and the mediaeval site of Stalać has not yet been established. Stalać reached its peak of development in the 14th and 15th century. One can not claim with any certainty whether, during this period, Ukosa was used as a final refugium or a watch-point. One of the romantic theories regarding this is mentioned in an epic song named "Smrt vojvode Prijezde" (The death of Duke Prijezda), who, not wanting to be captured alive by the Turks, along with his wife, jumped from the walls of Stalać into the Morava river. Contrary to Stalać, Ukosa lies directly above the bank of the South Morava, and it is therefore possible that this event took place in Ukosa rather than in Stalać.

It is certain that Ukosa and Kućište both conceal many secrets, some of which will be revealed with further archaeological research, set to continue in 2015.

Fig. 7 Kućište – skeletal grave of femal individual (photo: Dušan Rašković)

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Fig. 8 Ceramic whistle (photo: Petar Ćeranić)

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Fig. 9 Bone zipper purse (photo: Petar Ćeranić)

REZIME

ARHEOLOŠKI LOKALITETI UKOSA I KUĆIŠTE U GRAD STALAĆU

KLJUČNE REČI: UKOSA, KUĆIŠTE, MOJSINJSKO - POSLONSKE PLANINE, UTVRĐENJE, RANO GVOZDENO DOBA, KASNO GVOZDENO DOBA, ANTIKA, RANOVIZANTIJSKI PERIOD.

Lokaliteti Ukosa i Kućište nalaze se u okviru naselja Grad Stalać, u blizini poznatog utvrđenja iz perioda poznog srednjeg veka. Lokaliteti su smešteni na Mojsinjskim planinama, iznad leve obale reke Južne Morave.

Prva manja sondažna iskopavanja na lokalitetu Ukosa izvedena su 1986. godine. Sistematska arheološka istraživanja Narodni muzej Kruševac sprovodi od 2009. godine, u okviru Projekta multidisciplinarnih istraživanja Mojsinjsko-Poslonskog kompleksa, podržanog od strane Ministarstva kulture Republike Srbije.

Istraživanja su pokazala da je lokalitet Ukosa prvi put nastanjen tokom perioda starijeg gvozdenog doba. Keramički materijal potvrđuje kontinuitet nastanjivanja i u epohi latena. Arheološki nalazi svedoče da su Rimljani, pogotovo u nemirnim vremenima kasne antike, koristili strateške mogućnosti Ukose. Poseban značaj ima otkriće ostave od 115 komada kasnoantičkog bronzanog novca. Postojanje antičkih ciglarskih peći i nekropole u Grad Stalaću svedoči o burnom životu na ovm prostoru tokom antike.

Utvrđeno je postojanje ostataka ranovizantijskog utvrđenog naselja. Trasa bedema prati konfiguraciju planinskih terasa na kojima je podignuta. Deo bedema otkriven je na zapadnoj strani lokaliteta. U okviru utvrđenja konstatovano je postojanje građevina od tvrdog materijala, otpadnih jama i skeletnih grobova različite orijentacije. Pokretni

materijal zastupljen je nalazima keramike, oruđa, oružja, fibula, nakita, medicinskih instrumenata, dekorisanih koštanih aplikacija itd.

Nastavak života na lokalitetu, nakon avarsko-slovenskih osvajanja, potvrđuju nalazi datovani u period VIII-XI veka. Otkriće srebrnog krsta sa predstavom razapetog Hrista svedoči o završnoj fazi korišćenja utvrđenja u poznom srednjem veku.

Na lokalitetu Kućište utvrđeno je postojanje nekropole sa skeletnim sahranjivanjem.

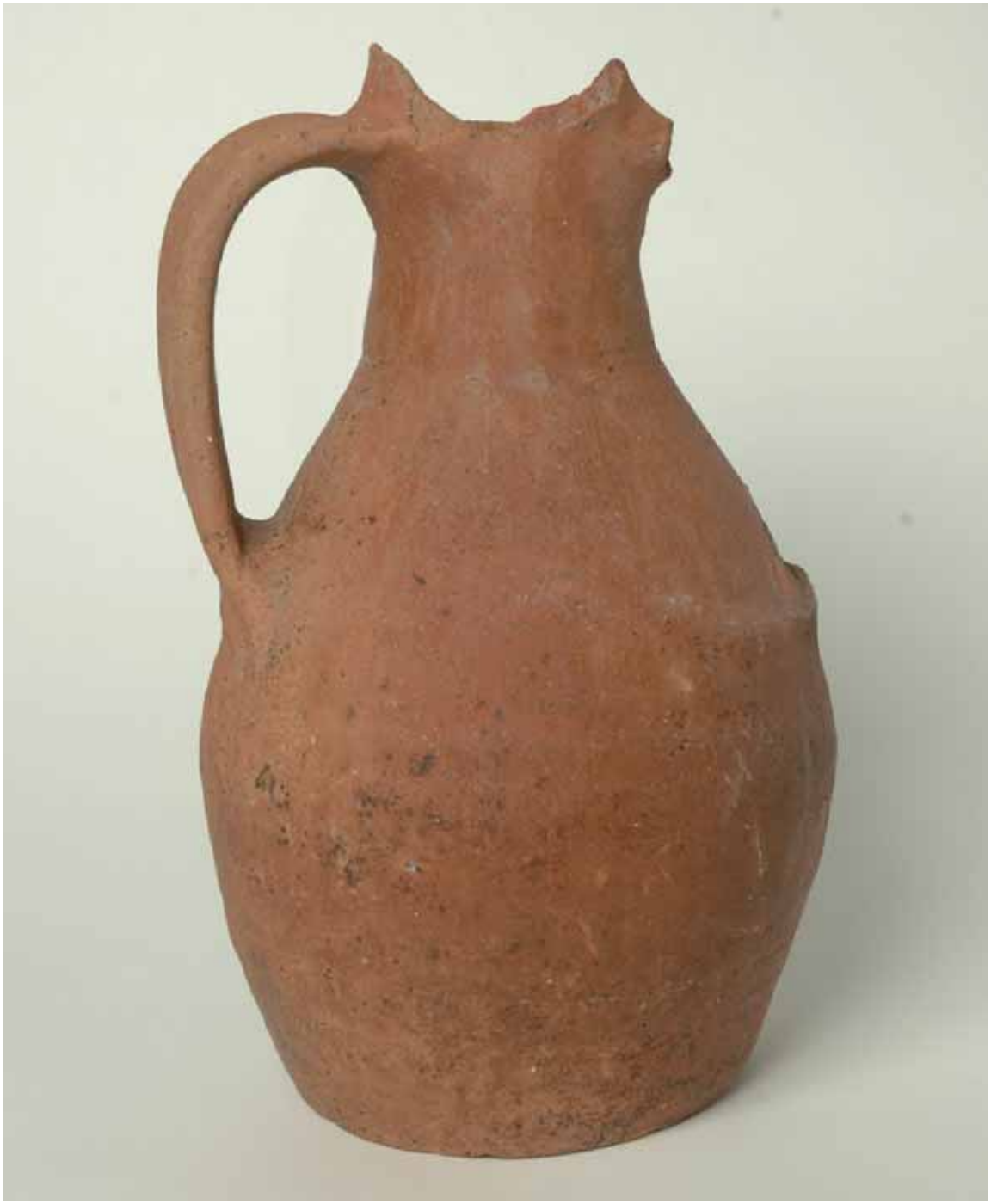

Fig. 10 Pitcher (photo: Petar Ćeranić)

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904:737.1(475)”11”
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069.5:902/904(475)”2006/...”
COBISS.SR-ID 219285260

Original research article
Received: December 10th 2014
Accepted: November 15th 2015

TO DISCOVER A HOARD... AND WHAT NEXT? OUR EXPERIENCES CONNECTED WITH THE STUDY, PRESENTATION AND POPULARIZATION OF THE FIND

ABSTRACT

In 2006, an early medieval hoard of silver coins and cast silver was found in Dąbrowa Górnicza – Łosień, near Kraków. This 12th-century find, called the “Steelworker’s Hoard”, discovered on the Silesian and Lesser Poland borderline, is connected with the beginnings of silver and lead metallurgy in Poland (11th – 13th centuries). This valuable find was deposited in the Municipal Museum „Sztygarka” in Dąbrowa Górnicza. The Museum was entrusted with the challenging task of the presentation, popularization and study (including metallographic and metrological examination) of the hoard. Some interesting examples of the iconography of dinars from “Steelworker’s Hoard” have oriental roots.

KEYWORDS: EARLY MIDDLE AGES, HOARD, SILVER AND LEAD METALLURGY, SILVER COINS, DENARS, ICONOGRAPHY, MUSEUM, STUDY, PRESENTATION, POPULARIZATION.

Over the last 20 years, traces of early medieval mining and metallurgy of silver and lead from the 11th or 12th centuries have been discovered on the borderline of such historical regions of Poland as Silesia and Lesser Poland. The centre of silver and lead production discovered in Poland and situated between Olkusz, Bytom, Siewierz and Tarnowskie Góry probably became (together with the centre in the Harz Mountains) the most important site of mining and smelting of these metals in Central Europe (Buko 2011; Foltyn 2009; Rozmus 2004 a). The production of silver and lead commenced in the above-mentioned area in the early Middle Ages, has continued with changing intensity until now, and it particularly flourished between the 15th and 17th centuries.

The discovery of the 12th-century hoard of silver coins and silver nuggets in Dąbrowa Górnicza – Łosień was an important archaeological find. The hoard was discovered during standard research at a regular excavation site and can be regarded as a special bonus for archaeologists. Thursday, the 13th July 2006 was the brightest day during archaeological works lasting for several seasons at the excavation sites which showed the beginnings of the history of silver and lead metallurgy. That

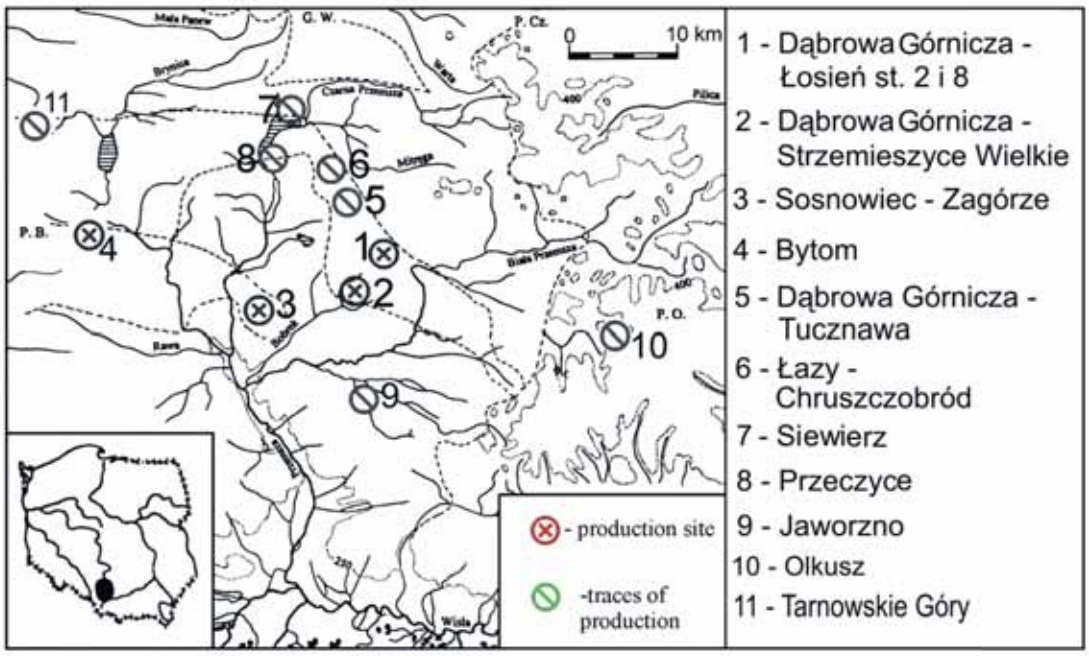

Fig. 1 The map of early medieval metallurgical sites (the borderline of Lesser Poland and Silesia) (B. Sz. Szmoniewski)

was the day when one of the biggest and most interesting hoards of the Piast Poland was discovered in Dąbrowa Górnicza – Łosień (Silesian Voivodeship). The hoard hidden in a clay pot was brought to light not by chance – as it frequently happens during construction works – but as a result of regular excavation works. What is interesting, hoards – that is precious and purposefully hidden objects, are rarely found during planned archaeological works (Krudysz et al. 2009; Tokaj and Rozmus 2012).

The hoard found in Łosień was named "Steelworker's Hoard"/ "Metalurgist Hoard". A deposit of silver denars and cast silver had been buried in the 12th century, at the beginning of a turbulent period in the Polish history that was called "The Fragmentation", approximately between 1160 and 1165. The disappearance of the metallurgic settlement may have been caused by an armed invasion. There are several factors supporting this theory: military items found in this place, abandoned furnace with a full charge that steelworkers had not apparently had time to empty, and also – most likely – the fact of hiding the treasure itself. It is widely known that in times of unrest, war, invasion and massacre threats, people tend to hide their valuables (Tokaj and Rozmus 2012).

A major centre for glazing ceramics – a real sensation in the early medieval times in Poland – was also found in Dąbrowa Górnicza – Łosień. Numerous finds of weights also showed extensive trading relationships of miners and smelters of silver and lead (Bodnar, Rozmus, Szmoniewski 2007). The influence of ancient oriental ornamentation (for example the motifs of an eagle and a hare) and the Byzantine culture is visible in the early medieval coins from Dąbrowa Górnicza – Łosień. The antique objects were influenced by the Eastern culture, including Byzantine adornment. Moreover, spindle whorls made of Volhynian schist, coming from the territory of today's Ukraine were discovered. The graves at the early medieval cemetery in Strzemieszyce Wielkie (3-4 kilometers from Łosień – currently a district of Dąbrowa Górnicza) are surrounded by stones, which shows the influence from Kievan Rus (Marciniak 1960; Rozmus, Rybak and Bodnar 2005).

After several seasons of archaeological re-

Fig. 2 The discovery of the hoard in Łosień on 13 July 2006 (a photograph by A. Wójcik)

search conducted by various research teams, we can speak about "a region of silver and lead metallurgy" existing in the early Middle Ages. Another thesis may also be formulated, stating that this metallurgy was of substantial significance for the formation and development of Poland. For many years Polish scientists, when discussing the role of economic foundations of the state of the first Piasts, considered the question of the origin of silver found in these lands as one of the most important issues. Silver was used for the production of ornaments and for minting coins. Hack silver and silver clumps (similar to those constituting the "Steelworker's Hoard") may have been used for settling trade transactions. The earliest analyses of the origin and sources of the silver material discovered in the Polish hoards from the 9th and 10th centuries indicated import as the exclusive source of silver. First it was assumed that the Arab coins called „dirhem" brought to Poland from the Orient had provided the material. Then another hypothesis was considered, namely that the silver may have come from the Harz Mountains (Buko 2011; Rozmus 2004 a, 2009, 2012 b).

At present, it is assumed that starting from the second half of the 11th century, the silver came from the Western part of the Kraków region, precisely from the basins of the Przemsza and the Brynica rivers, where the traces of silver and lead extraction and smelting were discovered (Rozmus 2012b).

The discovery of the "Steelworker's Hoard", was also a challenge for the Municipal Museum „Sztygarka" in Dąbrowa Górnicza, where this valuable find was deposited. The Museum first had to fulfill specific conditions related to storing and exhibiting of such an archaeological object. For this purpose, a special display cabinet was purchased and a security alarm was installed and connected to the municipal police station. Next steps included the conservation and study of the hoard (with respect to metrology, iconography and particularly metallography). The Archaeological Division and the Marketing Division of the Museum are both responsible for the challenging task of popularization of this find. It is worth mentioning that Dąbrowa Górnicza and the surrounding region are typically industrial and are more often associated with the 19th and 20th-century coal

Fig. 3 The research of the hoard conducted by the authors of the forthcoming "Steelworker's Hoard" monograph (in the photograph: Joanna Tokaj and Dr Dariusz Rozmus; a photograph by B. Sz. Szmoniewski)

mining and steel industry rather than with a strong centre of silver and lead metallurgy (Tokaj, Cyankiewicz and Garbacz-Klempka 2012; Garbacz - Klempka, Rozmus 2015).

We are actively engaged in conducting the research of the "Steelworker's Hoard" and we undertake numerous activities aiming at the dissemination of the find. Exhibitions and lectures, among others, well serve this purpose. We systematically present the results of archaeological research in scientific and non-scientific publications and organize presentations and exhibitions. One of the most interesting issues presented by us is medieval minting, including Roman minting art – unique in Europe. The Museum in Dąbrowa Górnicza arranged a permanent exhibition with the reconstruction of a minting workshop and prepared a photographic exhibition that visited several cultural institutions. The initial processes, such as cutting out blanks from flattened silver bars, were reconstructed in the form of a fresco. The minting stand – a wooden base where reconstructed dies for striking coins were placed – constitutes an interactive part. It was frequently used when presentations showing how coins had been struck were organized both in the Museum and during outdoor events (Cyankiewicz and Tokaj 2011; Rozmus and Tokaj 2010; Tokaj and Rozmus 2012).

The permanent exhibition shows particularly interesting examples of medieval coins. They depict knights, sovereigns or saints, sometimes showing them in a static, majestic pose, but there are expressive fighting scenes as well. We can also admire a wide range of depictions involving animals, however not always real. And thus warriors bravely fight beasts – lions and dragons, and predatory eagles attack defenceless hares (Rozmus 2012 a; Tokaj 2012; Rozmus and Tokaj 2012).

Not only did medieval coins have esthetic values, but they also served other purposes. Sovereigns frequently used them to convey certain messages to their subjects or political rivals. The mysterious language of medieval numismatics is

Fig. 4 a-b Metallographic examination of the coins at the University of Science and Technology in Kraków. In the photograf S. Rzadkosz (a photograph by P. Jurecki)

extremely difficult to understand today (Suchodolski 2012).

The authors of this article wish to point out the best examples of early medieval iconography, particularly those unknown outside Poland. The 12th-century coins issued by Ladislaus II the Exile (1138-1146) and Boleslaus the Curly (died 1173) constitute an example of Roman micro-engraving art which is unique on a European scale. The iconography of coins shows Western European, Czech and Byzantine – oriental influence. Some of the engravings – such as the denar of two brothers and the denar of three brothers do not have any analogies in the iconography of medieval coins in Europe. They show two or three prince's celebrants sitting at a table in a majestic scene in which they are raising up a prince's orb (the denar of two brothers) (Tokaj and Rozmus 2012).

The subject of our studies are scenes with oriental roots that were changed by the Byzantine civilisation. We are currently working on the symbolism of coins depicting hunting scenes of Byzantine – oriental origin and on the symbolism of majestic effigies. We have so far worked out the iconography of depictions of St. Adalbert. An important motif is an effigy resembling an icon which shows the head of St. Adalbert, a bishop and a martyr from a noble Czech family of Prince Slavník. The bishop was martyred in his efforts to convert the Baltic Prussians. St. Adalbert is not only the patron of Poland, but also of the Czech Republic and Hungary (Suchodolski 2000, 2005; Labuda 2000; Rozmus and Tokaj 2010).

Apart from the research of the iconography of denars, we are conducting analyses leading to a full monograph of the find. First, each coin and lump was photographed, weighed and measured, and then cards with magnified denars were prepared on the basis of the photographic documentation, which significantly facilitated the work of the researchers. Next, the coins within their types were divided into variants – that is denars which had been coined with the use of a specific coin die. Thus the so called "connection chains" were created, which help to determine which coins were coined earlier than others. Lumps of silver and

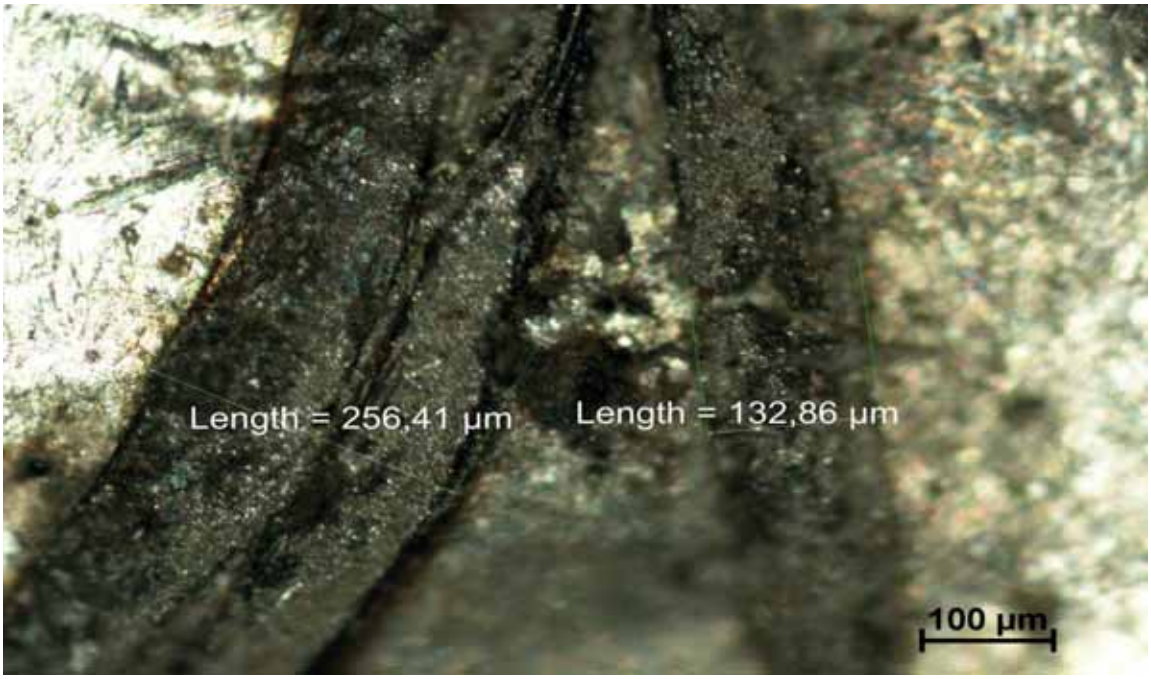

Fig. 4 a-b Metallographic examination of the coins at the University of Science and Technology in Kraków (a photograph byP. Jurecki)

chosen coins were also examined metallographically. The examination was conducted in cooperation with the University of Science and Technology in Kraków and the Museum of Archaeology and Ethnography in Łódź. The results of the examination were compared with the examination results of lumps from other medieval hoards (Garbacz-Klempka, Rozmus and Tokaj, 2013; Tokaj, Cyankiewicz and Garbacz-Klempka 2012).

All the above activities were undertaken within the frames of the project carried out since 2011, called "Industriae Theatrum ex Silesia". The project involved people of all age groups (so called lifelong learning). One of the events that deserves particular mention accompanied a series of lectures directed to students of the University of the Third Age. During one of the lectures, employees of the Faculty of Foundry Engineering from the University of Science and Technology in Kraków presented a living history show of smelting with the use of medieval methods.

Referring to the use of natural resources, and in particular lead, in the Middle Ages, we decided to reconstruct the processes of melting and smelting alloys composed mainly of lead. The basis for the experiment were archeological finds from Lesser Poland and Silesia, as well as written sources from the 12th century (Teofil Prezbiter 1998). The conclusions of the observations and research found more practical application as they were transferred from a laboratory to be used in the reconstruction works. Designs of the furnace for melting metals, crucibles and appropriate alloys were prepared. Project participants took part in the final stages of the process, which gave them the opportunity to gain practical knowledge about the medieval craft of melting and smelting metals. The furnace smoked, the alloy in the crucible changed to liquid, previously prepared casting moulds were filled and then opened after cooling down. In this way, within the frames of the project, medieval ornaments were made, using patterns known from archeological research. Thus, this scientific and research work took on a practical dimension and contributed to the dissemination of knowledge concerning metal ores, medieval technological processes and finished products made of metals and their alloys. Therefore, one of the most essential aims of the project was achieved: the industry of the Middle Ages was shown in a

Fig. 5 The reconstruction of a medieval mint in the Municipal Museum „Sztygarka" in Dąbrowa Górnicza (a photo by J. Tokaj)

modern city and with active participation of its inhabitants, using the findings presented in scientific and research works (Tokaj, Cyankiewicz and Garbacz-Klempka 2012).

The interest of the researchers in the process of minting coins in the Middle Ages resulted in the reconstruction of the above mentioned minting workshop.

Coins were struck at mints, which were manufactories that employed several dozen people. Mints were administered by magister monetae who managed a team of employees, including

Fig. 6 A fragment of a permanent exhibition of the "Steelworker's Hoard" in the Municipal Museum „Sztygarka" in Dąbrowa Górnicza (a photograph by K. Borda)

mint masters, apprentices, workers and die engravers. In all likelihood, the administrators also held public functions, most likely they were responsible for all financial resources of the mint.

In order to strike coins, dies had to be made first. They were most likely of the shape of a cylinder or a truncated cone. The face was that part of a die where the image to be placed on the silver planchet was engraved. Carving the design for a coin was an extremely laborious and precise work, therefore it also required high qualifications. The engraving was made with a graver and a pair of compasses.

When striking a coin, the planchet was situated between the dies, and then the upper die was hit with a hammer. The average life of a pair of dies varied – they could crack after striking several dozen or even several thousand coins. Polish mints most likely employed local prince's goldsmiths to produce dies (Suchodolski 1973; Kiersnowski 1964).

Since the discovery of the hoard, that is for the last 8 years, the results of the archaeological research have been systematically presented in both scientific publications and publications for the general public, as well as in the local press and even tabloids. Several specialist lectures and outdoor and mass activities have been organized (an event at a shopping mall, a theme event „ The Autumn of the Middle Ages"). Some of the lectures and lessons have been directed to both students of the University for the Third Age and the University for Children.

In 2012, the Museum, together with the Society of Friends of Dąbrowa Górnicza and the University of Science and Technology in Kraków, carried out a project "Valuable, priceless, extracted from the earth..." and issued a bilingual brochure „Steelworker's Hoard" from Dąbrowa Górnicza – Łosień and a bookmark with the pictures of the most valuable coins from this Hoard. The project that included both lectures and presentations of coin minting succeeded in popularizing interdisciplinary issues from the history of art, medieval science, numismatics and archaeology to the general public (Tokaj and Rozmus 2012).

Fig. 7 a-b Type 4 denar of Boleslaus IV the Curly: the obverse and the reverse
(the „Steelworker's Hoard", a photograph by J. Popielarz)

Fig. 8 a-b Type 3 denar of Ladislaus II the Exile: the obverse and the reverse
(the„Steelworker's Hoard", a photograph by J. Popielarz)

To sum up our experiences over the last few years, we can say that thanks to the discovery of the hoard and a wide range of activities popularizing the discovery, the Museum in Dąbrowa Górnicza – which is not a museum with a long tradition – gained an interesting opportunity of promotion. In 2014 was published the monograph of the Metallurgist Hoard (Rozmus, Suchodolski, Tokaj 2014).

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REZIME
OTKRITI BLAGO...I ŠTA ONDA? NAŠA ISKUSTVA SA OBRADOM, PREZENTACIJOM I POPULARIZACIJOM NAZALIŠTA

KLJUČNE REČI: RANI SREDNJI VEK, OSTAVA, METALURGIJASREBRAIOLOVA,SREBRNINOVAC, IKONOGRAFIJA, MUZEJ, OBRADA, PREZENTACIJA, POPULARIZACIJA.

Godine 2006, tokom arheoloških istraživanja, otkriveno je blago iz XII veka od preko hiljadu srebrnih novčića, zajedno sa oko 2 kilograma kovanog srebra. Nalaz potiče iz grada Dombrova Gurniča (Dąbrowa Górnicza), četvrti Uošenj (Łosień), koji se nalazi u blizini Krakova, gde je bila kneževska kovnica novca.

Otkriće blaga bilo je neka vrsta kulminacije istraživačkog rada sprovedenog na granici provincija Malopoljske i Šleske. Ranije na ovom području nekoliko poslednjih istraživačkih sezona rezultiralo je otkrićem ranih srednjovekovnih nalazišta, povezanih sa počecima metalurgije srebra i olova na području Poljske (od Xi do XIII veka).

Blago, koje se zove „Topioničarevo blago", takođe je izazov za Gradski muzej Štigarka (Sztygarka) u gradu Dombrova Gurniča, gde je čuvano kao jedno od najvrednijih otkrića na ovome području. Muzej je prvo morao da ispuni određene uslove (uključujući bezbednosne mere), u vezi sa mogućnostima čuvanja i izlaganja ove vrste arheoloških nalaza. Naredni koraci, koji su uključili održavanje i obradu blaga, rezultiraće objavljivanjem monografije. Odeljenje za arheologiju i odeljenje za marketing Gradskog muzeja nastojali su da popularizuju ovo arheološko otkriće. Od otkrića blaga sistematski se predstavljaju rezultati arheoloških istraživanja grupama posetilaca različite starosne dobi.

Najzanimljiviji obrađivani primeri ikonografije ranih srednjovekovnih novčica predstavljaju različite prizore orijentalnog porekla (npr. prizori lova, slike veličanstvenog Sv. Vojtjeha Adalberta, zaštitnika Poljske). Pored izučavanja ikonografije novčića, takođe se vrše istraživanja iz oblasti metalurgije i metrologije.

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904:725.73”652”(497.11)
691.421.2(398)
COBISS.SR-ID 219286540

Original research article
Received: 25th May 2015
Accepted: November 15th 2015

THE ROLE OF BRICK IN HYDRAULICITY OF VIMINACIUM MORTARS: DECORATIVE MORTARS FROM THE THERMAE*

ABSTRACT

The hydraulicity of the Viminacium mortars is still somewhat unknown, but with laboratory analyses, performed on a small number of samples, and similar research performed worldwide, some conclusions can be drawn. These bring us closer to this topic, which again contribute to our becoming acquainted with the Viminacium building materials, their usage, behaviour in constructions and their mutual relationships.

Throughout history, artificial products of soil, specifically bricks and ceramics, represent some of the most commonly used materials with pozzolanic features in the creation of hydraulic lime mortars. In accordance with their function, the Viminacium thermae represent a place with high levels of humidity in the air and water in a large number of rooms, thereby representing a suitable example for analysing the use of hydraulic mortars, which above all needed to be waterproof. This was achieved with the use of bricks, a material produced locally in Viminacium.

Fragmentarily preserved remains of wall paintings from the Viminacium thermae are not only numerous and various, but they spatially also include almost all parts of the building. This paper includes the remains of decorative mortars discovered during archaeological research in 2004 and 2007 that had bricks in their structure, which was confirmed with a visual review of mortar cross-sections when brick was used in fragments. It was also suspected due to the reddish colour of some of the layers, most likely connected to the use of brick dust.

KEYWORDS: HYDRAULICITY, LIME MORTAR, BRICK, POZZOLANIC FEATURE, DECORATIVE MORTARS, THERMAE, VIMINACIUM.

INTRODUCTION

The Romans used non-hydraulic and hydraulic mortars, depending on the accessibility of the raw materials needed for their production and on their role in different constructions. Hydraulic lime mortar features can be achieved in several ways: by using quarry sand with a high percentage of

* The article results from the project: *Viminacium, Roman city and military camp – research of material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation (no 47018)*, funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Fig. 1 Brick kils from the craftsmen's centre during excavations.
Photo-documentation of the Republic Institute for the Protection of Monuments

clay as an aggregate, natural or artificial hydraulic lime as a binder or by the use of certain materials of natural or artificial origin, with pozzolanic features, as an addition or substitute for aggregate.[1]

Just like artificial materials, natural materials with pozzolanic features gave hydraulicity to mortar, actually strength, water resistance and a binding possibility under water when reacting with lime.[2] Nevertheless, lime mortars with the addition of natural materials set much quicker, thereby being more favourable for the building of all kinds of constructions. (Lancaster 2005: 65) Lime mortars with added brick were excellent for use in the external finishing layers, but also in all other wall or floor layers with humid and warm conditions, such as baths, (Böke et al. 2006: 1121, Elsen: 2006, 1419, Stefanidou et al. 2014: 572) due to their higher resistance to water penetration. (Hale et al. 2003: 135-136) In many historical buildings, mortar was used that was made of both kinds of pozzolanic materials, depending on the accessibility of the raw materials.[3]

At the beginning of the 2nd century AD, during the "time of peace and the period of labour and economic prosperity", (Васић 1895: 29),[4] Viminacium developed into a centre of brick production in this part of the Danube Limes. (Jordović 1995: 95, 105)[5] (Fig. 1) Ever since that time, this building material became invaluable for wall facing, its core and levelling course, it was used independently for entire walls, indoor and outdoor floors, (Fig. 2, Fig. 3, Fig. 4, Fig. 5) and was also used as an artificial pozzolanic additive to lime mortars.

The Viminacium thermae were excavated on two occasions, from 1973 to 1974 and from 2003

1 See Radivojević 2004: 38-39 and in Adam, 1999: 129-132.

2 It is important to distinguish between the terms "hydraulic" and "pozzolanic", since hydraulic materials can react only with water, while pozzolanic materials need both water and lime for a reaction. (Griffin 2004: 24).

3 For examples see Özkaya 2005: 76.

4 See more about this in Мирковић 1968: 64-65.

5 About craftsmen' centres for brick production in Viminacium see also Raičković 2007: 15-17 and Raičković, Redžić 2006.

Fig. 2 Brick wall of Viminacium thermae. Photo-documentation of Institute of Archaeology Belgrade

Fig. 3 Bricks in wall facing of Viminacium thermae. Photo-documentation of Institute of Archaeology Belgrade

to 2007. (Fig. 6) Both excavations revealed that there were several phases in the building of the thermae, specifically that each subsequent building was erected on the remains of the previous one. (Kondić, Zotović 1974: 96-97, Миловановић 2004: 53) The beginning of the use of the Viminacium thermae can be connected to the end of the 1st and the beginning of the 2nd century, whilst the building lost its primary function at the end of the 4th century AD. (Миловановић 2004: 53; Kondić, Zotović 1974: 96-97) During the archaeological research of the Viminacium thermae, five apses were revealed, along with a central room with hypocaust and several lateral rooms. All of the building parts visible today were in use during the 3rd and the 4th century AD. (Миловановић 2004: 53)

VIMINACIUM BRICK FEATURES AND HYDRAULICITY

Artificial materials with pozzolanic features used throughout history include calcinated clays, slag, flying ash, ashes of rice husks, coffee husks etc. The most famous one of all is calcinated clay, presented as crushed or minced brick and ceramics. (Rapp, 2009: 266-268 и у Rossi, Russo, Russo 2009: 319-325)

Brick and ceramics are processed of easily accessible raw materials (Bugini, R. et al. 1993: 387) In contrast to natural, often inaccessible materials with pozzolanic features,[6] they represent the artificial materials most commonly used throughout history in all parts of the world, for producing lime mortars which required hydraulic features. In Turkey, this mortar was named horasan, in India surkhi, in Arabian countries it was called homra, (Böke et al. 2006: 1115), while in the Roman Empire its Latin name was *opus signinum*. (Vitruvius 2006: 144)[7] It is best known by its Italian name cocciopesto, used in Southern Europe, while in Venice, it is also called terrazzetto. (Elsen 2006: 1419) In Minoan Crete, crushed ceramics were already being used for making lime mortars, (Moropoulou *at all* 2000: 50, 55, Malhotra, Mehta 1996: 3, Hughes, Sugden 2000:351, Artioli 2010: 246-248) and together with crushed brick, it was also used by the Etrurians, Hindus and the Greeks. (Malhotra, Mehta 1996: 3, Artioli 2010: 246-248)

The area of Viminacium and its vicinity belongs to the south-eastern part of the coal basin of

6 One example of the use of mortar with the addition of brick due to a lack of natural materials with pozzolanic features is Hadrian's wall, (Elsen 2006: 1419) with mortars made of lime, crushed brick, crushed sandstone, sand and the remains of baking lime from ovens, while some had animal fats as an additive. (Marie Teutonico et al. 1993: 34).

7 Vitruvius mentions *opus signinum* as a mortar mixture with broken bricks, tiles or pottery in the process of laying floors.

Fig. 4 Bricks of hypocaust and in wall structures of Viminacium thermae.
Photo-documentation of Institute of Archaeology Belgrade

Kostolac. The terrain's sediments consist of loess, clays, marls, sands, alevrite, pebbles, coal clays and coals. (Jovović et al. 2013: 22-26) The "large scale brick industry" (Васић 1907: 69) flourished in this Roman city due to all the accessible raw clay materials. The Viminacium builders often used brick and ceramics in mortar as an artificial material with pozzolanic features.

Nevertheless, if bricks and ceramics were to have pozzolanic features, they needed to be fired at low temperatures and contain high percentage of clay, actually to have in specific chemical composition. (Ugurlu, Boke 2009: 2443)

The firing temperatures in which bricks obtain pozzolanic features have been specified differently in different research and are measured between 600ºC and 900ºC, (Elsen 2006: 1419, Nežerka et al. 2014, 18, (Tekín, Kurügol 2011: 959) or between 450ºC and 800ºC. (Böke et al. 2006, 1115) The higher the firing temperature, still within the limits stated above, the better the pozzolanic features of the bricks. (Rapp, 2009: 267) After reaching temperatures higher than 900ºC, bricks possess very limited pozzolanic features. (Pinheiro, Montenegro, Gumieri, 2010: 2) However, during the analyses of some modern samples from various European countries, it was confirmed that even after being fired at temperatures higher than 900ºC, they still possessed exceptionally high pozzolanic features. (Wild et al. 1997: 171,174)

As with all other ancient bricks from the 4th century in the territory of Serbia, the Viminacium bricks were usually fired at temperatures up to 800ºC. (Radivojević, Kurtović-Folić 2006: 697) Laboratory sample analyses of mud mortars, discovered on brick kilns in Viminacium, showed that the temperature range reached in these kilns was between 600ºC and 900ºC. (Raičković 2012,

Fig. 5 Bricks as finishing floor layer in Viminacium thermae.
Photo-documentation of Institute of Archaeology Belgrade

tab.3) Based on the presence of certain minerals, analysis of Viminacium pottery fragments (Raičković 2012, tab. 2) revealed that the firing temperature of the examined samples was about 850ºC,[8] while analysis of a Viminacium building brick sample (Cornale, Moni 2007) showed that it was fired at a temperature higher than 900ºC.

The Viminacium bricks and ceramics, therefore, most likely possessed pozzolanic features, but it is certain that there were products without these features. Ancient builders empirically developed brick production techniques, since scientific explanations of the effects of temperature on a brick's features were not postulated until the beginning of the 20th century. (Tekín, Kurügol 2011: 960) Nevertheless, it is likely that ancient builders were capable of recognising products suitable for certain needs. Supporting the use of specific bricks, there are analyses of mortars with added bricks and bricks themselves from Ottoman baths of the 14th and 15th century. They showed that brick fragments used in mortars possess high pozzolanic activity, while bricks used for construction possess different levels of the activity. This could indicate that bricks with pozzolanic features were deliberately chosen for the production of hydraulic mortars and probably they were recognised only because they contained more clay minerals. (Böke et al. 2006: 1121) The use in mortar of bricks possibly fired at very high temperatures and certain ceramic types fired at such temperatures was most likely only aiming to improve the aggregate mass and the mortar's mechanical features, while pozzolanic features were embedded only in those fragments originating from products which fulfilled the conditions mentioned above.

8 According to analogue research Barlueng et al. 2013:214-216.

Fig. 6 View of Viminacium thermae today. Photo-documentation of Institute of Archaeology Belgrade

According to international standards, the sum of percentages of the oxide content of SiO_2, Al_2O_3 and Fe_2O_3 in natural pozzolanic materials, but also in brick products with pozzolanic features, should be higher than 70%. (ASTM C618-12a: 2012, Pinheiro, Montenegro, Gumieri 2010: 2) The total content of the oxides SiO_2, Al_2O_3 and Fe_2O_3 in a brick sample from a Viminacium tomb from the 4th century is 85.10%. (Radivojević, Kurtović-Folić 2006: 698) The shard analysis from various Viminacium vessels showed that the total amount of the mentioned oxides does not exceed 70% only in 8% of the samples, while in some samples it reaches as high as 90%. (Raičković 2012, tabs.4-7) The total of the oxides SiO_2, Al_2O_3 and Fe_2O_3 in mud mortar used to build a brick kiln, in all of the samples exceeded 70%, and in one of them as high as 90.25% (Raičković 2012, tab.8), indicating the soil structure and the technology for making building materials from it.

It is interesting to mention a natural creation, known locally as "crvenka", which, in the form of a red, brown, black and ochre layer, can easily be noticed in the profiles of the nearby hills of the villages around Viminacium, in which there was a underground coal mine during the 19th and the 20th century.[9] (Fig. 7, Fig. 8) This represents layers of sedimentary rocks which experienced a metamorphosis caused by the combustion of the lower coal layers. Coal could be ignited in a natural way, by spontaneous combustion when coming into contact with oxygen or a lightning strike or a fire caused by some human factor, (Murphy: 2013: 2-3) which is often encountered worldwide under different names, the most common of which are clinker and porcellanite.[10] "Crvenka" was used by the Romans of Viminacium in road and wall core structures[11] (Fig. 9, Fig. 10) and, in accordance

9 About this mining see Мајовски Вучетић 2010, and about red clay see also Nikolić 2013: 27-28.

10 See examples from Romania: *Rădan, Rădan* 2011: 266-270, Czechia: Žáček, Skála, Dvořák 2010: 1-32 and USA: Murphy 2013: 2-4 and Rogers 1917: 1-10.

11 Regarding the use of "crvenka" in Viminacium buildings see Golubović, Korać 2008: 33-36 and Nikolić, Bogdanović 2012: 43-44. Even in modern times, clinker is used as the final layer on roads without asphalt in areas where there are no pebbles and where clinker represents the hardest rock. See U.S.

Fig. 7 Hill above Stari Kostolac village with visible red layer of „crvenka". Photo by the authors

with its role in construction, was in the shape of larger or smaller, more or less fired pieces.

Depending on the firing temperature, "crvenka" could be a partially coherent and very poriferous rock, reminiscent of slag from a blast furnace when it is closer to a source of high temperature, but also a material similar to brick, when it is formed at lower temperatures. (de Boer, Dekkers, van Hoof 2001: 94) In southern England, mosaic tesserae have been found and plates in the *opus sectile* technique, originating from several Roman buildings and made of these naturally fired rocks, from the second half of the 1st and the beginning of the 2nd century AD. Such decorations belong to early Roman mosaics in this territory and there are also indications that there were workshops introducing clinker into elements of interior finishing. (Allen, Fulford 2004: 9-38) These materials were therefore accessible to all the social strata, military, public and private. The largest use of "crvenka" in Viminacium can be placed into the same chronological frame, in the time of the still undeveloped brick industry, but also during later periods of crisis, given that it was most likely a cheap and easily accessible material. (Nikolić 2013: 28)

Worldwide research has already established the pozzolanic features of this natural creation (Jevtić, Zakić, Harak 2002: 60; Gutt, Gaze, 1975: 439-450, Ríos, Williams, 2008: 2482-2492), depending on its creation conditions, the firing temperature and the classification of the primary rocks. If future research about the local "crvenka" reveals its pozzolanic features, and knowing already the "rule" regarding the use of local materials in Roman architecture,[12] the use of "crvenka" as a pozzolanic addition to lime mortars in Viminacium buildings could be examined. The red colour of Viminacium mortars could then be ascribed to the added brick or ceramics, as well as to the addition of "crvenka". As an example from a region of Romania with a similar geological structure shows, high temperatures during the firing of the original clay leads to the formation of new minerals in fired clays, such as hematite (*Rădan,*

Dept. of the Interior, Bureau of Land Management, 1984: 61 and Murphy: 2013: 2.

12 Regarding this see also Radivojević, Kurtović-Folić 2006: 693.

Fig. 8 Hill above Stari Kostolac village with visible red layer of „crvenka“, detail. Photo by the authors

Fig. 9 Part of the early gate tower partially destroyed by the later road entering the northern gate of the legionary fort. Photo-documentation of Institute of Archaeology Belgrade

Fig. 10 Foundation structure from the bulding in the temple complex with visible „crvenka“.
Photo-documentation of Institute of Archaeology Belgrade

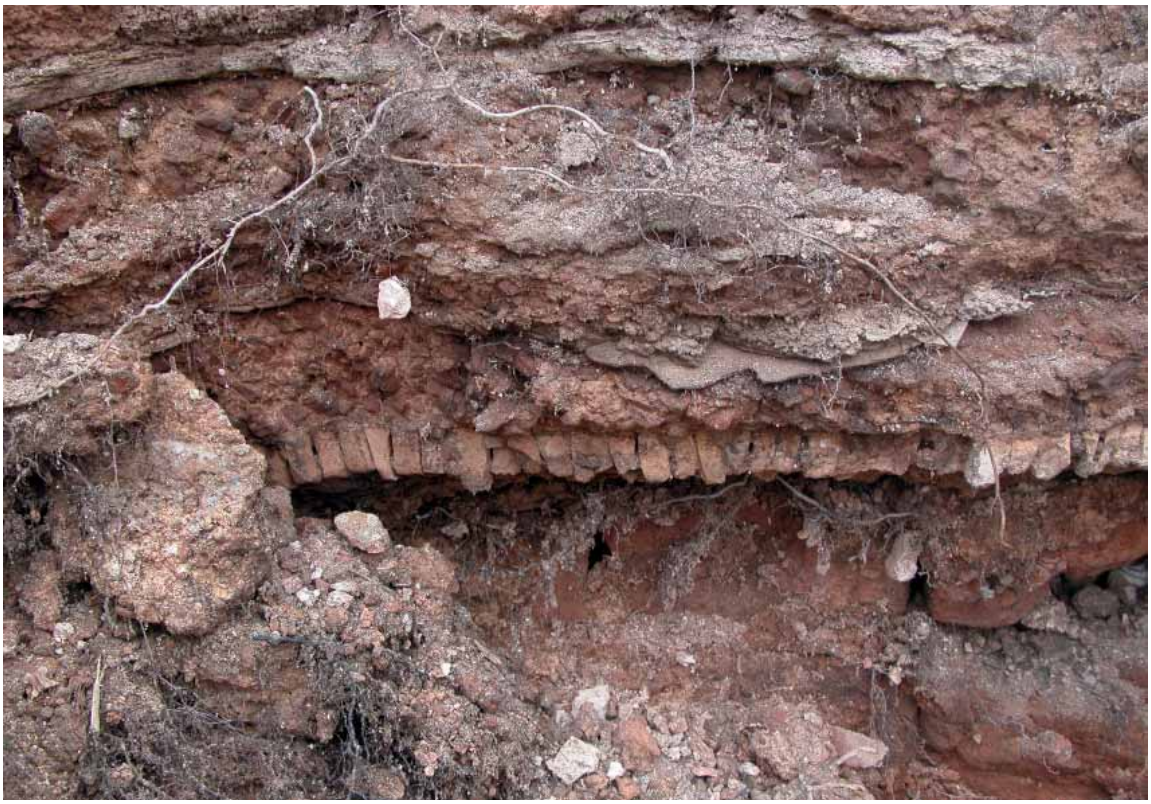

Fig. 11 Floor layers of Viminacium thermae with brick in the form of large fragments.
Photo-documentation of Institute of Archaeology Belgrade

Rădan 2011b: 267-268, *Rădan, Rădan* 2011a: 147), a natural source of several, most commonly red, pigments. (Walsh, Chaplin 2008: 189)

THE ROLE OF BRICK IN VIMINACIUM MORTARS

Even by only visually examining the Viminacium mortar samples used for masonry, rendering and plastering, one can notice differences in the mortar structure and brick admixture, indicating that Roman builders were well-acquainted with the preparation of mortar with specific features. (Bugini et al. 1993: 386) In structural mortars, lower mortar layers of floor constructions and mortars for rendering, brick admixture is visible in the mortar structure in the form of smaller or larger fragments, (Fig. 11, Fig. 12) while in those mortars used for, plastering, wall-paintings and finishing floor layers, the brick appears in the form of small fragments, but also in the form of a dust. (Fig. 13, Fig. 14) The dust was integrated with lime, with or without a sand admixture, and gave the mortar a red appearance, especially noticeable when the mortar was polished.

In areas where there were no natural materials with pozzolanic features, brick played an important role in the structure of mortars used for construction. Nevertheless, for economic reasons, lime mortar without any admixtures was often used, while the use of structural mortar with brick admixtures was limited to more important, public and even monumental constructions. Probably the most successful example of the use of brick in structural mortar is Hagia Sophia in Istanbul. The mortar joints were very wide, comparing to the width of the bricks. This mortar, made with brick dust and brick fragments, can be called a proto-concrete. (Livingston, R.A. et al. 1992: 721-736)

This rule of economy applied by ancient builders is also visible in an example from a completely different area, from a much earlier era and with admixtures of other materials, on the buildings of ancient Olynthus, from the 4th century BC. Here, for economic reasons, mud mortar was used for building stone walls exposed to humidity, after which the walls were rendered with hydraulic mortars[13]. Furthermore, in examples of Roman structures in France containing fresh water, the frequent use of brick admixtures can be noticed in mortars used for plastering and different floor layers, while the use of such mortars for building walls is somewhat rare (Coutelas 2011:147). Mortars used in supporting constructions do not need to make walls water-resistant. Brick and ceramic admixtures, therefore, appear also in mortars used for walls not directly connected to water containing structures, with the function of protecting the inner wall surfaces from external humidity factors. (Degryse et al. 2002: 1459).

After examining the material from the Viminacium thermae, it is easily understood that mortar with a brick admixture was always applied in structures that required humidity- and water-resistance, specifically in floors and outer wall layers, (Fig. 15, Fig. 16) as well as in mortars used for plastering and rendering pools and canals but, very rarely, as a structural mortar.

BRICK IN DECORATIVE MORTARS OF THE THERMAE

This paper also deals with the remains of mortar used for plastering and rendering the thermae walls, mostly painted or decorated afterwards and, therefore, also referred to as decorative mortars, which were discovered during archaeological research in 2004 and 2007.[14] (Fig. 17). Some of these decorative mortars were applied directly on

13 Information provided by Prof. Dr Ioanna Papayianni and Ass. Prof. Dr Maria Stefanidou (Laboratory of Building Materials, Civil Engineering Department AUTH, Greece), during the lecture "Case Study: Olynthos, Chalkidiki" (MARE 14 Workshop) where an author of this paper participated.

14 About fragment restoration see more in Rogić, Despotović, Milovanović 2009: 75-81.

Fig. 12 Rendering layers of Viminacium thermae with brick in the form of large fragments. Photo-documentation of Institute of Archaeology Belgrade

Fig. 13 Floor layers of Viminacium thermae with brick in the form of small fragments and in the form of a dust. Photo-documentation of Institute of Archaeology Belgrade

the walls, but some of them were executed onto a first layer of plaster or render (preparing layer or leveling layer). It depended on the state of a wall and on the material a wall structure was built of.

Brick admixtures served multiple roles in decorative mortars. According to some authors, as well as making mortar hydraulic or waterproof as an artificial material with pozzolanic features, it also absorbed humidity, therefore enabling painters a longer working period when applying the fresco technique. The painting basis needed to be humid enough and brick admixtures delayed the process of water loss or evaporation, thereby slowing drying (Šulić, 2010: 3). It can be connected to the thesis that "brick ground" (brick wall) "absorbs superfluous water, and keeps the plaster much longer in a fit state for painting upon." (Taylor, 1843: 38). Also, it is important to notice that the contact between brick and fresh mortar causes water transport, but also depends on the relationship between dimensions of the pores of both materials. (Groot 1997:122) It is interesting to mention that mortars containing natural pozzolana were probably not used as a support for fresco painting, which was the most often applied technique in Viminacium thermae. It is impossible to get a good adherence of the pigments when painting on the mortar containing natural pozzolana, which is the result of different chemical reactions. (Bläuer Böhm 2000: 111)

After analysing painted decorations from Roman villas in Hungary, it was noticed that quite often, over the intonaco, but prior to the painting layer, a pinkish layer was applied, made of brick powder. It can be concluded that this was a "rule" in the period in which they were constructed, specifically the end of the 1st and during the 2nd century AD, with the aim of offering water-proofness and protection of the painted layer from water or humidity from the wall. (Kirchoff 2008: 251-254) In mortars without a painted layer and as part of the intonaco, brick often produced a reddish or

Fig. 14 Rendering layers of Viminacium thermae with brick in the form of small fragments and in the form of a dust. Photo-documentation of Institute of Archaeology Belgrade

Fig. 15 Outer wall of Viminacium thermae, with red mortar having brick in its structure. Photo-documentation of Institute of Archaeology Belgrade

Fig. 16 Outer wall of Viminacium thermae, with red mortar having brick in its structure, detail.
Photo-documentation of Institute of Archaeology Belgrade

pinkish colour. (Wiseman, Zisi 2014: 185)

Based on the amount and the form of the brick admixtures in decorative mortar layers (in arriccio and intonaco), the fragments from the Viminacium thermae can be divided into four groups. (Table 1 and Table 2) Brick was here mostly used as a dust, but also in the form of smaller fragments. The largest number of fragments belongs to the third group.

First group. The first mortar group, which includes fragments in which only the intonaco contained brick dust can most likely be ascribed to mortars for internal decorative plastering, for colouring and painting walls in rooms in which humidity was more or less concentrated, but not in rooms with water present in larger amounts. The role of this kind of mortar was to secure rooms and walls from humidity penetration. With mortars in this group, it can be noticed that the arriccio or intonaco were rather thick.

With some mortars, without a painted layer, the reddish intonaco layers with brick dust are visible. Here, the intonaco colour serves a decorative purpose. There are also mortars with a "reddish intonaco"[15] painted red and additionally polished, with the aggregate of these mortars having been finely sieved.

Second group. The second mortar group includes fragments in which only the arriccio contains brick powder, probably used as decorative mortars on walls of rooms in which there was no permanent presence of humidity or water. The presence of brick in the arriccio is explained with the risk of possible humidity and water penetration into the wall from the background, as in the case of walls built without bricks and where there is no mortar layer with brick content. (Wiseman, Zisi 2014: 167) These fragments can therefore be ascribed to the inner surfaces of outer walls or the opposite sides of walls that possessed one side exposed to the aforementioned agents.

Third group. The third mortar group, with dust or fragments in both layers, includes mortars used as painting bases, monochrome or with motifs, and

15 Mortars with aggregates of brick dust.

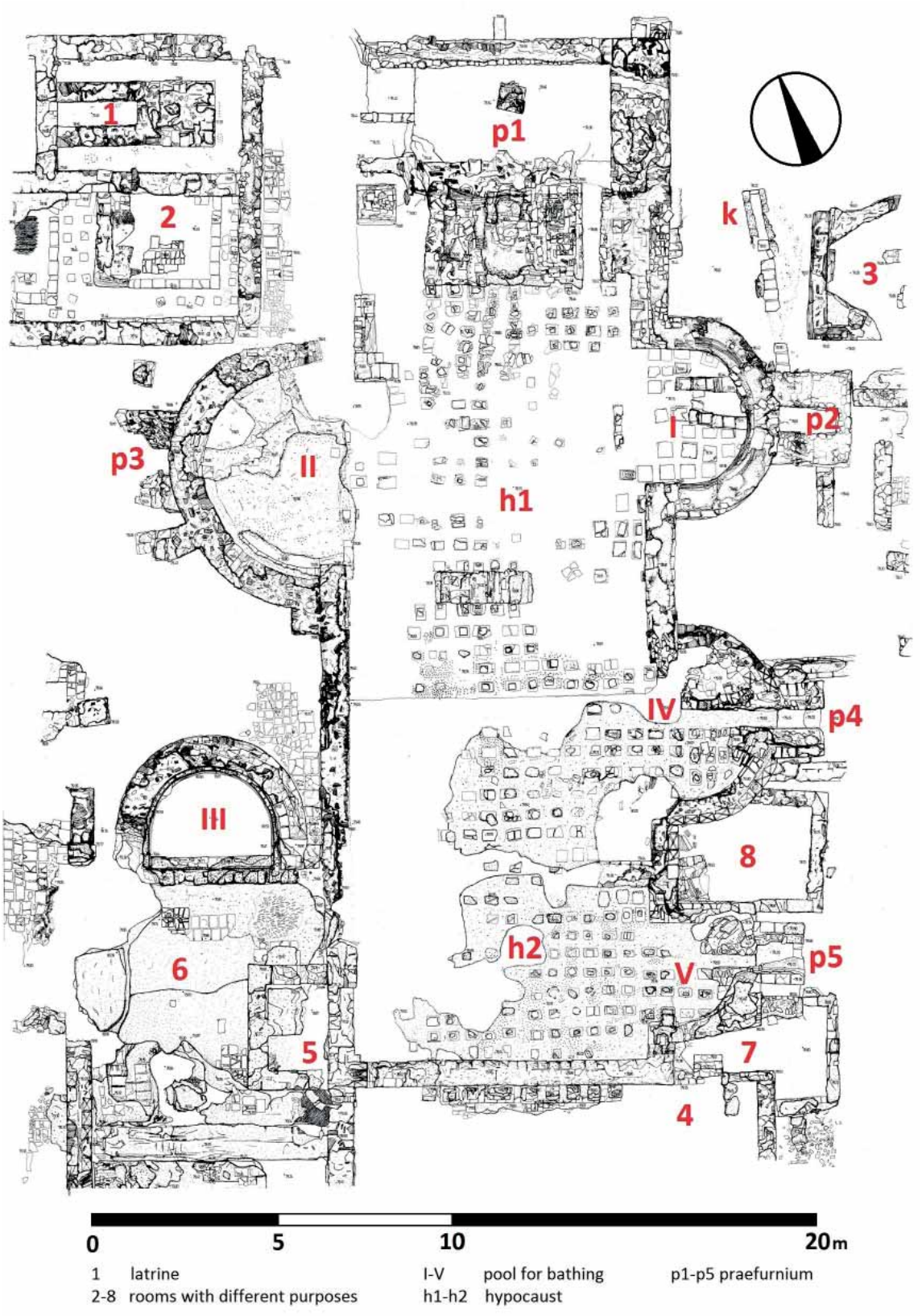

Fig. 17 Layout of Viminacium thermae.
Photo-documentation of Institute of Archaeology Belgrade

as mortars without a painted layer, where the colour was determined by the brick in the intonaco's structure. These mortars were most likely on walls exposed to water, specifically the walls of bathing pools and the outer faces of external building walls.

In this mortar group, pieces can be noticed that possess a thicker intonaco and a thinner arriccio. They most likely represent mortars of reduced quality, indicated by a small fragment compacity and a huge number of pores formed over time.

Fragments containing larger brick pieces in the arriccio were probably used for rendering outer building walls, since brick in this form gives mortar a greater resistance to weather conditions. The thickest arriccio layers contain the largest brick fragments. Examination of Roman mortars from Hadrian's Wall showed that the use of smaller particles of bricks creates strong hydraulic mortars, since such particles possess high pozzolanic features, while larger particles act more as a porous addition absorbing air into the mortar, therefore making it more resistant to frost and salt crystallisation. This means that mortars used for external rendering, with the aim of increasing frost resistance, should contain particles of larger dimensions. (Teutonico et al, 1993:41-42)

Fourth group. The fourth mortar group should be considered as mortars used for rendering external building walls, or building facades, with a single, thicker mortar layer and without a painted layer. Due to atmospheric influences, it was necessary for the mortar to contain bricks in its entire structure, here in the form of dust, thus giving hydraulic features, namely endurance and setting in water. Due to the colour of the brick, it possessed a red finish, hence considered a decorative mortar.

CONCLUSION

In the case of decorative mortars from the Viminacium thermae, brick was mostly used for ensuring resistance and setting mortar under water and in humid conditions, in contrast to the use of brick in structural mortars, where it was used mostly to ensure a hydraulicity which would make the mortar stronger. Regarding the mortar fragments discussed in this paper, it is clear that the artists involved in the painting of the thermae were well-acquainted with the purpose of brick in mortar and applied it properly, whilst sometimes using mortars of reduced quality, leaving them porous and less compact.

Preserved fragments of the thermae wall paintings were not only numerous and various, but also spread throughout the building. Although they alone can not offer any data about the decoration of the Viminacium thermae, a huge difference in technology and painting quality can be noticed. There are red polished surfaces, reddish unpolished surfaces without a painted layer, dark blue and dark purple painted polished surfaces with decoration, as well as white intonaco backgrounds without a painted layer, with or without decoration on them. It seems that a huge number of the thermae walls were reddish in colour, originating from the intonaco with brick admixture and no painted layer.

After analysing the role of brick in the hydraulicity of the Viminacium mortars and its application through the examples of adding it to the decorative mortars of the Viminacium thermae, this paper tends to show that many conclusions regarding a historic building can be drawn directly from the analysis of the building materials. The function of rooms and the role of the construction elements of a building depended very much on the materials applied and vice versa. Examining a building is therefore not to be separated from becoming acquainted with the materials and technologies used for their processing and application both during the building process itself, and after.

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ACKNOWLEDGEMENTS

Authors of the paper thank Dr Angelina Raičković Savić for permission to use laboratory results from her unpublished PhD thesis (Raičković, A. 2012) during the research for this paper.

REZIME
ULOGA OPEKE U HIDRAULIČNOSTI MALTERA VIMINACIJUMA: DEKORATIVNI MALTERI GRAĐEVINE TERMI

KLJUČNE REČI: HIDRAULIČNOST, KREČNI MALTER, OPEKA, PUCOLANSKO SVOJSTVO, DEKORATIVNI MALTERI, TERME, VIMINACIJUM.

Viminacijumske terme su, s obzirom na veliku koncentraciju vlage u vazduhu, česte izmene temperature i prisustvo većih količina vode u pojedinim prostorijama, analizirane kroz upotrebu krečnih maltera sa dodatkom opeke. Oni su korišćeni za malterisanje i dekoraciju zidova, a opeci su dugovali postojanost u vlazi i vodi, odnosno hidrauličnost.

Prisustvo opeke u dekorativnim malterima se potvrđuje vizuelnim pregledom preseka maltera kada je opeka korišćena u fragmentima, ali i naslućuje kod crvene boje pojedinih slojeva koja verovatno potiče od prisustva mlevene opeke.

Prema količini i obliku opeke prisutne u ariču i intonaku, dekorativne maltere građevine termi možemo podeliti u četiri grupe. Prvu grupu bi činili malteri gde je prisustvo opeke zabeleženo u intonaku, druga grupa obuhvata one fragmente gde se opeka nalazi u sastavu ariča, u treću grupu spadaju malteri gde oba malterna sloja sadrže opeku, a četvrta grupa predstavlja maltere izvedene u jednom sloju sa agregatom od opeke.

Analiza fragmenata dekorativnog slikarstva termi Viminacijuma navodi na zaključak da veliki broj zidova termi nije bio obojen, već da je svoju crvenkastu boju dugovao prisustvu opeke u intonaku. Ovde se vidi kako su Rimljani Viminacijuma uspešno primenili pravilo rimske arhitekture o upotrebi lokalnih materijala. Osim što je bila nosilac hidrauličnosti i vodonepropusnosti kod maltera za zidanje i malterisanje, opeka je kod dekorativnih maltera termi Viminacijuma bila i deo podloge, kao što im je davala boju i teksturu, odnosno njegov konačni izgled.

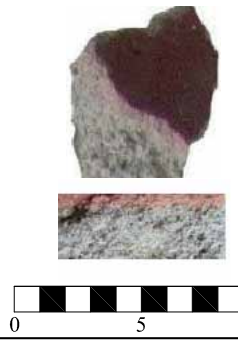
	PHOTO		ARRICIO + INTONACO		PAINTED LAYER	ROOM
GROUP 1		THICKNESS	1.0cm + 1.0cm		fresco	space between II and III
		COLOUR	white	pinkish	red to orange	
		COMPOSITION	marble dust and slaked lime	brick dust and slaked lime	painted surface with no motifs	
		CONDITION	middle compactness high porosity dry vegetable fibres	middle compactness high porosity	not polished	
		THICKNESS	3.0cm + 0.5cm		fresco	1
		COLOUR	grey	reddish	red	
		COMPOSITION	quartz dust and slaked lime	brick dust and slaked lime	painted surface with no motifs	
		CONDITION	middle compactness high porosity	middle compactness high porosity	polished	
	PHOTO		ARRICIO + INTONACO		PAINTED LAYER	ROOM
GROUP 3		THICKNESS	1.6cm + 0.4cm		fresco	I
		COLOUR	reddish	reddish	red	
		COMPOSITION	brick dust, brick coarse (max 1cm) and slaked lime	brick dust and slaked lime	painted surface with no motifs	
		CONDITION	low compactness high porosity	middle compactness high porosity	polished	
		THICKNESS	3cm + 0.2-0.3cm		fresco	I
		COLOUR	white	pinkish	red to orange	
		COMPOSITION	brick coarse and slaked lime	brick dust, brick coarse and slaked lime	painted surface with no motifs (colour of intonaco?)	
		CONDITION	middle compactness middle porosity	middle compactness middle porosity	not polished	

Table 1 Fragments of decorative mortars from the Viminacium thermae divided into groups. Photo-documentation of Institute of Archaeology Belgrade.

	PHOTO		ARRICIO + INTONACO		PAINTED LAYER	ROOM
GROUP 2		THICKNESS	1.0cm +	0.2cm	fresco	1
		COLOUR	red	white	red	
		COMPOSITION	brick dust and slaked lime	sand and slaked lime	not painted surface with linear motifs	
		CONDITION	middle compactness high porosity	middle compactness middle porosity	not polished	
		THICKNESS	0.8 - 1.0cm +	0.3cm	fresco	7
		COLOUR	pinkish	white	red	
		COMPOSITION	brick dust and slaked lime	quartz dust and slaked lime	not painted surface with linear motifs	
		CONDITION	middle compactness high porosity	middle compactness high porosity	not polished	
		THICKNESS	2.7cm +	0.3cm	fresco	7
		COLOUR	pinkish - grey	greyish	red	
		COMPOSITION	brick dust, sand and slaked lime	marble dust and slaked lime	spots (mramorization) with linear red motifs	
		CONDITION	low compactness high porosity dry vegetable fibres	middle compactness middle porosity	not polished	
	PHOTO		ARRICIO + INTONACO		PAINTED LAYER	ROOM
GROUP 4		THICKNESS	0.8-1.0cm		no painted layer	1
		COLOUR	orange		-	
		COMPOSITION	brick dust, brick coarse and slaked lime		-	
		CONDITION	middle compactness high porosity not polished		-	

Table 2 Fragments of decorative mortars from the Viminacium thermae divided into groups. Photo-documentation of Institute of Archaeology Belgrade.

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902.3:621.317.444(497.11)"2013"
COBISS.SR-ID 219287052

Original research article
Received: January 24th 2015
Accepted: November 15th 2015

ADVANTAGES AND DISADVANTAGES OF A PARALLEL AND ZIGZAG METHOD OF ACQUISITION IN WALKING MODE IN MAGNETOMETRIC ARCHAEOLOGICAL RESEARCH

ABSTRACT

The occurrence of anomalies along traverses which are the subject of magnetic surveys in walking mode imposed the need to test different methods of acquisition and processing of magnetic data. For the testing polygon, the field above the previously identified archaeological anomaly in the archaeological site "Kremenite Njive" (Barajevo, Republic of Serbia) was used. An investigative polygon with dimensions of 25 x 25 m was used and the data was acquired using an Overhauser GSM-19GW (GEMLink) gradiometer, with and without the Global Positioning System. To obtain a regular data grid, the sampling was conducted at a 1s interval, and with a distance between the traverses of 1m. The traverses for this process were oriented in a north-south and east-west direction.

The best results or, more accurately, those with the absence of linear anomalies were observed when using the parallel method of acquisition, regardless of how the traverses were oriented compared to the magnetic meridian. This type of acquisition, except for clipping the peak of the gradient of the Earth's magnetic field, does not require additional data filtering. However, to reduce the time needed for field measurements, the zigzag mode is often applied which requires additional data processing such as: adjusting the traverses of the mean or median to a common value, decorrugation or the use of non-linear interpolation. Modern magnetometers (gradiometers) usually have a GPS system whose acquisition error level is significantly higher than that which is desirable in an archaeological survey. Therefore, it is better to use a total station to read the geographic coordinates of the investigation polygon where the magnetic measurements are acquired, rather than GPS which assigns uniformly-arranged coordinates along the x and y axes of the data.

KEYWORDS: MAGNETIC SURVEY, ZIGZAG AND PARALLEL ACQUISITION IN WALKING MODE, LINEAR ANOMALIES, ARCHAEOLOGY.

INTRODUCTION

The differences in the physical properties of the subsurface materials are the basic prerequisite for the application of geophysical methods to be successful.

The use of iron-based materials during human history allows for the successful application of magnetometry, which is now one of the leading choices of geophysical methods for archaeological reconnaissance.

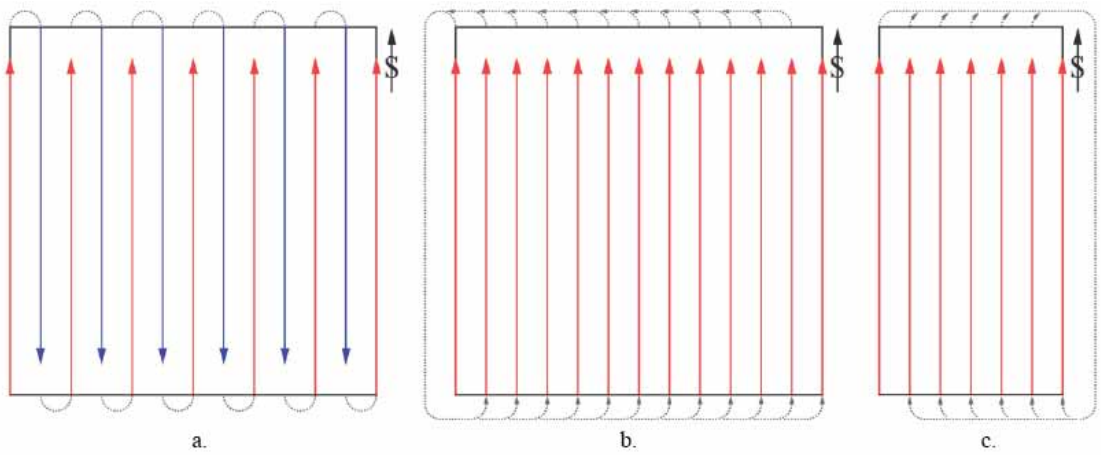

Fig. 1 Illustration of N-S orientation of traverses. Key: a. zigzag fashion; b. parallel fashion; c. mid-field in parallel fashion.

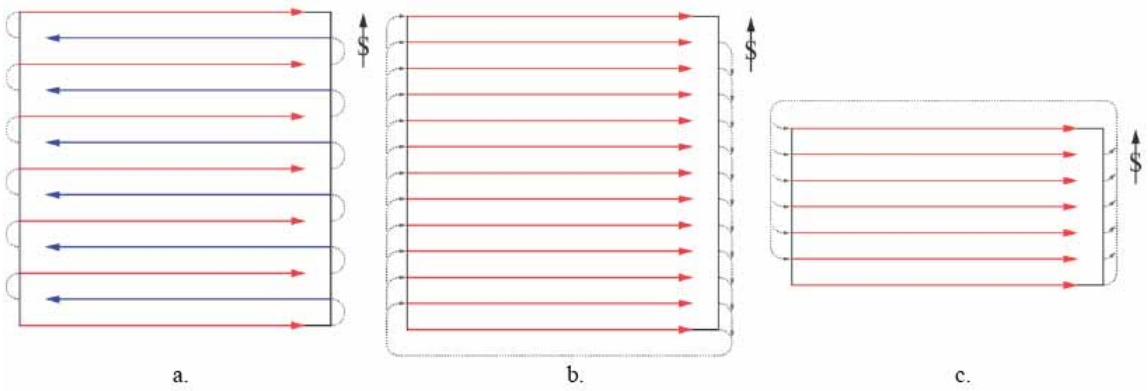

Fig. 2 Illustration of E-W orientation of traverses. Key as for Fig 1.

Besides iron-based materials, it is very important to have the presence of small amounts of magnetic minerals from the iron oxide and iron sulphide groups, either organic or inorganic in origin, which cause a difference in the magnetic susceptibility of archaeological objects and the environment that surrounds them.

The best responses to magnetic data are provided by materials that have been exposed to high temperatures, i.e. those that have acquired thermoremanent magnetisation.

The accuracy of a magnetic survey is directly related to the accuracy of the instruments used, and the development of instruments has kept up with developments in modern physics, resulting in present-day magnetometers that are accurate up to 0.02 nT.

One of the instruments with this degree of accuracy is the Overhauser GSM-19GW magnetometer from the Canadian company GEMLink, with a gradient tolerance up to 10,000 nT/m (Smekalova, Voss and Smekalov 2008).

Besides its high accuracy, an important advantage of this instrument is its ability to measure the gradient of Total Magnetic Intensity (TMI), which is achieved by using two identical probes. By measuring TMI on two coupled probes in the same time interval, allows the avoidance of variations of TMI in the base survey.

Also, another important function of the instrument is the data acquisition walking mode, which is characterised by performing automatic measurements based on a pre-defined time interval.

The time intervals for automatic sampling in

walking mode that the instrument allows are from 0.2 to more than 60s (GSM-19 Instruction Manual 2008).

According to the theory of proton precession on which this instrument is based, the orientation of the probe in non-equatorial areas should not affect the data quality. However, a common occurrence during magnetic surveys is a linear anomaly along the traverses on which the acquisition has been made in the walking mode (McCullough 2007, Burks 2014).

In order to reach a proper conclusion as to what causes linear anomalies and how to avoid them, an investigative polygon with dimensions of 25 x 25 m was formed above the previously identified archaeological anomalies at the archaeological site "Kremenite Njive", near Barajevo, Republic of Serbia (Vasiljevic 2013). Here the data was collected with the gradiometer in walking mode, using several different procedures depending on the orientation of the traverses and a combination of with and without Global Positioning System (GPS).

The sampling time was set to 1 s and the distance between the traverses to 1 m in order to obtain a regular data grid with the same spacing between the points along the x and y directions.

DATA ACQUISITION IN ZIGZAG AND PARALLEL METHOD

Magnetometric data acquisition on traverses is usually performed in a zigzag or parallel fashion (David et al. 2008).

During the acquisitions of the three modes, traverses were oriented along a north-south direction. In the first case, the operator, at the end of the profile, made a semicircle and continued the measurement on the next adjacent profile in a zigzag fashion. Throughout the acquisition, the data was saved in the same file with the included GPS data. With this method of measurement, the adjacent traverses were reverse oriented (Figure 1.a.).

In the second mode of acquisition, the operator, after the completion of measuring each traverse, circumvented the test polygon, and on the next traverse entered on the same side as the previous one, in a parallel fashion. Using this type of acquisition, all profiles were oriented in the same direction (Figure 1.b.).

To accelerate the measurement, in the parallel third mode, it was started from a mid-field point. The operator, after the completion of measuring the traverse, circled around test polygon to the opposite side relative to the second measuring mode (Figure 1.c.).

In all three modes, the measurement was started from the same point, the south-west corner of test polygon.

Figure 1

After the completion of the first three methods of measurement, the same polygon traverses were reoriented by 90°, i.e. in an east-west direction and the next three measurements were performed in the same way as in the first three methods of measuring when the orientation was in a north-south direction (Figure 2). Just as with the north-south orientation, each individual measurement was also saved in the same file with the included GPS.

Figure 2

In the previously described measurements, all the data during the acquisition was stored in the same file, which does not allow for the processing of individual profiles.

To be able to process the individual traverses, the measurements were continued using the principle of "one traverse-one file". The traverses were oriented along a north-south direction and acquisitions conducted using the following three methods.

As with the first measurement, in this case, the data was sampled in a zigzag fashion. However, contrary to the first method, in this case, the data of each profile was stored in a separate file.

The last two methods of measurement were carried out on the eastern half of the polygon with the same orientation of profiles, and all the data

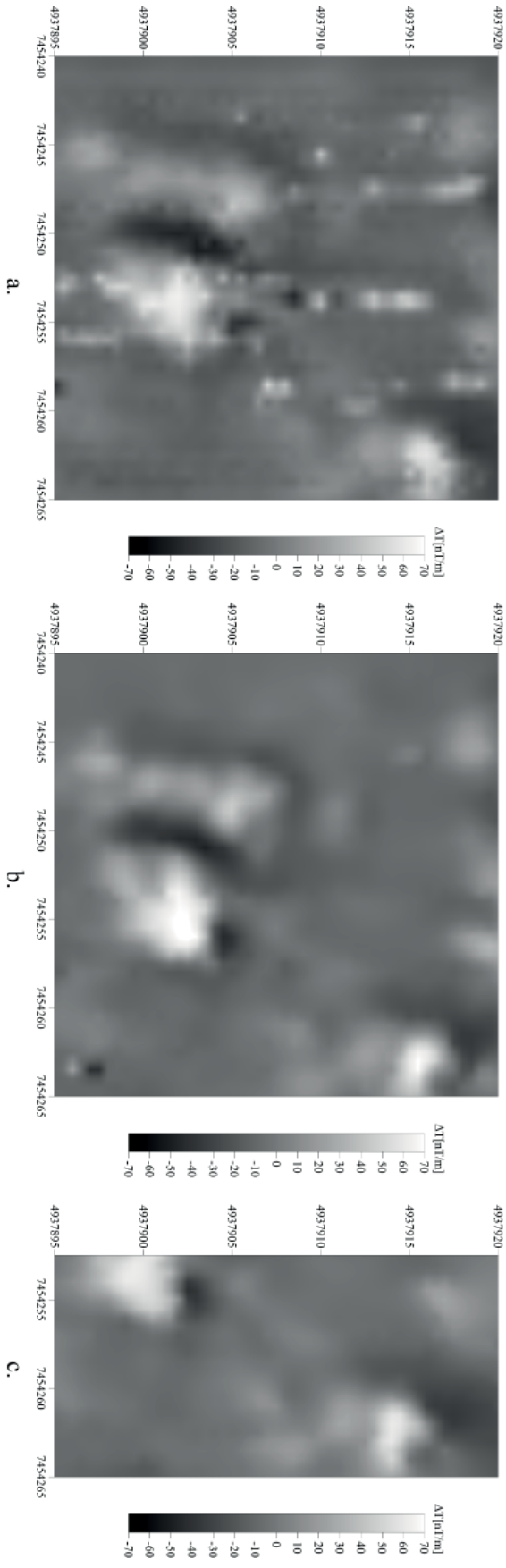

Fig. 3 Contour map of a vertical gradient of TMI in N-S orientation. Key as for Fig 1.

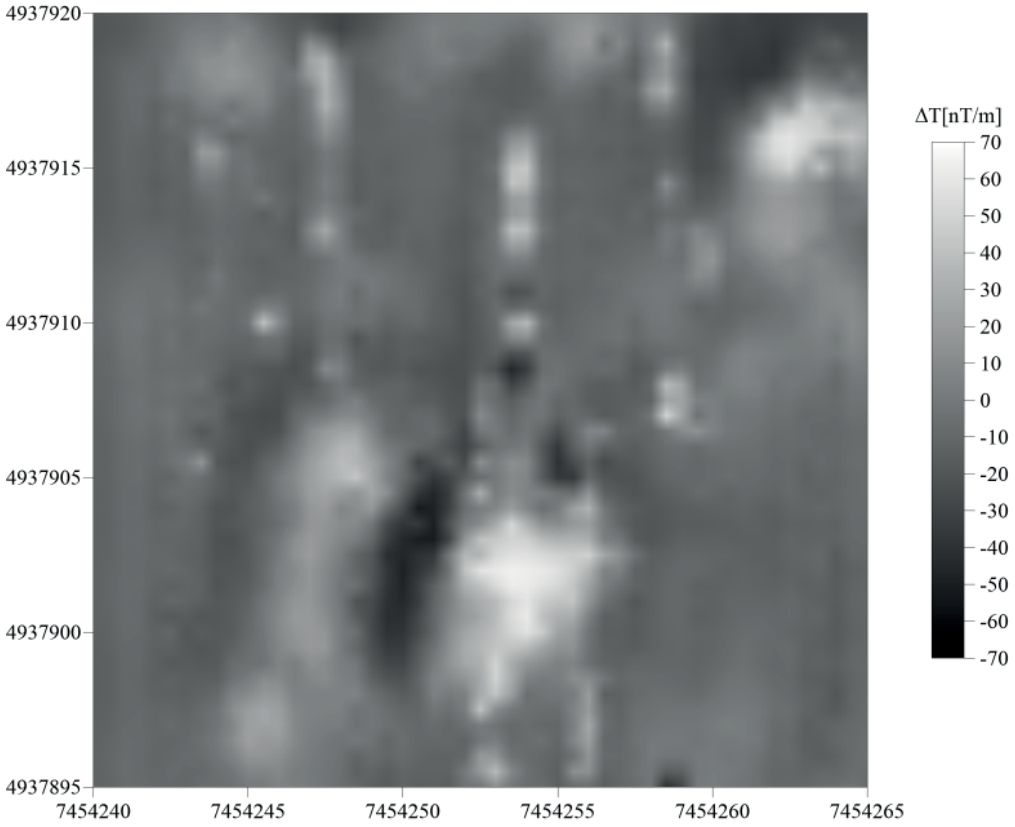

Fig. 3a Contour map of a vertical gradient of TMI in N-S orientation. Key as for Fig 1.

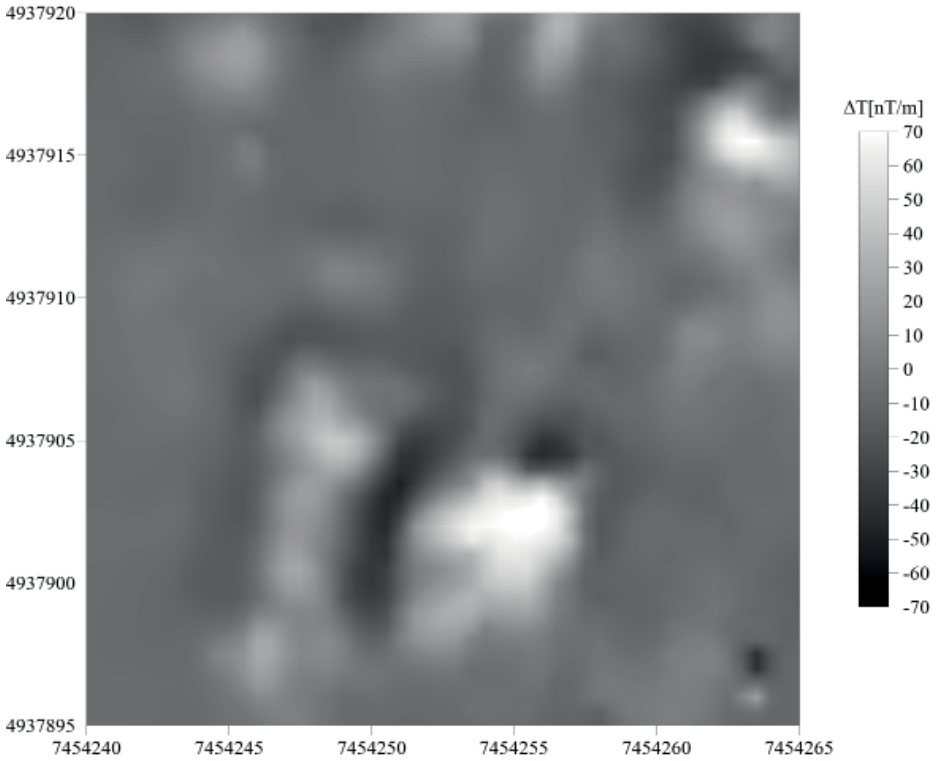

Fig. 3b Contour map of a vertical gradient of TMI in N-S orientation. Key as for Fig 1.

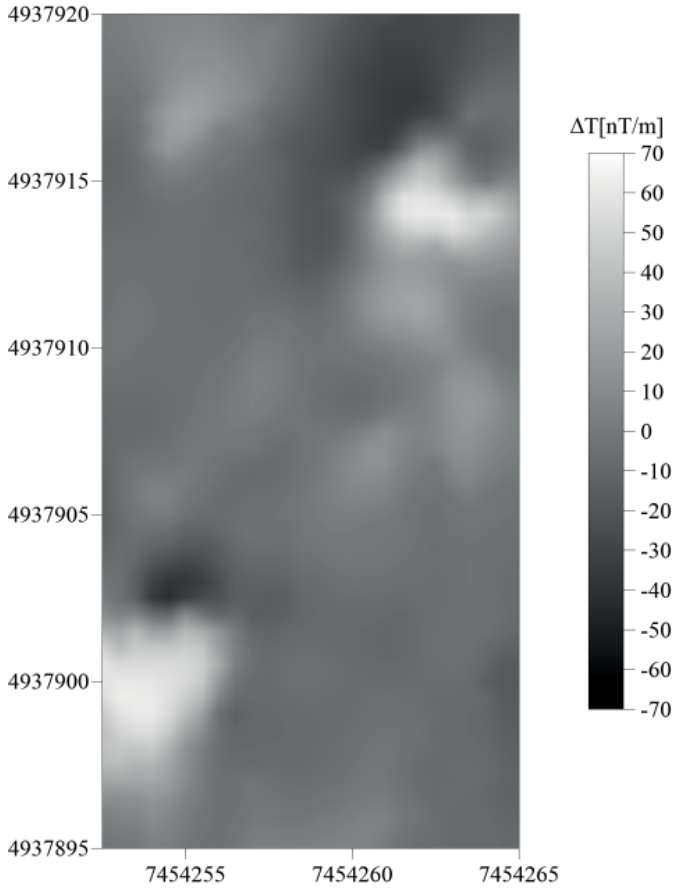

Fig. 3c Contour map of a vertical gradient of TMI in N-S orientation. Key as for Fig 1.

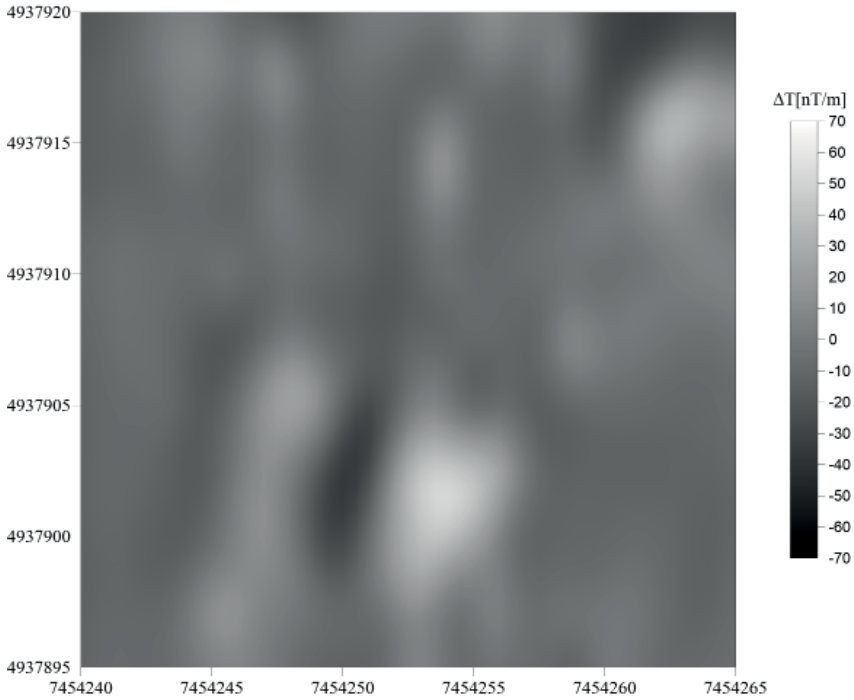

Fig. 4 Vertical gradient of TMI contour map of zigzag fashion in N-S orientation filtered by moving average filter in two directions.

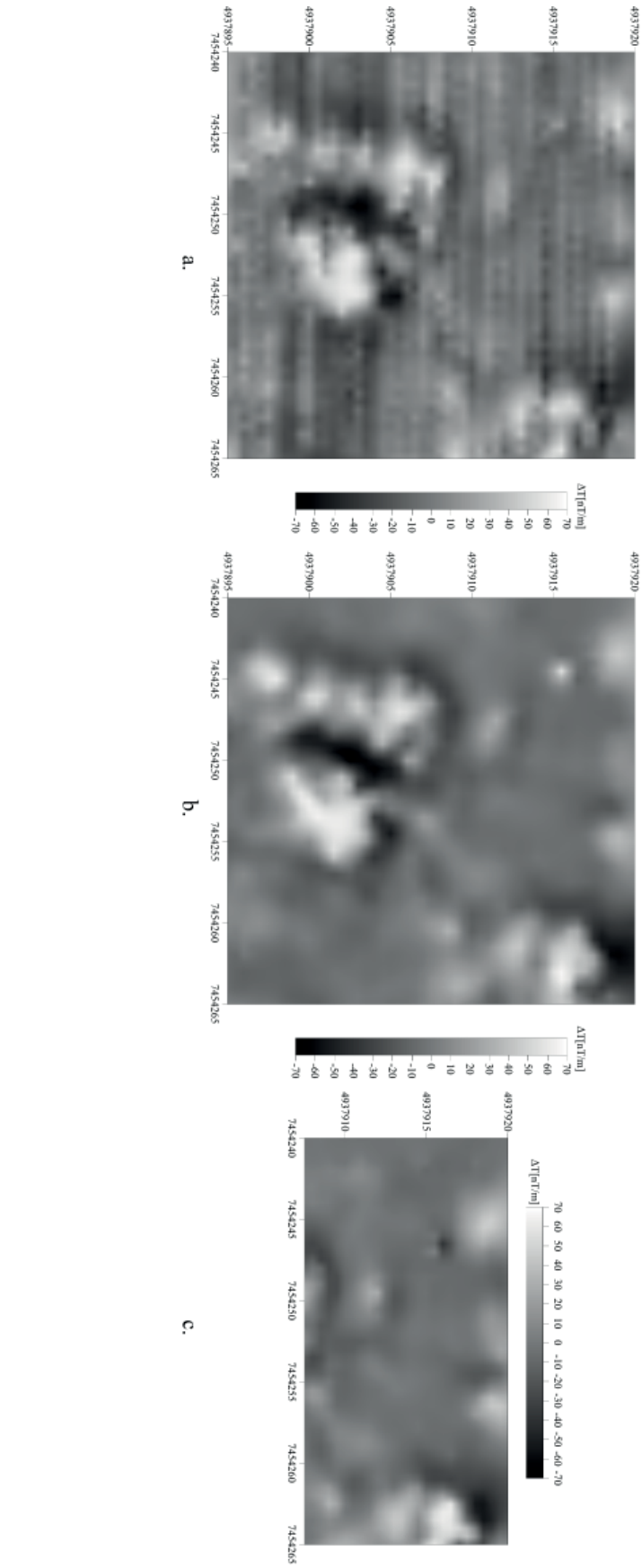

Fig. 5 Contour map of a vertical gradient of TMI in E-W orientation. Key as for Fig 1.

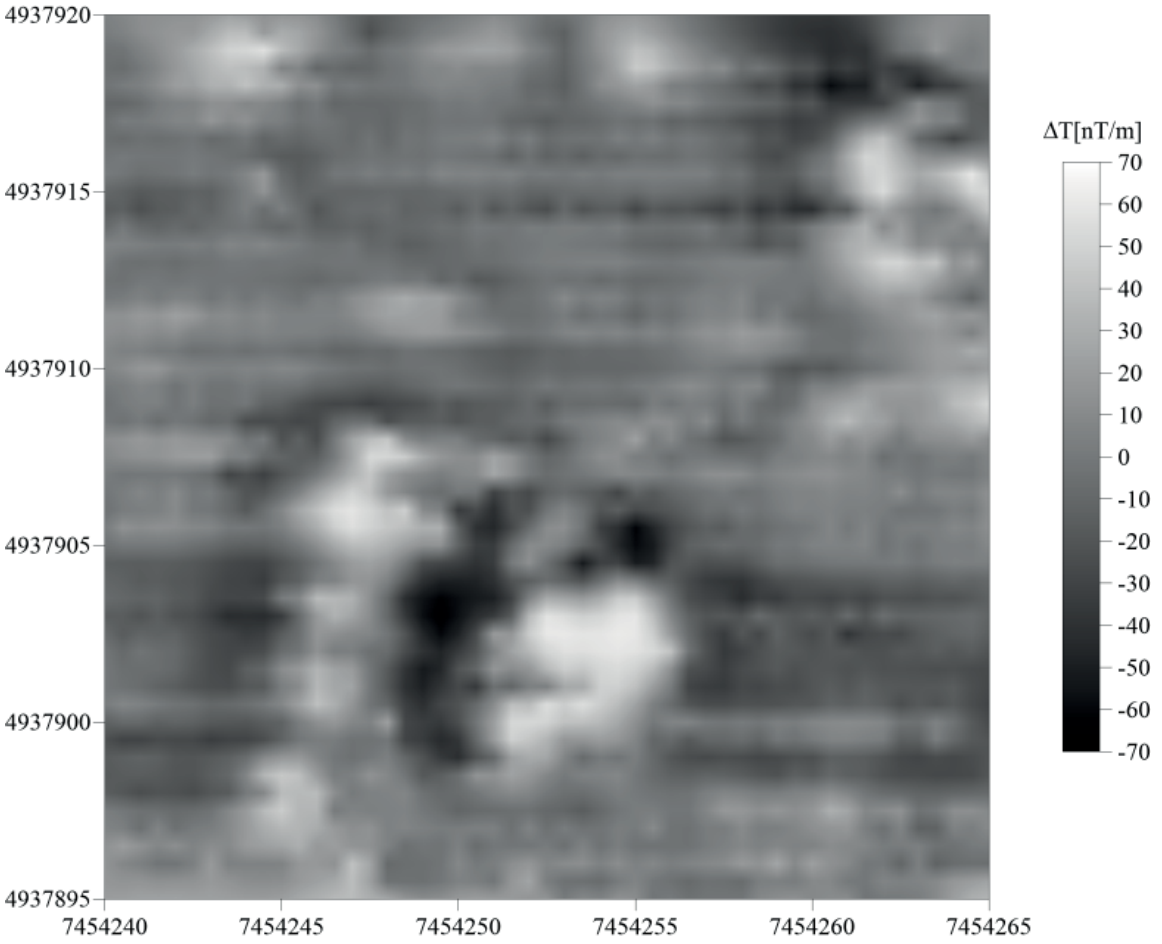

Fig. 5a Contour map of a vertical gradient of TMI in E-W orientation. Key as for Fig 1.

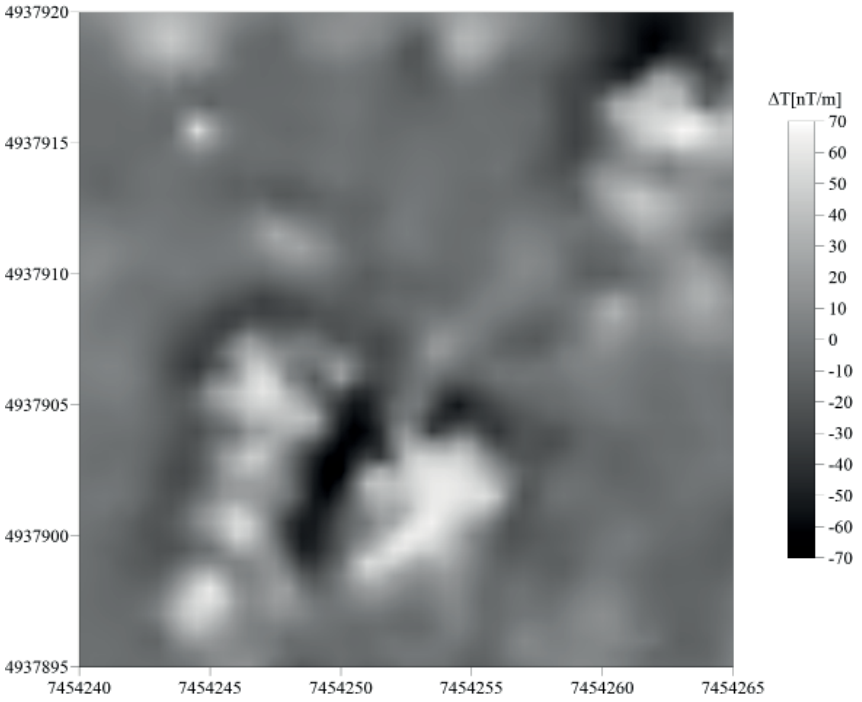

Fig. 5b Contour map of a vertical gradient of TMI in E-W orientation. Key as for Fig 1.

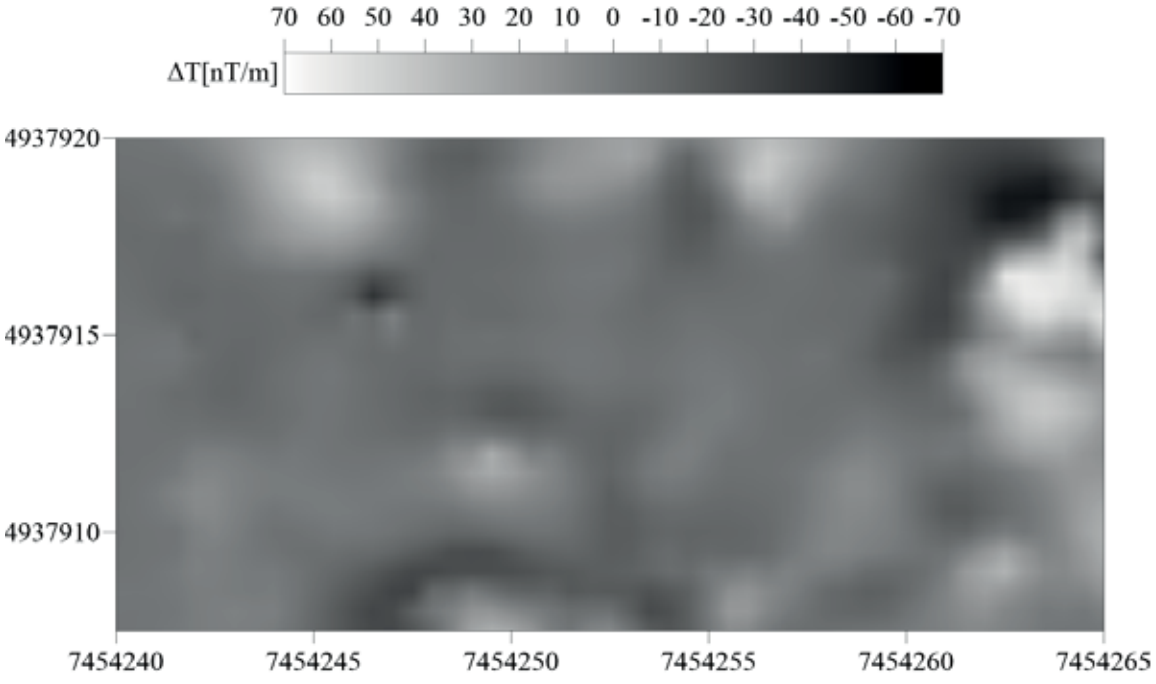

Fig. 5c Contour map of a vertical gradient of TMI in E-W orientation. Key as for Fig 1.

was collected when moving towards the north.

In the first case, the data was stored using 'one traverse - one file', with GPS coordinates, and in the second case it was stored without GPS coordinates.

Before and after the last three measurements, the geographical coordinates of the polygon corner points were taken.

DATA PROCESSING

After the completion of the acquisition, the data was prepared for software processing. In the first three cases, the data which had been acquired outside of the polygons was clipped from the database, and also the data whose value was outside a range of ± 70 nT/m. The data was arranged in a regular grid using Kriging's interpolation method (Isaaks and Srivastava 1989) and presented as a map of a vertical gradient of TMI (Figure 3).

Figure 3

Although the instrument was only worn by one operator, linear anomalies were observed in the direction of acquisitions that blur or fleck other anomolies on the map and can lead to misinterpretation (Figure 3.a.). To eliminate this anomaly, a low-pass linear moving average decorrugation filtering process was applied to the data in two steps (Urquhart, 1988). In the first step, the data was filtered along the direction of the acquisition, and in the second step, the filtered data was filtered again, perpendicular to the direction of the acquisitions (Figure 4.).

Figure 4

What is important to note is that for the filter to be relevant, the data must be equally distributed along the x and y axes. If the data is sampled from an azimuth different from 0°, before applying the filter, the data needs to be rotated to the zero azimuths.

In the parallel acquisition to the north, there was no occurrence of linear anomalies along the direction of acquisitions and on this data, there was no need to apply the decorrugation filter and, after clipping the peaks, the data was ready for qualitative processing (Figure 3.b.).

Half of the field measured by the third method is shown in Figure 3.c. As in the previous measurement methods, there was no occurrence of linear anomalies along the direction of the acquisition.

Comparing Figure 3.b. with Figure 3.c, it can be determined that the data quality does not depend on which side the operator circles around the test polygon. Also, using a combination of the second and third mode of measurements, the time required for the data acquisition could be reduced.

As in the previous measurements, in the following three cases (the fourth, fifth and sixth) in the first step of processing, data outside the test polygon was clipped along with data whose gradient fell outside a range of ± 70 nT/m. The data was gridded using the same interpolation method and displayed as a map of the vertical gradient of TMI (Figure 5.).

Figure 5

In cases where data was sampled in a zigzag fashion, the linear anomalies appeared on the east-west profiles, which blur (fleck) other data, and for that reason it was necessary to apply decorrugation processing, as previously described (Figure 6.).

Figure 6

Comparing filtered and unfiltered data, it can be noticed that linear anomalies were removed from the vertical gradient of TMI map after filtering.

As in the case of orientating profiles in a north-south direction, with data sampled in the same direction, linear anomalies did not appear, so the data was suitable for further qualitative analysis, after having been clipped to the investigative area and the correct domain of gradient TMI.

The mid-field was measured in order to determine the data quality if the operator circumvents

the test polygon on the same side each time, or if he circles around the polygon to the other half of the field from the opposite side. From the analysis of the maps shown in Figures 5.b. and 5.c. it can be concluded that there was no difference in the quality of data.

The acquisition of the last three measurements was carried out using the principle of "one traverse-one file" so that it would be possible to process the data as separate profiles. Also, with this method of measurement, all the data fell within the margins of the test polygon, so the processing step where the data was spatially limited, was omitted.

In the first step of processing, the peaks were clipped, i.e., where the gradient value of the TMI was outside the range of ± 70 nT/m, after which it was interpolated using the Kriging method (Figure 7.a.).

Figure 7

Although it was measured in the same polygon, the anomaly map shown in Figure 7.a is completely flecked.

Figure 7.b. shows the post map of the measured points which, in any case, does not describe the situation in the field This arrangement of the measured points is the result of the error of the GPS, i.e., when starting each new traverse, the GPS re-started its communication with the satellites (OEMV Family Installation and Operation User Manual, 2010). Taking into consideration the time required for the measurement of a traverse, an error of 2m can be regarded as a common error for each traverse. In the case when the distance between two adjacent profiles is 1 m (in archaeology the distance between two adjacent profiles is often less than 1m), this error can result in the complete flecking of the anomalies, such as in this case.

Expecting that the GPS error will lead to such a spatial distribution of the measured points, before and after the completion of the measurements with GPS, the geographic coordinates of the corner points of the investigation polygons were recorded. Taking the average value of the measured coordinates, the data is distributed regularly along the x or the y axis, and the map is shown as a vertical gradient of TMI (Figure 8.).

Figure 8

Linear anomalies along the direction of the acquisition entirely flack the main anomaly and can lead to a completely wrong interpretation (Figure 8.).

Considering that the data was collected using the principle of "one traverse-one file", each profile could be processed separately. The traverses were separated according to the direction of the acquisition, with one group categorised by traverses whose direction of the acquisition was pointed to the north, and the other group with the acquisition to the south. After separating the traverses by the direction of acquisition, the data was interpolated using the linear Kriging method and displayed as a gradient map of TMI, with the direction of the acquisition to the North (Figure 9.a.), and to the South (Figure 9.b.).

Figure 9

Taking into account the intensity of the vertical gradient of the two adjacent traverses, it can be concluded that the linear interpolation method leads to the linear anomalies along the direction of acquisition.

A decorrugation process using a low-pass moving average filter was applied to the data interpolated by the linear Kriging method (Figure 8.), in the direction of acquisition and in the direction perpendicular to the direction of acquisition (Figure 10.a.).

Figure 10

The same data was gridded using a nonlinear local polynomial method, and it was observed that there was an absence of linear anomalies, which supports the hypothesis that the process of linear interpolation causes anomalies along the traverses where the acquisition was performed (Figure 10.b.).

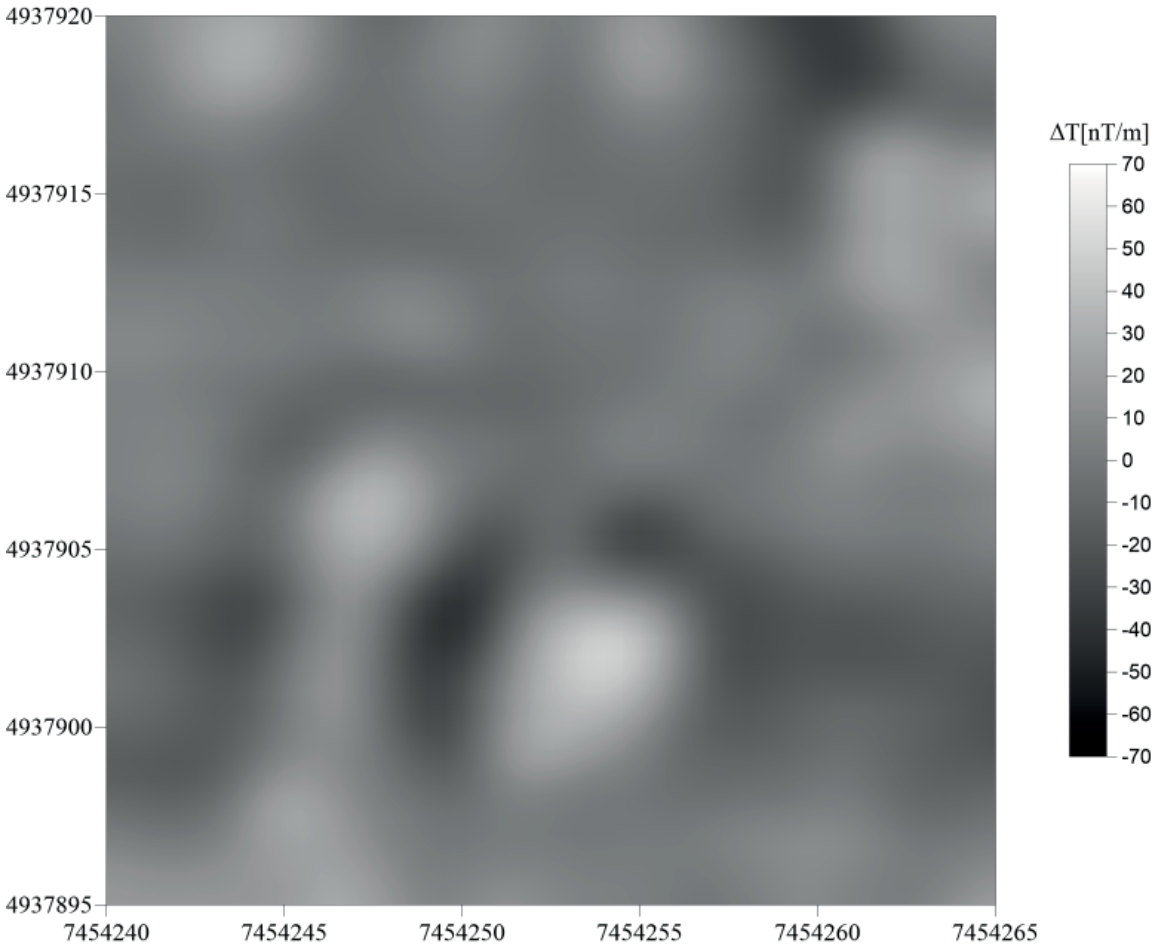

Fig. 6 Contour map of vertical gradient of TMI of zigzag fashion in E-W orientation filtered by moving average filter in two directions.

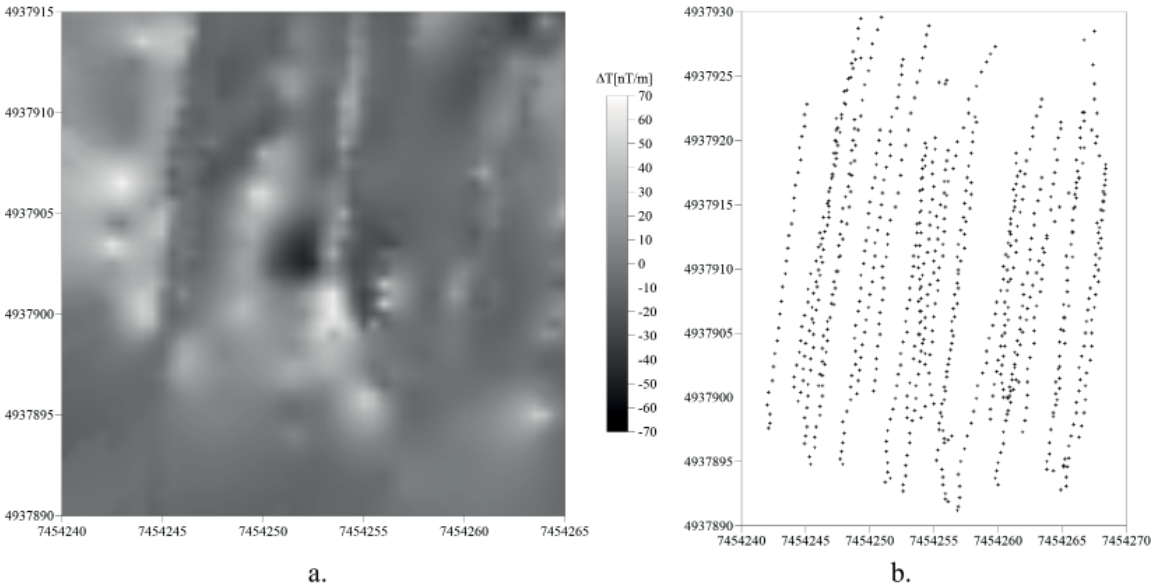

Fig. 7 a. Contour map of vertical gradient of TMI; b. post map of measuring data in zigzag fashion, N-S orientation, where data of each traverse were stored in a separate file.

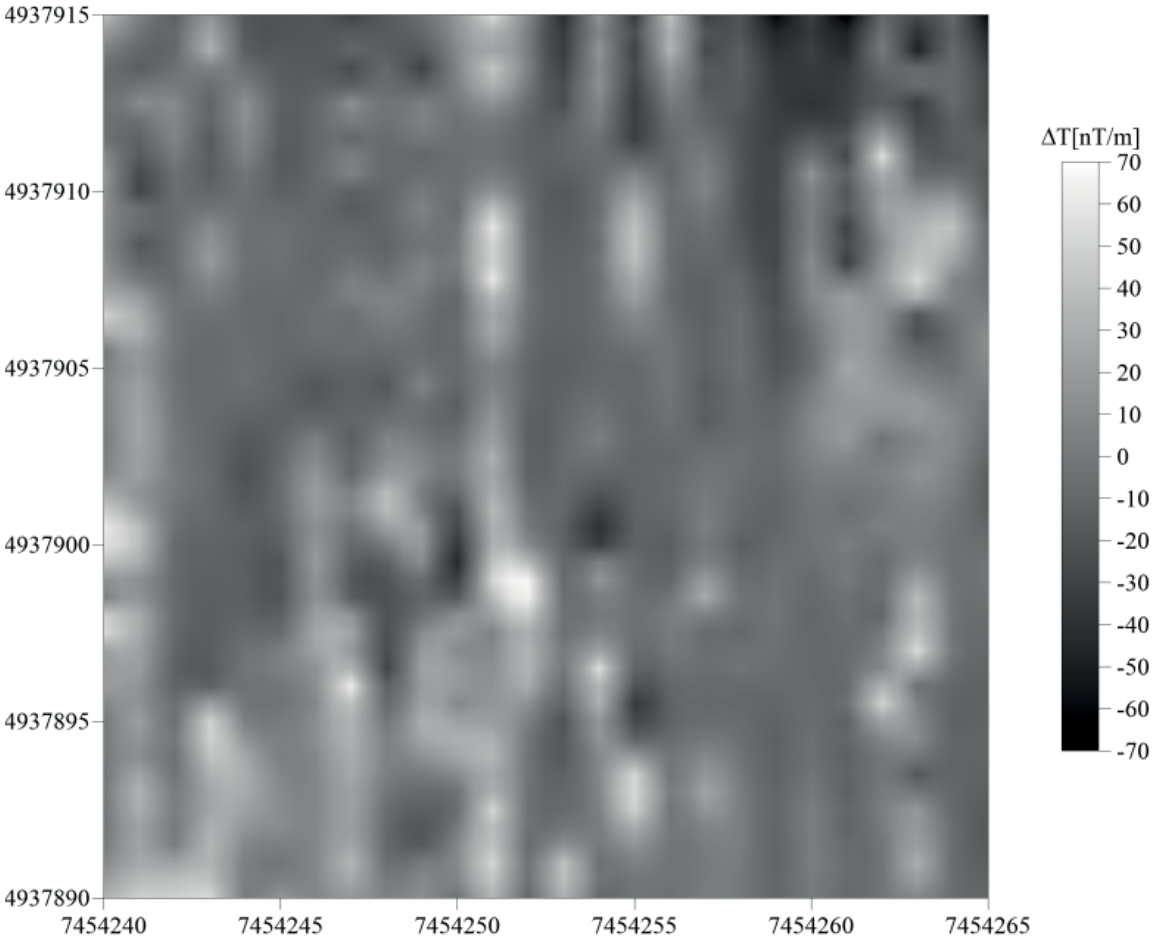

Fig. 8 Contour map shown in Figure 7.a. in relative coordinates.

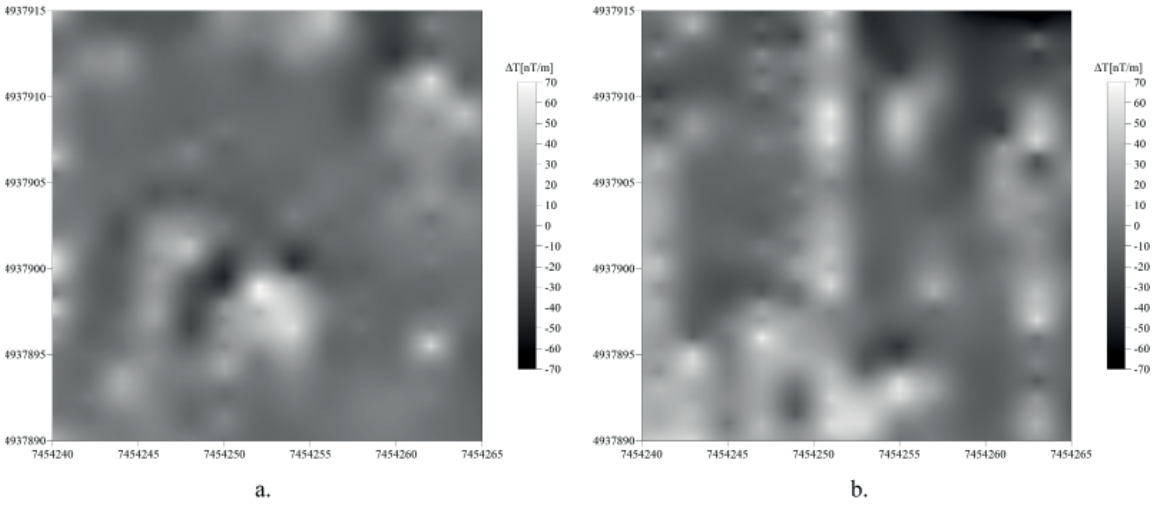

Fig. 9 Contour map of vertical gradient of TMI shown in Figure 8.
separated on the traverse orientation: a. to North; b. to South.

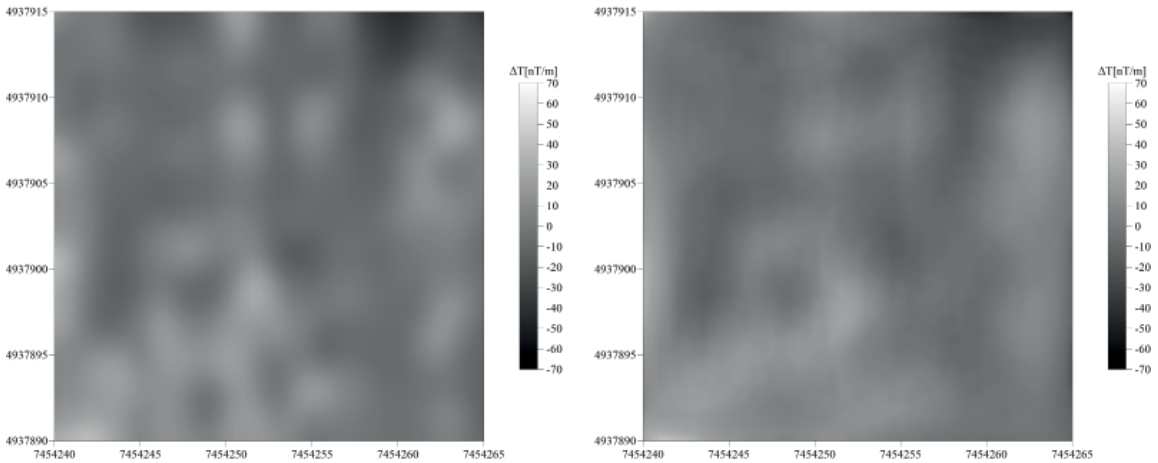

Figure 10. Contour map shown in Figure 8. a. Filtered by moving average filter in two direction; b. interpolated by nonlinear local polynomial method.

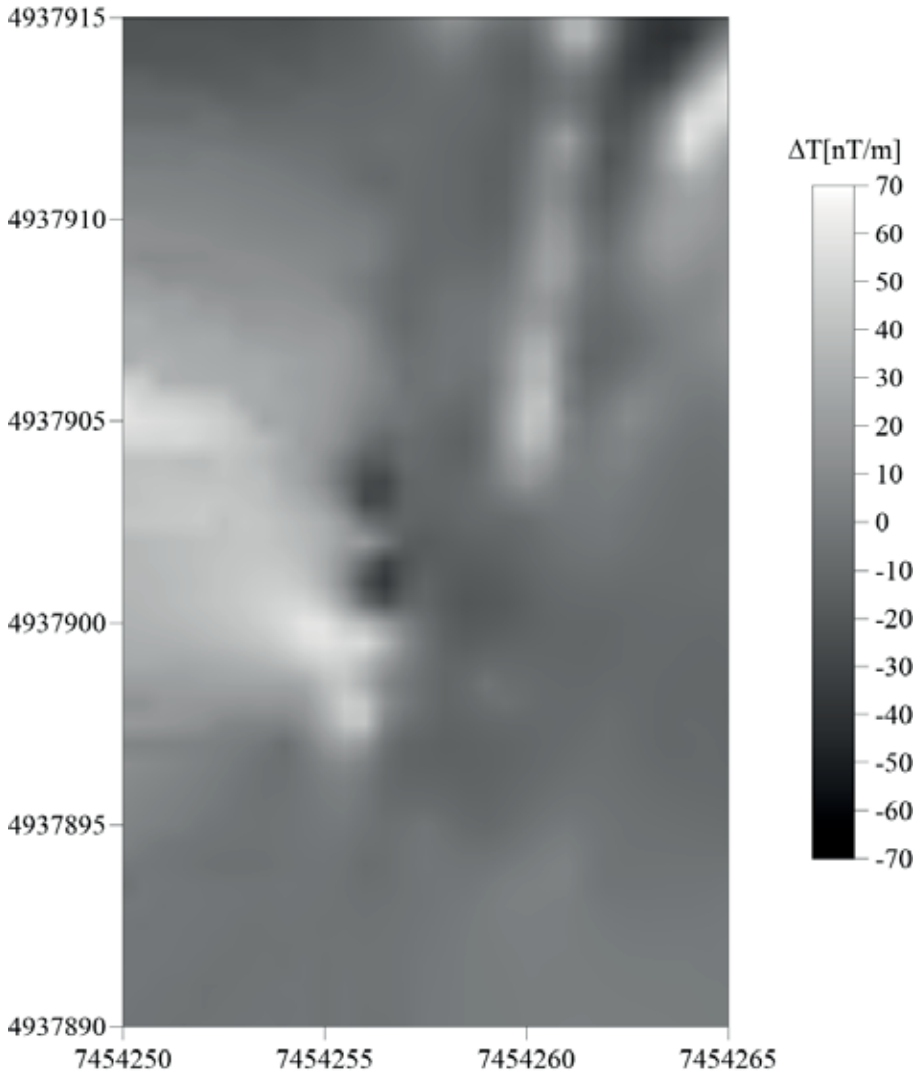

Fig. 11 Contour map of vertical gradient of TMI in last one case with flecked anomaly due to the large error of GPS.

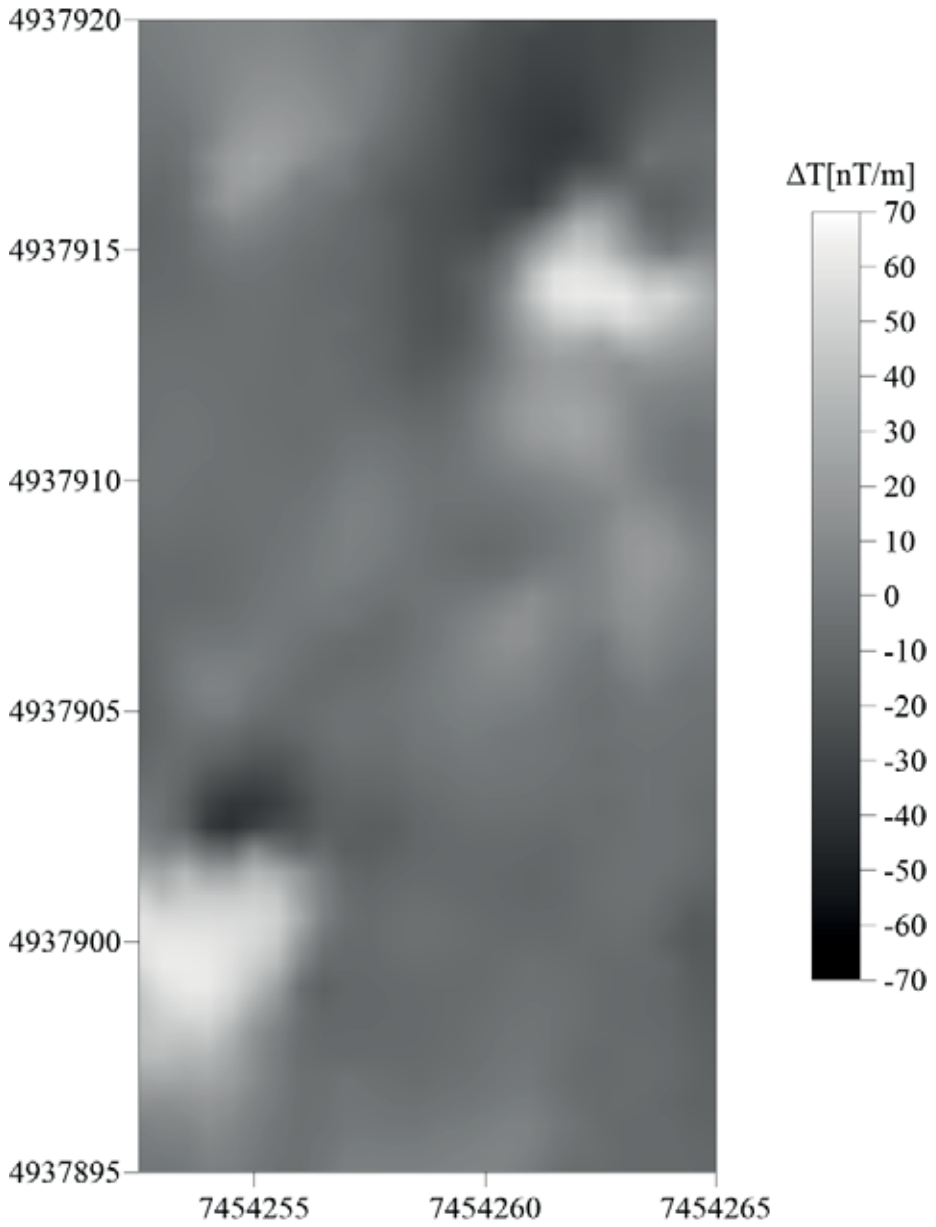

Fig. 12 Contour map of vertical gradient of TMI in last one case with relative coordinates.

The last two measurements were carried out with the intention of displaying the differences in the data processed with GPS and its relative coordinates. However, the same problem occurred as in the previous measurement, such that as a result of the large GPS error and after linear interpolation, the main anomaly was completely flecked (Figure 11.). For this data, instead of GPS coordinates, relative coordinates were assigned along the x and y axes and interpolated using the Kriging interpolation method (Figure 12.).

Figure 11

Considering that the acquisition was carried out from the same mid-field, and in the same direction, it is logical to obtain the same map of the vertical gradient of TMI (Figure 12.).

Figure 12

When a magnetometric survey for archaeology involves high-resolution data and, despite the high accuracy of the instrument, it is desirable to have the polygon coordinates measured using an absolute station. Also, if large areas are to be explored, it is desirable to divide them into a series of smaller exploration polygons with margin lengths not exceeding 25 m.

CONCLUSION

The linear interpolation method is the most common choice of interpolative methods for the processing of magnetometric data for archaeology.

However, linear anomalies often appear along the traverse with interpolation. A common processing method is to adjust the individual traverse to the mean or median value (David and other, 2008). In order to simplify the technique, traverses are usually adjusted to a zero mean or median value. During the processing of data from the "Kremenite Njive" fields, this technique proved to be unsuccessful. The reason is most likely that this technique has a favourable impact on data with a smaller gradient along the traverse. Much better data is obtained using a decorrugation filter, i.e., data filtered by a low-pass linear moving average filter, in two steps, in the direction of acquisition and in the direction perpendicular to the direction of acquisition. Also, the absence of linear anomalies is observed using the non-linear interpolation method. In this case, the local polynomial method proved to be the best.

In order to avoid linear anomalies it is necessary to apply a parallel method of data acquisition in the walking mode. Instead of forming separate files, it is recommended that all data be stored in one. In order to be able to individually process the traverses, and to control the data, it is necessary to separate the files by using a software tool during the acquisitions.

Some companies whose gradiometers are specialised for archaeological research resolve the problem of the zigzag method of acquisition by using the instrument's software. Before the start of the acquisition process, the operator sets the direction and the method of acquisition. The instrument's software then prepares the data collected in the zigzag method for further computer processing, treating them as if they were collected using a parallel method.

Linear anomalies can be avoided by combining two instruments, one measuring the even, and the other the odd traverses in the parallel acquisition method.

Despite the high accuracy that global navigation systems offer, it is advisable to use absolute stations. Current commercial navigation systems do not satisfy the accuracy required by archaeological research. In addition, their accuracy is directly affected by the environment and the weather.

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REZIME

PREDNOSTI I MANE PARALELNOG I CIK-CAK POSTUPKA AKVIZICIJE U HODAJUĆEM MODU PRI MAGNETOMETRIJSIM ISPITIVANJIMA U ARHEOLOGIJI

KLJUČNE REČI: MAGNETOMATRIJSKA ISPITIVANJA, CIK - CAK I PARALELNA AKVIZICIJA U HODAJUĆEM MODU, LINEARNE ANOMALIJE, ARHEOLOGIJA.

Korišćenje materijala izrađenih od gvožđa tokom ljudske istorije omogućilo je uspešnu primenu magnetometrije za arheološko rekognosciranje. Pored gvozdenih materijala, veoma je bitno prisustvo male količine magnetičnih minerala iz grupe gvožđe-oksida i gvožđe-sulfida, organskog ili neorganskog porekla, koji prouzrokuju razliku u magnetskoj susceptibilnosti arheoloških objekata i sredine koja ih okružuje.

Tačnost magnetometrijskih istraživanja je u direktnoj vezi sa tačnošću instrumenata, a jedan od instrumenata sa osjetljivošću od 0,02 nT je magnetometar *Overhauser GSM-19G* kanadske firme *GEM-Link*. Prema teoriji protonske precesije, na čijim je fizičkim osnovama zasnovan ovaj instrument, orijentacija sonde u vanekvatorijalnim područjima ne bi trebalo da utiče na kvalitet podataka. Pri magnetometrijskim merenjima, hodajućim načinom uzorkovanja, uočena je pojava linijskih anomalija duž profila. Da bi se došlo do adekvatnog zaključka šta prouzrokuje ove linijske anomalija i kako ih prevazići, na ranije ispitanom arheološkom lokalitetu Kremenite Njive (u blizini Barajeva, Republika Srbija), formiran je istražni poligon dimenzija 25 x 25 m. Akvizicija je obavljena gradiometrom, hodajućim načinom uzorkovanja, korišćenjem različitih postupaka merenja u zavisnosti od orijentacije profila u odnosu na magnetski meridijan u kombinaciji sa i bez *Global Positioning System*-a (GPS).

Linearni metod interpolacije je najčešći izbor

interpolacije pri obradi magnetometrijskih podataka za potrebe arheologije. Uz ovu interpolaciju često idu i linijske anomalije duž profila. Najčešće se prevazilaze svođenjem pojedinačnih profila na srednju ili medijalnu vrednost. Prilikom obrade podataka sa prostora Kremenite Njive ova tehnika se pokazala kao neuspešna. Mnogo bolji podaci su dobijeni primenom dekorugacije tj. filtriranjem uskopojasnim linearnim filterom *moving average* u pravcu akvizicije i u pravcu upravnom na pravac akvizicije. Uočeno je da se upotrebom nelinearne interpolacije mogu izbeći linijske anomalije duž profila. Na istražnom poligonu najboljim se pokazao *local polynomial* metod intertpolacije.

Ukoliko se žele izbeći linijske anomalije u hodajućem modu akvizicije potrebno je primeniti paralelan postupak akvizicije podataka u hodajućem modu uz korišćenje apsolutne geodetske stanice, jer trenutni komercijalni navigacioni sistemi ne zadovoljavaju tačnost koja je neophodna za arheološka istraživanja.

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904:797.215(38)"-05/-03"
COBISS.SR-ID 219288076

Original research article
Received: September 21st 2015
Accepted: November 15th 2015

DIVING IN ANCIENT GREECE DURING THE LATE ARCHAIC AND CLASSICAL PERIOD (6TH-4TH CENTURY BC)

ABSTRACT

The existence of categories of divers and the anxiety for discovery of an early breathing apparatus suggests that the issue of diving was quite thoughtful in classical times and ancient divers were already acquainted with some form of diving apparatus. But the absences of data make every effort of research difficult. How the ancient divers dived, what was their behaviour during submerged, what kind of equipment was available at their times, and how these were functioned, are matters that are still remaining with no answers until the moment that new data will be emerging.

Diving in classical times is a subject that fascinated researchers and deserves the effort for a further study.

KEYWORD: DIVING, ANCIENT GREECE, LATE ARCHAIC PERIOD, CLASSICAL PERIOD.

The words «*κατάδυση*» (katádysi = diving) and «*δύτης*» (dýtis = diver) derive from the ancient Greek verb «*δύω*» (dýo) which occurs from the Homeric epics, while the term «*δύτης*» (= diver) appears subsequently. Since then, various names were created for those engaged in diving, depending on the skills they had or the diving depths they were approaching. Concluding from their names, «*κολυμβητές ὕφαλοι*» (kolymvitésýfaloi), or «*κολυμβητές ὕφυδροι*» (kolymvités ýfidroi), «*βύθιοι*» (výthioi), and «*ὑπονηχόμενοι*» (yponyhomenoi) (Pollux 2004: A97-98) Hesychius of Alexandria 1979, it is almost certain that these divers were acting below sea surface «*ὑπὸ τῆς ἁλός*». The two first terms include the word «*κολυμβητές»,* which correspondes to 'swimmers', but with the addition of the second word «*ὕφαλοι»* or «*ὕφυδροι»* express the meaning that there are able to dive. In iconography its hard to distinguish if a swimmer just swims or if he is about to dive. For example, on the famous attic vase of 570 BC, painted by Kleitias, (Fig. 1) we can see, among others, details of Theseus Cretan adventure. On that detail, Theseus's ship is depicted on the shore while a person is swimming beside the ship. Considering that most of young people had already disembark, why this man is swimming? Is it an artistic effort of showing that this man accompanied the ship by this action? More acceptable, in my opinion, is that he is swimming up to the point that he will deside to dive in order to arrange the mooring. It is widely known that a large proportion of divers were fishermen (Ioannidou 2014). They fished shellfishes, sponges, corals etc. usually using strong nets such as «*γαγγάμη*» (gangámi) or «*γάγγαμον*» (gángamon) (Pollux 2004: 97-98; Hesychius of Alexan-

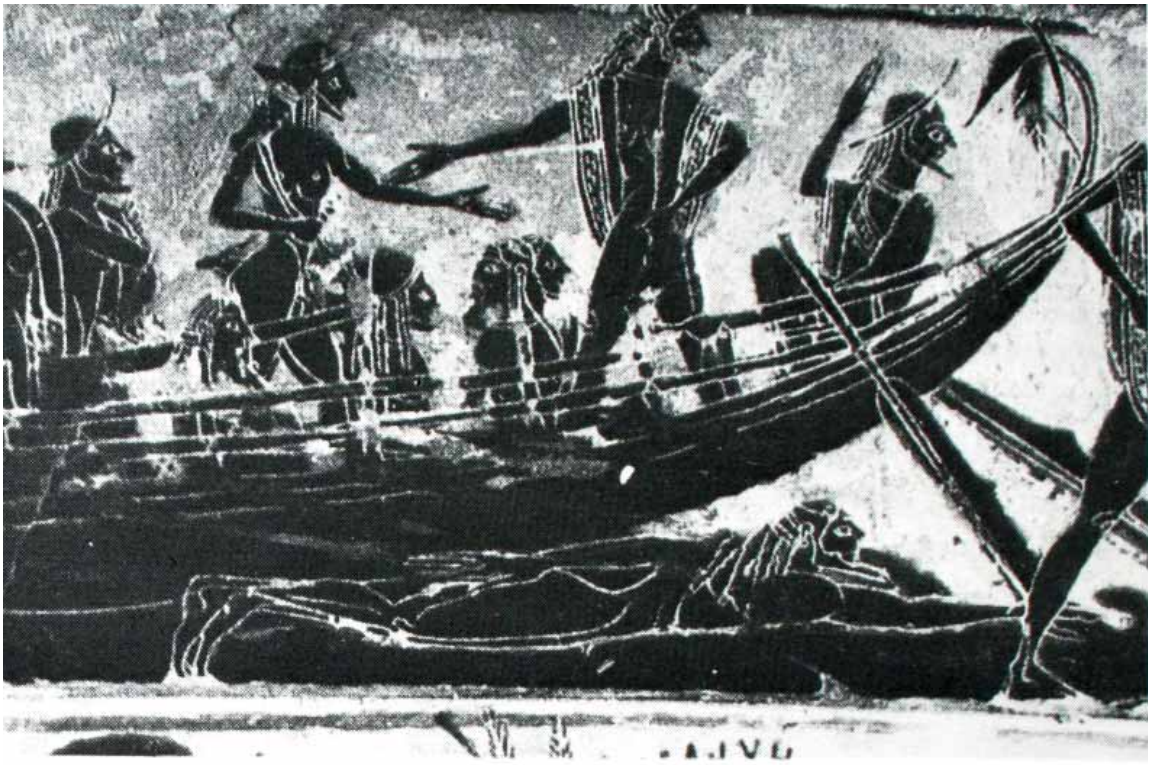

Fig. 1a Athenian attic crater, the so-called 'Vase Françoise' 570 BC. (Museo Archeologico, Florance, no 4209. Photo from Basch, L., Le muse imaginaire de la marine antique, Athens 1987, 205).

dria; Ioannidou 2014). But besides divers-fishermen and sponge divers, there were also those who were exclusively occupied in the shipping sector. They were checking seabed and hull's condition, mooring etc. Perhaps the swimmer on kletias vase is a diver of this category.

Another category, the «*ἐπιπολάζοντες*» (epipolázontes) (Pollux 2004: 97-98; Hesychius of Alexandria; Ioannidou 2014), were actually swimming or keeping position closer to the surface, possibly looking deep down in order to observe the seabed.

Last but not least, «*ἀρνευτήρες*» (arneftíres) (Hesychius of Alexandria; Ioannidou 2014) were those who went head first into water from a high point like the modern divers from diving board. This term exists from Homeric epics and a wonderful depiction of such '*arneftír'* diver is dating from about 470 B.C., founded at the frescoes of the Tomba del Tuffatore (Tomb of the Diver) at Paestum (Fig. 2). In ancient texts, we meet another category too. These divers are conciderated, by a modern meaning, as the first underwater demolition teams which aimed at underwater tasks in order to sabotage enemy ships.

First documented information we derive from the 5th century BC. concerning the famous diver *Scyllis* or *Scyllías* from Skioni of Macedonia. *Scyllías*, while serving in the fleet of Xerxes, escaped and swam covering a distance of 80 stadia, with emergence and diving, to get to Artemisio and denounce to Greeks the intentions of Xerxes. He also dove through the Persian anchorage and cut all of the enemy's ship's mooring lines (Herodotus, 1975: 8, 8). According to Pliny (Pliny. Natural History, 35.139), the Roman painter Androbius had paint Scyllias cutting King Xerxes's rope anchors:

[Androbius painted a Scyllus Cutting the Anchorropes of the Persian Fleet]

«Androbius pinxit Scyllum, ancoras praecidentem Persicae classis».

During siege of Spartan Guard at Sfakteria by Athenian Forces (424 BC), divers «*κολυμβητές*

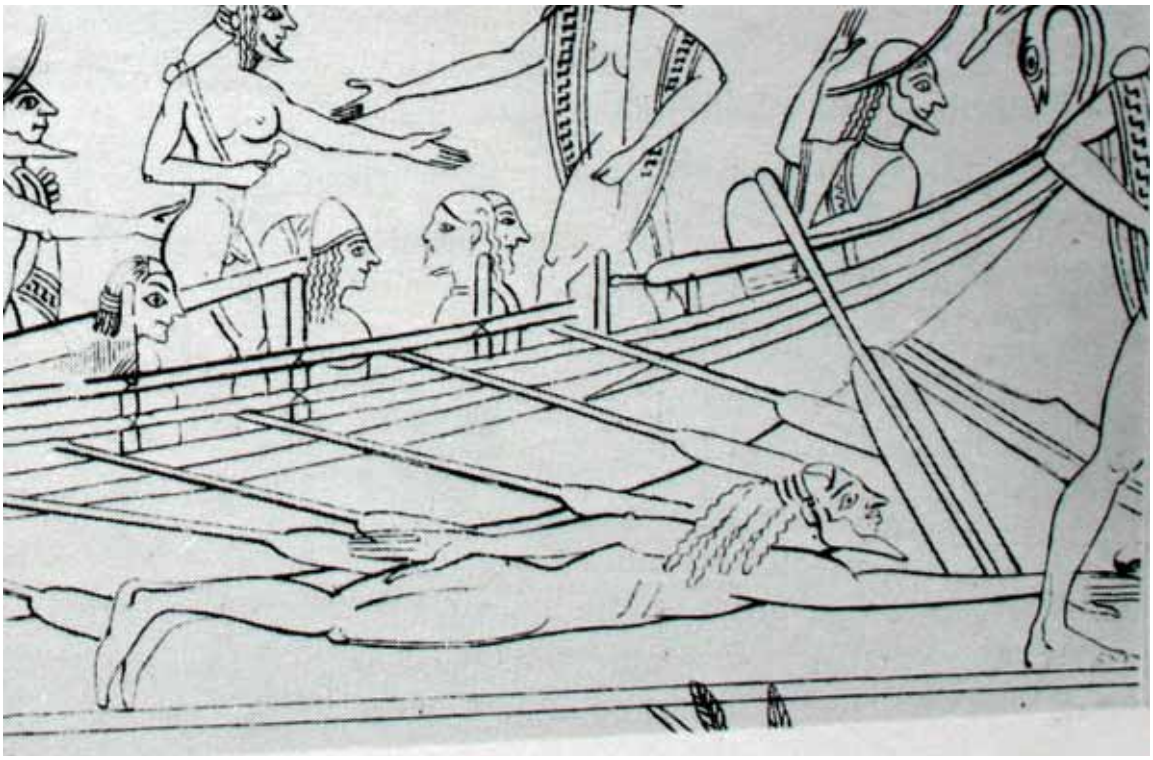

Fig. 1b Design by Minto 1960. Photo from Basch, L., Le muse imaginaire de la marine antique, Athens 1987, 205).

ὕφυδροι» were transport food below the sea (Thucydides, 2001: 4, 26).

During the Athenian expedition in Sicily (415-413 BC), Syracusians divers placed piles under the sea surface to cause damage to ships of the Athenian fleet. As we learn from Thuycidides, Athenians confronted this by using divers who cut up the piles with saws. Strange though it may appear, these divers were professionals and worked on this mission as salaried employees.

[…Even these were sawn off by men who dived for hire]

«*…ἀλλὰ καὶ τούτους κολυμβηταὶ δυόμενοι ἐξέπριον μισθοῦ*» (Thucydides, 2001: 7, 25).

Other demolition teams encounter during the Siege of Tyre by Alexander The Great (334 BC)

[... Divers plunging in cut the cables]

«…ὕφαλοι κολυμβηταὶ τὰς σχοίνους αυτοίς υπέτεμνον» (Arrian, 2004: 2, 21).

The following evidence from 510 BC it may offers a characteristical example of the above mentioned. On a black-figured oinochoe from Attica (Fig. 3), we can see a ship and three men inside it. The type of the ship appears as a warship while these three men depicted with no symmetrical forms, according to the dimensions of the vessel. Such disharmony of these large enough figures could be interpreted as the effort of the artist to give emphasis to these men and their task. We cannot consider them as fighting warriors as they depicted naked without helmets, shields or any weapons. Neither as fishermen. No fishing items are depicted from the artist. If he really wanted to draw a fishing activity he will used, among others, the appropriated items and, mainly, a fishing vessel.

The first young man standing on ship's ram, shows that he is ready to make a movement while the third one, who seams elder, is making a gesture. Giving his blessing, advice or an information, it is hard to distinguish. If the first man wanted just to disembark, action that surely not take place from the ram, why is he naked? It is quite obvious that these men are divers and the first one is about to dive from the lower level of the ship.

Fig. 2 Depiction of 'arneftír' diver, 470 B.C. Frescoes of the Tomba del Tuffatore (Tomb of the Diver) at Paestum. Photo by Michael Johanning. (https://en.wikipedia.org/wiki/Tomb_of_the_Diver

However, questions arise regarding the second young man. What is he holding? Could it be spear, pole, boathook or tube?

According to my opinion they are divers who are occupied in the shipping sector or they could belong to a part of underwater demolition team. In any case they seem that they about to start an underwater task. Could that task be an examination/ preparation for putting piles, enemy's observation as well as to transfer information.

ABOUT DIVING EQUIPMENT

The diving equipment of the ancient Greeks was still at the experimental stage. Each diver, depending on the type of diving he choosed, would care to study his needs and to search for additional accessories that would facilitate his task. Tools such as knives, ropes, nets, etc. were stored in a bag or tied in a belt around the waist or hips to allow complete freedom of diver's arms and his movements. It had been mentioned also that they tied sponges round their ears to prevent a violent entering of sea water and damage eardrums (Aristotle, 1995: 33, 962a, 3).

But what the ancient breath-holder diver was really seeking, in order to upgrade his equipment, was an apparatus that would permite him to stay underwater longer. Remaining at the bottom could be done by holding his breath. The breath holding in diver's terminology has been established as "apnea"(Chrisholm, Hug. Apnoea1 1911), a term derived from the ancient Greek word «*ἄπνοια*» which means, however, the lack of wind (windless). Ironically it is not related to human respiratory system. The ancient word corresponding to unintentional / intentional interruption of the respiratory cycle is «*ἀπνευστία*» (*apnefstía*) (Aristotle, 1995: 33, 962a, 5; Stamatakos 1999).

The voluntary *apnefstía* should not exceed an average of 2 to 2.5 minutes. We imagine that these

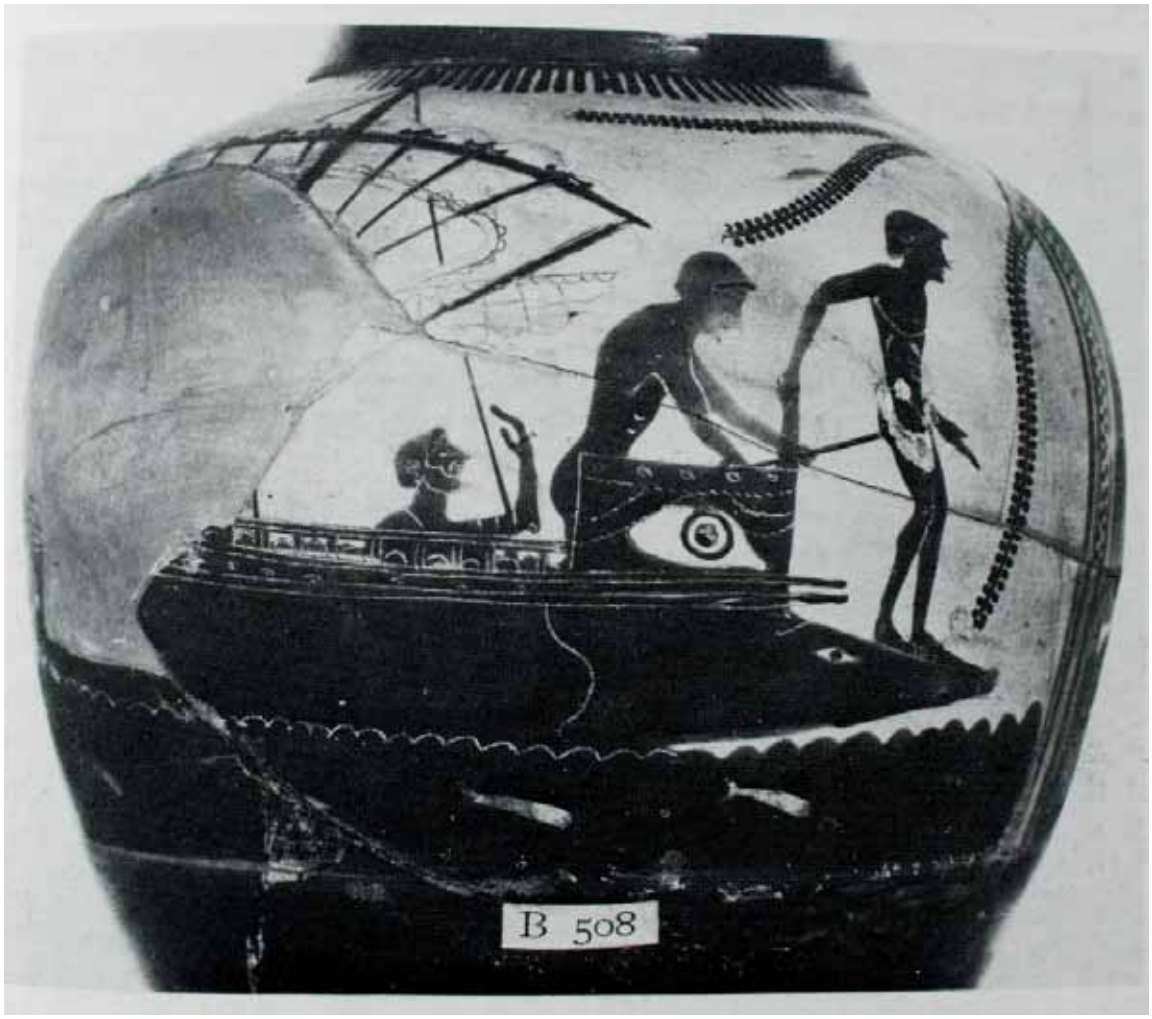

Fig. 3 British Museum, London. Current Collection: B 508. Previous Collection: 1867.5-8.964. Photo from Basch, L., Le muse imaginaire de la marine antique, Athens 1987, 225).

limits roughly maintained since ancient divers. Remarkable is the first record in history where these limits were exceeded. Interstringly enough Greek and Italian press of 1913, describes the strength of Symian sponge diver Γεώργιος Στάθης Χατζής George Stathis Hadjis. He, on July 16, 1913 dived up to 88 m. (according to other sources to 75m.) and remained in the bottom three minutes and 58 seconds in order to pass a loop to the anchor of the Italian battleship «Regina Margherita».[1]

A breathing apparatus, which was invented by its own divers and not by some who have dealt with the science of physics, mentioned by Aristotle:

[just then as divers are sometimes provided with instruments for respiration, though which they can draw air from above the water, and this main remain for a long time under the sea...]

«Οἷον οὖν τοῖς κολυμβηταῖς ἔνιοι πρὸς τὴν ἀναπνοὴν ὄργανα πορίζονται, ἵνα πολὺν χρόνον ἐν τῇ θαλάττῃ μένοντες ἕλκωσιν ἔξωθεν τοῦ ὑγροῦ διὰ τοῦ ὀργάνου τὸν ἀέρα,...» (Ogle, 1912: 2, 16/659a 9).

1 In Italian press the name was written: Georgios Haggi Statti and that caused much confusion at the republications. At Encyclopaedia of Helios (εγκυκλοπαίδεια του Ηλίου), vol 6, [in Greek], it is written wrongly as Georgios Kaggis (Γεώργιος Κάγγης). Newspaper: "The Tribune of Symi" (Συμαϊκό Βήμα), 133, (1974): 5. Unfortunately the same mistake exists in some modern Greek thesis too.

Fig. 4 Lecythos from Attica (480-470 BC). National Museum of Athens, no 487.
[after Ormerod 1924]. Photo from Basch, L., Le muse imaginaire de la marine antique, Athens 1987, 270).

Unfortunately there is not enough information about this device which seems quite interesting as it was provided fresh air from outside. If it is not a simple idea of using a piece of reem or tube, then we are unlucky, indeed, to miss such an important information due to insufficient data.

Other type of respiration device appears again on another Aristotle's work. Corcerns the famous «*λέβης*» (lévis = cooker, boiler, cauldron), a premature diving helmet but without having a "fresh air circulation" system:

[... for they enable the divers to respire equally well by letting down a cauldron; for this does not fill with water, but retains the air, for it is forced down straight into the water; since, if it inclines at all from an upright position, the water flows in].

«...ὁμοίως γὰρ ἀναπνοὴν ποιοῦσι τοῖς κολυμβηταῖς λέβητα καταφέντες. οὐ πίμπλαται γὰρ οὗτος τοῦ ὕδατος ἀλλὰ τηρεῖ τὸν ἀέρα. μετὰ βίας γὰρ ἡ κάθεσις, ὀρθὸν γὰρ ὁτιοῦν παρεγκλιθὲν εἰσρεῖ» (Aristotle, 1995: 32, 960b, 30).

But even at this point there are not enough insights that can lead to reliable conclusions and to understand the utility of this device, such as, for example, if there was an opening covered airtight by a glass so the diver can see. If not, then we will work on the assumption that the utility of such apparatus was just only for diver's short intermissions of "apnefstia".

DIVING AS A FORM OF EXECUTION

Among the types of diving mentioned above, there have been also cases that this faschinating aquatic exercise had simultaniously a 'black' version. 'Diving by force' was creating as a type of execution for person who had been convicted of crimes. The ancient Greek word «*καταποντισμός*» (katapontismós) has the meaning of drop someone from a high point to the ground or to the sea, to sunk someone alive, while the term «*σχοινισμός*» (schinismós = the strappado)[2] means to tide someone with rope and drop him to the ground/sea.

The acting of throwing a person to sea alive is quite frequent in ancient Greek mythology and history. Out of a punishment for crimes, it was a result of war actions, piracy, personal conflicts or even human jettison (Herodotus 1975: 8, 118). An ideal example appears of diving as an execution for crimes on text of Plutarch, on which it is written that the murderers of Hesiodos are sank alive (Plutarch 1928: 162e).

What really surprise is that there are no references for 'strappado' in ancient Greek texts and its commonly known that this torture was put from the times of Inquisition, and as a naval punishment much centuries later. The lack of any concrete information about 'strappado' in classical period taking place on sea is well illustrated on an attica lecythos of 5th century BC (Fig. 4). On this depiction four men on a ship represent the crew. The figure wearing clothes, perhaps the one who is first in hierarchy, is observing the rest of the crew doing strappado to two men while a third one (perhaps the helmsman) is tied to the prow. The evidence of the tied helmsman guide our thoughts to the assumption that this scene may represent an action of piracy. In any case the use of ropes for dropping these two men into the sea corresponds to strappado either if this took place as a punishment for undisciplined crew or not.

2 Strappata (Italian), estrapade (French), garrucha (Spanish).

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REZIME

RONJENJE U ANTIČKOJ GRČKOJ TOKOM KASNOG ARHAJSKOG I KLASIČNOG PERIOD A (OD VI DO IV VEKA STARE ERE)

KLJUČNE REČI: RONJENJE, ANTIČKA GRČKA, KASNI ARHAJSKI PERIOD, KELASIČNI PERIOD.

Postojanje kategorije ronilaca kao i otkriće najstarijih instrumenata za disanje ukazuje da se o ronjenju vodilo računa u klasičnom periodu grčke kulture, budući da su drevni ronioci već tada bili opremljeni sa nekim vidom ronilačke opreme. Ali nedostatak brojnijih podataka znatno otežava istraživnje u ovoj oblasti. Kako su antički ronioci ronili, kakva oprema je bila dostupna u to vreme, kako je funkcionisala? Sve su to pitanja na koja još uvek nema pravih odgovora. Treba reći da tema ronjenja u periodu klasične Grčke privlači brojne istraživače danas i nadajmo se da će buduća istraživanja dati odgovore na neka od ovih pitanja.

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355.48(38)"362"
COBISS.SR-ID 219289612

Original research article
Received: September 21st 2015
Accepted: November 15th 2015

DRILL AND TACTICS OF EPAMEINONDAS'S THEBAN PHALANX IN THE SECOND BATTLE OF MANTINEIA 362 BC

ABSTRACT

The tactics of Epaminondas in surprise, timing, and combined arms are still a subject of study. The direction of the Battle of Mantinea is considered his crowning achievement. Though, it is not universally accepted which exact formation he used, and few reside on how the whole maneuver was carried out from the point of drill and issuing battle orders. In this paper, a detailed account is proposed as to the exact drill applied by Epaminondas' Theban hoplites in the second battle of Mantinea, 362 BC. Taking account of the available drill level of the time, the detailed description of Xenophon and of similar allied and enemy tactics and intentions, we suggest that the Theban infantry line reformed from phalanx battle order almost to marching order under cover of dust and successful friendly screening action by light troops and cavalry. In this way, both directional flexibility and speed of movement was achieved so as to crash onto the enemy right, were the troops of value (by virtue or nativity) were always stationed by decree of tradition. After succeeding in their charge, Thebans lost cohesion and in the confusion, their general as well. Being irreplaceable, the victors stayed aghast allowing the enemy a counterattack which snatched a draw from the jaws of defeat. This string of events is indicative of an elaborate and extra privy plan, demanding the presence of the mastermind proper to fulfill it. The only possible intent, which was risky, sensitive and decisive, is for Epaminondas to intend to reform his phalanx line perpendicularly to the enemy's already smashed one. This plan imitates standard Spartan flanking intentions without the need of the extreme Spartan maneuvering ability and indicates that the most suitable attack formation had been at this case to revert to marching order. Thus redeployment was easy, contrary to the generally assumed addition of fully deployed units in successive lines to achieve the desired depth with less effort. Such theories and conclusions may be bolstered only by experimental archeology and living history approaches, as dynamic concepts may be proved or disproved only by experiment, this study does not constitute proof. But entails a definitive positive value; if a concept is workable today, it has always been so, although the actuality is far from definitive.

KEYWORDS: HOPLITE, PHALANX, DRILL, EPAMEINONDAS, MANEUVERING.

INTRODUCTION

The phalanx of Epameinondas, especially at its more mature use in Matineia 362 BC, is the subject of intense speculation. For a second time, the Theban general manipulates his troops and the enemy so as to crash his opponent by charging with a very deep formation at the enemy right, where the best troops traditionally stand. After

one such success at Leuctra, in 371 BC, where the enemy was surprised by the first application of this tactic, one would expect that the Spartan professionalism would have devised countermeasures, as the Theban practice was extremely risky and time-sensitive: its execution offered a window of opportunity to the enemy to implement a flanking move-a Spartan specialty-and obliterate expeditiously and totally the charging column. Of course, generalship is expecting, foreseeing and countering; though, it is intriguing to understand how this master plan was implemented on the field. The challenge lies in finding a way which can ensure the prompt formation of the assault column, allow very fast closing with thev enemy without loss of order or cohesion, provide for follow-on after the breaching of the enemy line and combine with other arms so as to shirk anyexposure to superior Spartan maneuverability or steadfastness when similar numbers are engaged.

The surviving description of the battle is owed to "Hellenica" of Xenophon, a meticulous writer and expert in describing matters of tactics and technique as befits a seasoned warrior and author of training and tactical manuals. Xenophon is a staunch supporter of the extended, thin lines which allow flanking moves as orders the Spartan dogma (Kyropaedeia), and, of course, of the vigorous training and cohesion needed to instill solidarity to thin-lined phalanxes and drill to allow them to maneuver with tactical effect. From his description, compared and completed with elements of other works of his, as a contemporary to the events and a fellow soldier, we must extrapolate to understand the exact string of events.

To employ a tactical innovation, one needs a suitable tool. The Theban army of Epaminondas has two important characteristics allowing it such grading: First, it trains regularly and intensely (Plutarch Moralia 71.18), as no other civilian army has done during Xenophon's time-except the quasi-professional Spartan army (LP XI,8). Thus his men possess stamina, endurance, cohesion and discipline. The Theban (or, rather, the Boetian) army is not as sharp an instrument as the notorious red cloaks, but it is much bigger, can make up losses, integrate new allies fast and use them to good effect, perhaps after a retraining scheme (Hellenica VII.5.19). Second, it creates its myth and lore. Epaminondas insists in continuous training and separate encampment to create an air of superiority, mystique and curiosity (Plutarch, Moralia). It is very much an army antispartan of purpose but made of the same ingredients, only with stronger, heavier and numerically more troopers (Diodorus XV.87.1)- instead of the Laconian lean and mean and invaluable few.

LITERARY EVIDENCE, EXTRAPOLATIONANDARGUMENT

Facts, variables and correction factors

Biases and the standard level

First, Xenophon by definition despises Epaminondas, but cannot afford, as a genuine aristocrat, to slander or openly denigrate him. As a historian he is as objective as could be hoped for. His writing is colored but true. Thus, it is of the outmost importance to compare his narrative with more technical knowledge, especially if provided by him in his other works (Anabasis, Lakedaimonion Politeia -State of Lakedaimonians, Cavalry Commander - Hipparchikos, On Horsemanship - Peri Hippikis, Kyropaedeia).

The focal point in explaining tactics is drill and mobility. Both are well attested for the Spartans, the undisputed tactical masters of hoplite warfare for 200 years. They were reluctant to send expeditions far at the time of Xenophon (to be understood as "expeditions manned with Spartan Equals"), but had a long history of even overseas interventions during the 6th and 5th centuries (Lydia, Samos, Attica, Aegina) with task forces containing Equals (Herodotus I.83 III.54; V.63-4; VI.73). Moreover, they were very well

acquainted with such endeavors, as both Herodotus in 479 BC at the Plataea campaign and Xenophon at Lakedaimonion Politeia attest (XI.2). They can be very fast in strategic maneuvering; in 490 they surprise everyone when coming to the aid of Athenians in less than 3 days (Herodotus VI.120), in Thermopylae 480 BC they arrive at the nick of time to raze the Malian fields for Xerxes to find no supplies and just before Plataea, in 479 BC, their progress takes by surprise (Herodotus IX.11-12) friend and enemy alike (Athenians and Argives, respectively). But they move to fight; they do not fight by moving. Xenophon attests that Jason of Pherrae was the first general to do so (Hellenica VI.4.21), recognizing both a strategic and operational dimension in mobility. Is he ignoring Epaminondas? Perhaps he is a bit off the mark: Persian armies were doing so centuries ago, and some of Epaminondas operations might be regarded under such a light. There are some opposite thoughts, though: the invasion of Laconia by multiple routes is nothing different than the three-pronged advance of Xerxes between Thrace and Macedon (Herodotus VII.121) or the Athenian disastrous attack in Boeotia in 424 BC (Thucydides IV.89). The maneuvering culminating in the great battle of Mantineia in 362 BC (Hellenica VII.5.9-15) is something more than the Athenian and Persian competitive operational maneuvering before, during and after Marathon in 490 BC (Herodotus VI.102-3 and 115-8 respectively) but nothing different. After all, Xenophon is an expert on the subject: he serves for years as a condottiere near the greatest general of the old, moving-to-fight concept, Agesilaos of Sparta. And he does not see the mobility of the Theban army as of any consequence.

The issue in Mantinea 362 BC is clearly the drill, since mobility played no important role in the clash of phalanxes. Xenophon describes drill as a Spartan exclusivity with the other Greeks stubbornly ignorant (LP XI.4/8); though, one may accept an unorganized motion from camp to battle line in some cases, especially in more formal and restricted battles, but cases -as is Marathon 490 BC- cannot be explained without taking proper drill as a fact. Thus, the Deployment (paragogi) is the only logical way to transform a column of march to a battle line (LP XI.9) and it is very weird how all the expediting Greek armies could do so without implementing paragogi, according to Xenophon. Moreover, the countermarch (exeligmos-*ibid*) is the only drill satisfying the Occam's razor for the battle of Marathon. So, given that some of his drill information is incomplete, incoherent and irrational, it is logical to suspect deliberate self-restriction in making the Lakonian secrets known in detail. Consequently, should we assume some margin in this particular point? For example, after attesting the countermarch to reverse the front of a deployed phalanx, he mentions that in a similar way the Spartans achieve the exchange of its flanks (LP XI.9). This is problematic: if a man's front is half a meter and the usual file depth of the Spartans is 12, as in Leuctra (371 BC) for a 3600-strong Spartan phalanx (6 Morai of 600 men each-LP. XI.4) the front is 150 meters. The standard countermarch (Lakonian or Macedonian) was less than 15 meters and considered a feat of drill, training and discipline!!!!

The paradigm-shifter: the new Theban army

To resolve the issue in Mantineia, we must understand the formation of the Theban-allied army and determine its structure and potential; only in this way the string of events will be elucidated-and the just as important string of intentions. If focused on phalanx, this is impossible. Thebans must have retained the bronze-age 50 men basic heavy infantry unit (Iliad IV-393) and the Taxis brigade used in Athens (Hellenica IV.3) and by almost all other Greek army but the Spartan (L. P. XI.4). The Taxis is 1000 strong, give or take. The Theban heavy infantry where hoplites, but did not fight any more as a classical phalanx in mechanics and tactics; only as a technique. Instead of lim-

iting themselves to spear stabbing (doratismos) and shield shoving (othismos), they reverted at Epaminondas instigation to grappling at contact, were well-trained in individual combat, open to the thrill of the initiative to the point of individualism or even undisciplined, kept no dressing of the lines, rushed at the opponent in deep formations reminiscent of Homeric "towers" (perhaps similar to French columns). Such is the picture compiled by both Xenophon and Plutarch, who hold opposite views and are almost a millennium distant. Although instructors of close combat (oplomachoi) were supposedly denied access in Spartan territory, they were sought for in Athens and there is no reason to think differently of Thebes. Proficiency in Close Quarter Combat was important when phalanxes have clashed and one is broken, and the other in hot pursuit, thus losing its integrity. The Spartans did no such things. They did not break, to be pursued, and themselves pursued for a short distance as an unbroken phalanx, to null any individual advantage to adversaries. They were not out for mass murder, but for victory with as little loss of invaluable Laconian warriors as possible.

Given that the Theban novelty is to strike with great depth and fast at the enemy strong contingent, to the right, to break the phalanx and decapitate the enemy, gaining a decisive and immediate victory, as happens in both Leuctra and Mantineia, the outcome in both cases is questionable. After Leuctra the Thebans ask for reinforcements from Alexander of Pherrai to wipe out the remaining Spartans, despite the astounding victory in both psychology and body count. After Mantinea, they are advised by the victor, dying Epaminondas to sue for peace. Their victories are decisive but not total. The smashing of the opposing phalanx in a very limited front cannot disintegrate it, especially if it is big and filled with purpose (as in Mantineia but not in Leuctra). The deep formation and the irresistible charge, combining (unexplainingly) othismos and Pankrateion is instrumental, but it is only part of the picture. Xenophon describes meticulously that in Mantineia the Thebans screened successfully their phalanx transformation behind a screen of cavalry and light troops who bested their opposite numbers. Thus, the deployed phalanx reformed, by bringing more lochoi behind the front ones and acquiring great depth. There is a problem as to the size of lochos; in Xenophon's March of the 10,000 they are specifically mentioned as 50 and 100-strong, perhaps depending on the contingent. It is definitely the lower echelon of the Taxis in both Attic and Theban armies, as the Theban Sacred Band is 300 strong -but it cannot be considered a proper lochos due to the sacramental nature of the unit. Though, the 50-strong lochos fits nicely to the testimony of Theban phalanxes 25 and 50 deep (Delion 424 BC -Thucydides IV.93- and Leuctra 371 BC–Hellenica VI.4.12). If the Theban field lochoi are 50-strong, whole lochoi were deployed in just two or one file(s) respectively at the aforementioned battles.

This deployment of lochoi in very few, very deep files is nothing weird; it is similar to the order of march-only denser- and gives a deep formation, irresistible in shock action and fleet in charge, as it needs no dressing. It is also easy to manipulate in lateral direction in the battlefield so as to deploy the phalanx as needed, the deployment, though, is slow and presents the worst window of vulnerability. This deficiency and the exposed flanks are the reason nobody used it. But Epaminondas used proficiently his superior cavalry and light infantry, not to decide the issue (as a Spartan would have done, see Gylippos in Syracuse, 413 BC- Thucydides VII.6) but to allow its heavy infantry to decide the issue in a much more decisive way: a hoplite victory would crash enemy morale and incur horrific casualties as the shock would be by armored men striking in contact. This whole idea reminds of Napoleonic attack columns of the French infantry and to be implemented it is imperative to accept that the Theban army of Epaminondas possessed, among others, the drill level described by Xenophon as Spartan only.

Possible Vs available drill and maneuvering

The easy approach

Up to know it is intuitively assumed that the deployed Theban phalanx started its advance under cover of dust at the left. The leftmost phalanx-deployed Lochos having advanced 10-15 meters, the next at its right would have perform a half-turn left by each man, advance at its rear, half-turn right to regain its front and start advancing at the tail of the preceding one; this continues for the whole Theban contingent, creating a very deep formation at the width of one Lochos (Figure 1). It is simple enough and entirely doable, while retaining a very narrow front, just six men had the Theban Lochoi deployed to a file-depth of 8 men, as was normal for other Greek armies (as the Athenian). This would mean that in Delion three Theban Lochoi would line ahead and in Leuctra 6, while the arrangement is similar to the Persian in Plataea (Herodotus IX.31.1), whence the Thebans were the staunchest of the Persians'allies.

But it fails to fully comply with Xenophon's account in many respects, and it offers no real advantage in the collision match of othismos, as a normal lochos assaults the enemy and the amassment of more such lochoi in depth might have been of limited practical use at the shoving. The most important problem, though, is that after shattering the enemy, this formation can do little if the rest of the opposite phalanx does not turn and flee (Figure 2). Actually, if the units near the impact turn to the breach and charge from the side, it is very probable that the attacking column will be disintegrated, if hit at the shieldless side. The Thebans knew that the secret to obliterate an enemy army is to flank it and advance perpendicularly to its axis of advance, as the Spartans had done in Mantinea in 418 BC (Thucidydes V.73) and in Nemea, in 394 BC (where assaulted in such a, lateral charge, a rather decently-faring deeply deployed Boetian contingent of the enemy phalanx-Hellenica IV.3).

The factual approach

The alternative, as proposed herein, is the assumption that the recent level of Theban drill and confidence allowed something much more complicated, which would pay up with a much more decisive result. In this account, the Theban left, under cover of dust from the cavalry screen, transforms starting at the extreme left from phalanx line to column (epagogi-Figure 3), with increased depth and much narrowed front; possibly its front line is made exclusively of Lochos commanders (Lochagos), as their commands-Lochoi- are formed behind them in single file each. Next (rightward) lochoi followed suit and perhaps a second level of such lochoi might have been formed (Figure 4). The Theban formation becomes thus very deep, and the first line is composed by picked men, Lochoi commanders. Moreover in a very deep lochos, its members (lochitai) have better cohesion and might bring more weight to bear than the same number of men from successive lochoi. This extreme depth would much more fit the description of the Theban attack as a trireme ramming the side of the enemy, proposed by Xenophon (Hellenica VII.5.23) and cope with the crack Spartan first line from an advantageous position (Figure 5).

The most important issue is, though, what happened and what was going to happen next. After beating the enemy phalanx and rupturing it, Epaminondas was shot by a Lakedaimonian javelineer, a peltast, while he was ready to move on to the exploitation of the successful clash. With his loss, the Thebans could not capitalize on the initial-and, agreeably, decisive-success (Hellenica VII.5.25). As Xenophon says, the Athenians were victorious against the allied contingent of the right flank (ibid) and both contestants disengaged in good order with both ritually claiming victory and neither being confident to challenge the other's claim of victory (Hellenica VII.5.27). This version is Xenophon's, though the political history from then on shows that he is right. The second

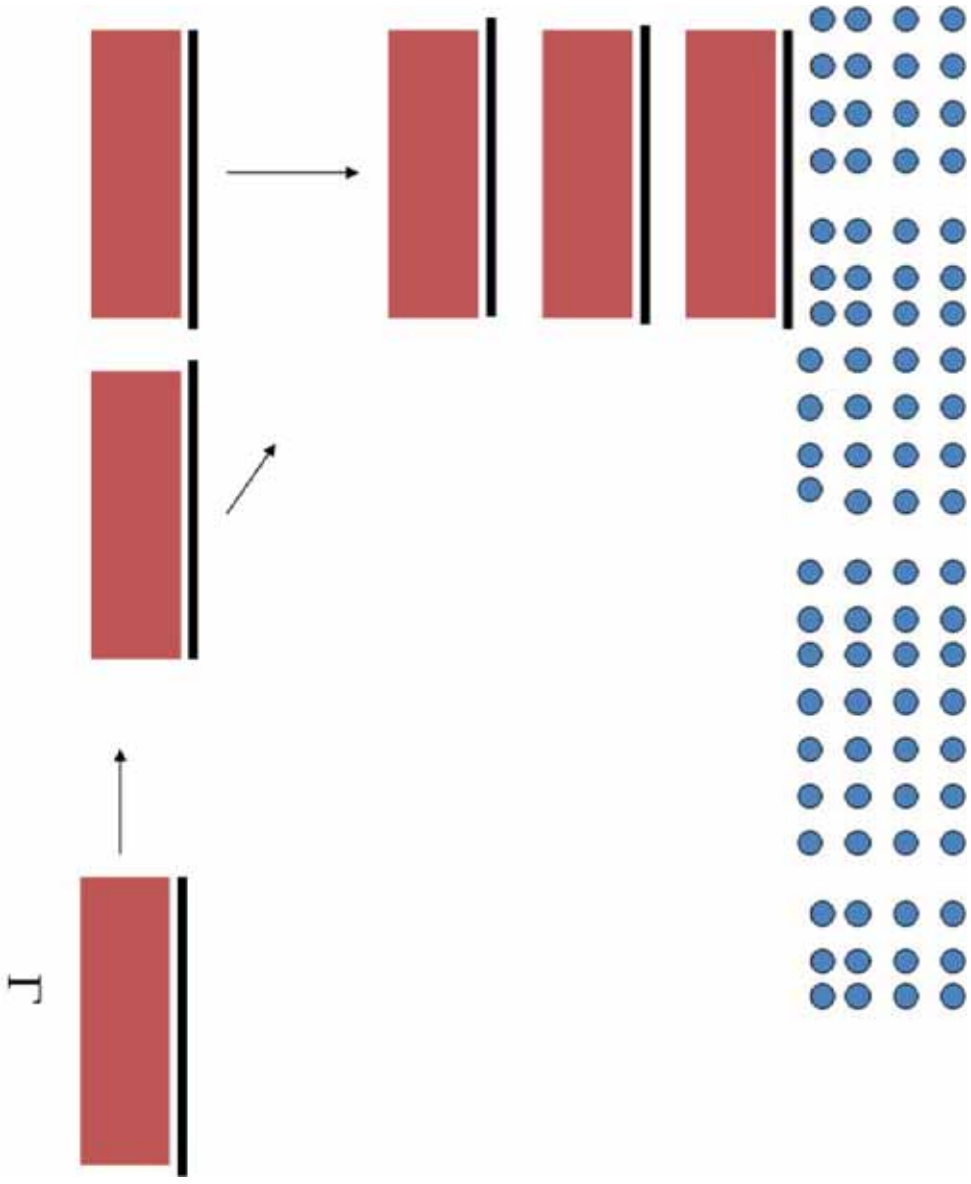

Fig. 1 Original hypothesis: Theban units form line ahead at the left by half-turning "shieldwards" and then "spearwards' and advance and charge in narrow front.

daughter of Epaminondas, the victory at Mantinea (Diodorus XV.87.6) was a half-blood child.

This realization shows the conventional wisdom of traditional Greek practice (as in Platea in 479 BC-Herodotus IX.27.6) to deploy at the left end their second best troops (the cream at the right), compared to Epaminondas' practice, to deny one of his flanks by keeping it lagging. One cannot bet on this being a stroke of luck for the antitheban side as the battle was unfolding, or some good Athenian tactician (there were 2 or 3 at this time) having understood his opponent's methods and devised suitable countermeasures. But the most important thing is to realize that the Thebans had not fulfilled their intention for full exploitation of victory, which was a standard operating procedure. It is impossible not to have a plan so as to disintegrate the enemy before the vulnerable, lagging flank becomes engaged by superior enemy forces. The whole idea was a run against the clock, as was performed brilliantly by the Spartan army in the battle of Nemea, in 394 BC. At this battle the Spartan right broke and disintegrated the enemy left and redeployed at right angle to the original front, advancing at the enemy flank which had been victoriously sweeping the field. Thus, if the Thebans were planning something similar, they needed redeployment. It is very tempting to suppose that after annihilating the Mantineans and Spartans, the Thebans were redeploying (paragogi-LP XI.6) into phalanx to take the rest of the enemy phalanx at the internal flank created by the frontal rupture of the extreme right (Figures 6-7) as had been the case in Tegyra in 377 BC. But in Mandinea the massive deployments dictated drill and discipline instead of brilliant improvisation by the elite professional troops of a very cohesive, permanent unit which had been enough for the small number engaged in Tegyra. At this point, Epaminondas, being with his men at the spearhead of the attack, was exposed and hit by the Lakonian light trooper who was there to cover the retreat of his beaten compatriots. By being wounded and incapacitated, Epaminondas was not able to give the orders for the redeployment and the Thebans did not exterminate the enemy phalanx in time; due to this, their own was badly mauled by the untouched enemy left (Athenians) and they themselves exposed and compromised. Without Epaminondas they were not so much equals to the redcloaks.

CONCLUSION

We conclude the key issue has been the lateral advance, which the Thebans were planning to execute by creating an internal exposed flank to the enemy, as they did not possess the maneuvering proficiency shown by the Spartans at the First battle of Mantineia in 418 BC (where they outflanked their opposing phalanx); on the other hand, the Thebans brought superior brute force to bear. If this simple fact is taken into account, all fall into place. The trireme-like assault, like the French charge columns, was supposed to crash with the best Theban troops into the enemy phalanx at a very limited width, and next, being driven into it to deploy perpendicularly to the enemy phalanx as it would have been placed squarely at its flank. The charge would sweep the enemy, who could not move fast enough to flank the Thebans or to get out of their way-but by reverting to outright rout. To perform all these, the Theban phalanx, deployed against the enemy one for some time, must have transformed under cover of dust to form its basic units into single-file extra deep, marching formation, but arranged both one next and one after the other. The best troops would all have been at the first line to crash on the enemy phalanx with the momentum of a running charge and of an extraordinary depth.

The only problem is the questionable ability of Thebans to execute such drill, a traditional privilege of the Spartans and their Agoge public training system. But this idea of Spartan monopoly might be exaggerated, as it originates from Xenophon have been. There are no contrary assertions,

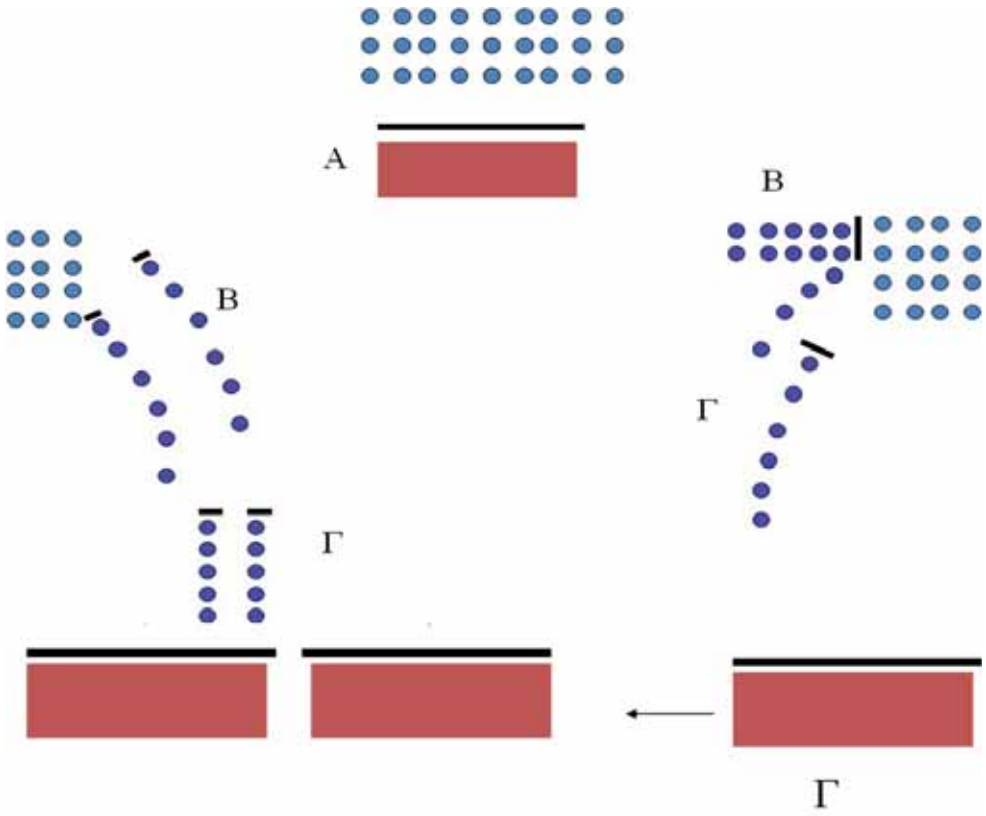

Fig. 2 Original Hypothesis: The following Theban units turn right and left to flank-attack the exposed units after the top of the column has broken through and is in hot pursuit of its immediate antagonists.

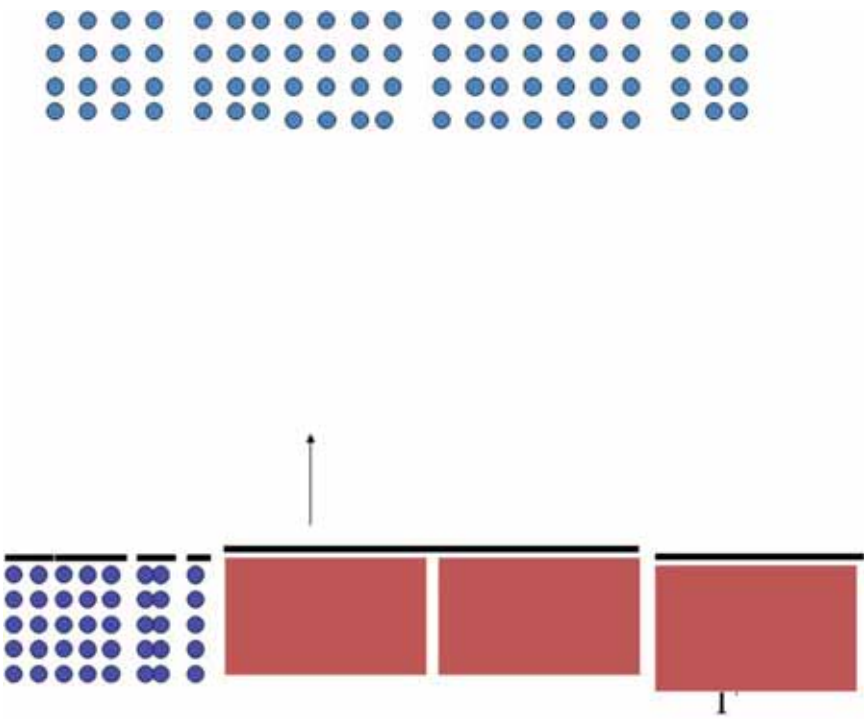

Fig. 3 Projected hypothesis: The Theban units transform from line to column bydiminishing the file number and increasing the file depth while maintaining the same linear density, thus shrinking the front.

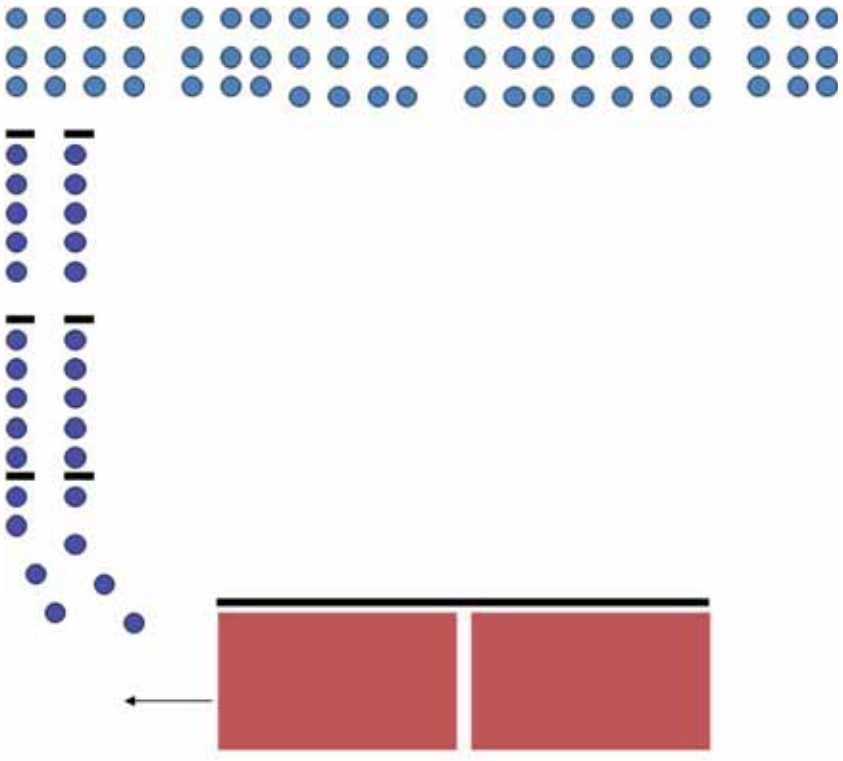

Fig. 4 Successive units move leftwards (shieldwards) by transforming in succession

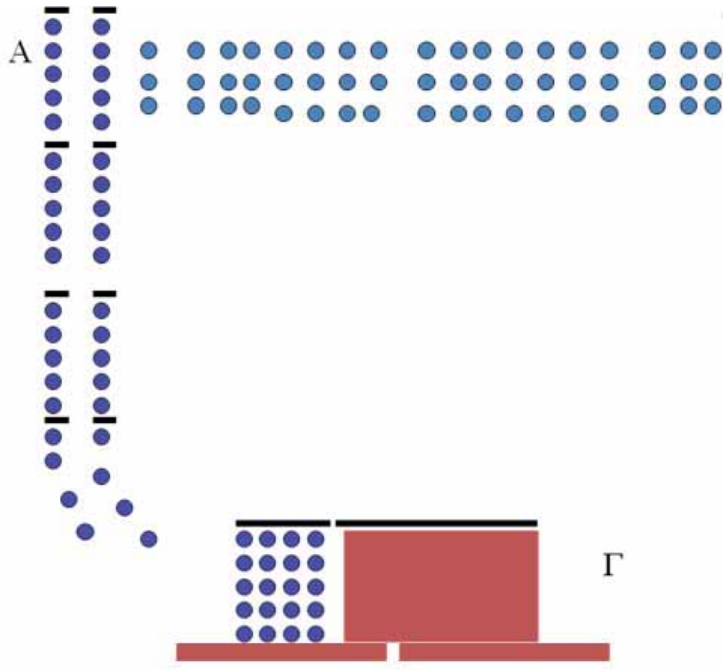

Fig. 5 The narrow front of the Thebans breaches enemy phalanx as a napoleonian assault column. At this point Epameinondas is slain

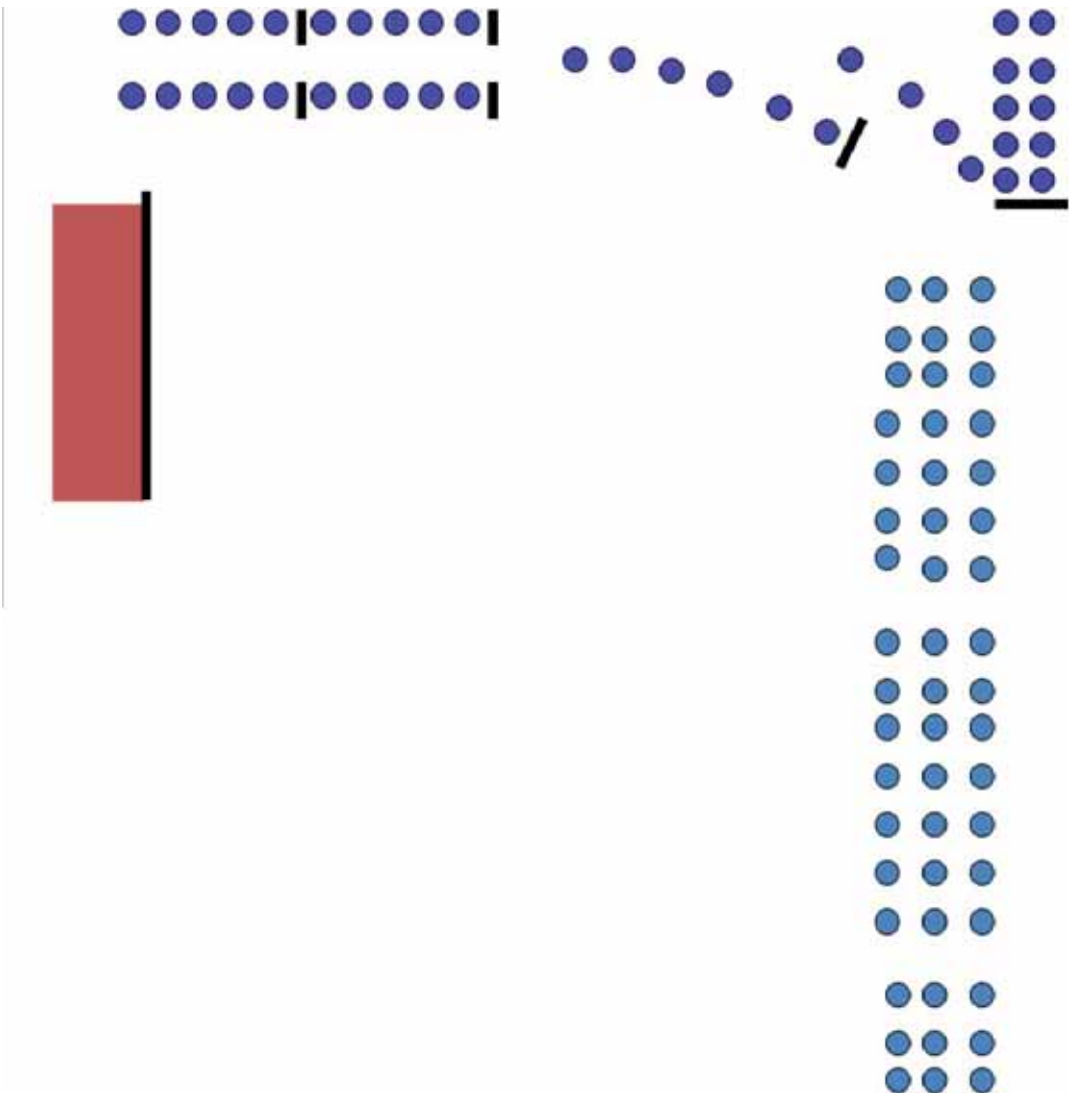

Fig. 6 Successive long files transform (Paragogi) to phalanx but with front tilted by 90° so as to attach the flank created by the breach. The word to do so was never given.

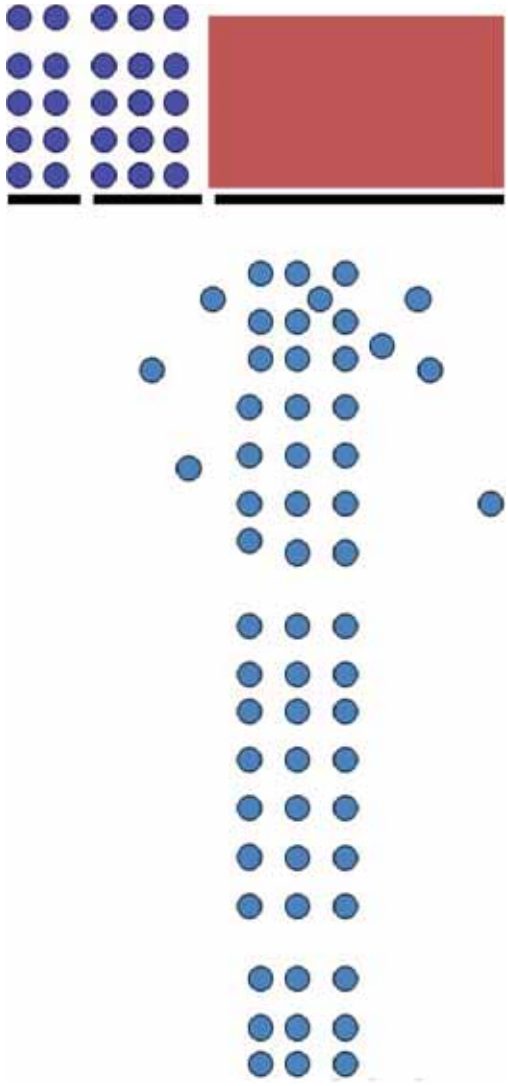

Fig. 7 The Theban phalanx would have sweapt the field and the exposed shieldless right flanks of all enemy units if they did not flee.

but some strong indications that this level of drill cannot have been Spartan monopoly. In any case, the assumptions presented need a robust plan of reenactment and experimental archeology. The prompt raising of weapons, the transformation on the move and the collision mechanics might back up one of the two transformation alternatives and prove or disprove the idea of the lateral advance on the internal flanks created by the clash and the way the change of front by 90º was achieved in limited time and space. If proven, this might change our view in how Spartans turned in Mantinea and Nemea and perhaps even the about-turn of the Athenian wings in Marathon.

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REZIME
PRODOR I TAKTIKA EPAMINONDOVE TEBANSKE FALANGE U DRUGOJ BITCI KOD KOD MANTINEJE 362 GODINE STARE AERE

KLJUČNE REČI: HOPLITI, FALANGE, PRODOR, EPAMINOND, MANEVRISANJE.

Epaminondova taktika koja se sastojala u iznenađenju, vremenu, kao i kombinaciji oružja još uvek predstavlja predmet istraživanja istoričara. Bitka kod Mantineje se smatra njegovim vrhunskim dostignućem, iako nije opšte prihaćena formacija koju je on koristio u ovoj bici. U studiji smo pokušali da detaljnije osvetlimo tok prodora koji su primenili Epaminondovi tebanski hopliti u drugoj bici kod Mantineje 362. godine stare ere.

Uzimajući u obzir raspoložive podatke o prodoru, kao i detaljan opis Ksenofonta pokušali smo da predložimo moguću verziju ove velike bitke.

Teorijska postavka u vezi taktike i ishoda bitke mogu se donekle potvrditi ili opovrgnuti samo eksperimentalnom arheologijom. To svakako ne predstavlja dokaz, ali podrazumeva pozitivnu vrednost, iako je odgovor još daleko od definitivnog.

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COBISS.SR-ID 219293452

Original research article
Received: August 24th 2015
Accepted: November 15th 2015

AN ARCHAEOLOGIST'S TRANSLATION OF PYLOS TABLET TA 641-1952 (VENTRIS), WITH AN INTRODUCTION TO SUPERSYLLABOGRAMS IN THE VESSELS & POTTERY SECTOR IN MYCENAEAN LINEAR B

ABSTRACT

In partnership with The Association of Historical Studies, Koryvantes (Athens), our organization, Linear B, Knossos & Mycenae (Wordpress), conducts ongoing research into Mycenaean archaeology and military affairs and the Mycenaean Greek dialect. This study centres on a fresh new decipherment of Pylos tablet TA 641-1952 (Ventris) by Mrs. Rita Roberts from Crete, who brings to bear the unique perspectives of an archaeologist on her translation, in all probability the most accurate realized to date. We then introduce the newly minted term in Mycenaean Linear B, the supersyllabogram, being the first syllabogram or first syllable of any word or entire phrase in Linear B. Supersyllabograms have been erroneously referred to as "adjuncts" in previous linguistic research into Mycenaean Linear B. This article demonstrates that their functionality significantly exceeds such limitations, and that the supersyllabogram must be fully accounted for as a unique and discrete phenomenon without which any approach to the interpretation of the Linear B syllabary is at best incomplete, and at worse, severely handicapped.

KEYWORDS: MYCENAEAN LINEAR B, SYLLABOGRAMS, LOGOGRAMS, IDEOGRAMS, SUPERSYLLABOGRAMS, ADJUNCTS, LINEAR B TABLETS, PYLOS, PYLOS TA 641-1952 (VENTRIS), DECIPHERMENT, TRANSLATION, POTTERY, VESSELS, TRIPODS, CAULDRONS, AMPHORAE, KYLIXES, CUPS, GOBLETS.

Why are there so many ideograms in Mycenaean Linear B, 123 all told, with 30 in the pottery and vessels sector alone? This is no idle question. Of the 123 Linear B ideograms listed in Wikimedia Commons,[1] fully 30 or 24.5 % are situated in the pottery and vessels sector of the Mycenaean economy, as illustrated in Table 1.

But why so many? As I emphatically pointed out in the talk I gave at *The Third Interdisciplinary Conference, "Thinking Symbols"*, June 30-July 1 2015, at the Pultusk Academy of the Humanities, just outside of Warsaw, Poland, in partnership with The Association of Historical Studies, Koryvantes (Athens), with whom our organization, *Linear B, Knossos & Mycenae* (Wordpress), is in full partnership, "No-one *deliberately* resorts to any linguistic device when writing in any language, unless it serves a useful purpose beneficial to more effective communication, *contextual* or *otherwise.*" (*italics mine*). Although in that con-

1 Wikimedia Commons: Category: Linear B https://commons.wikimedia.org/wiki/Category:Linear_B?uselang=en-gb

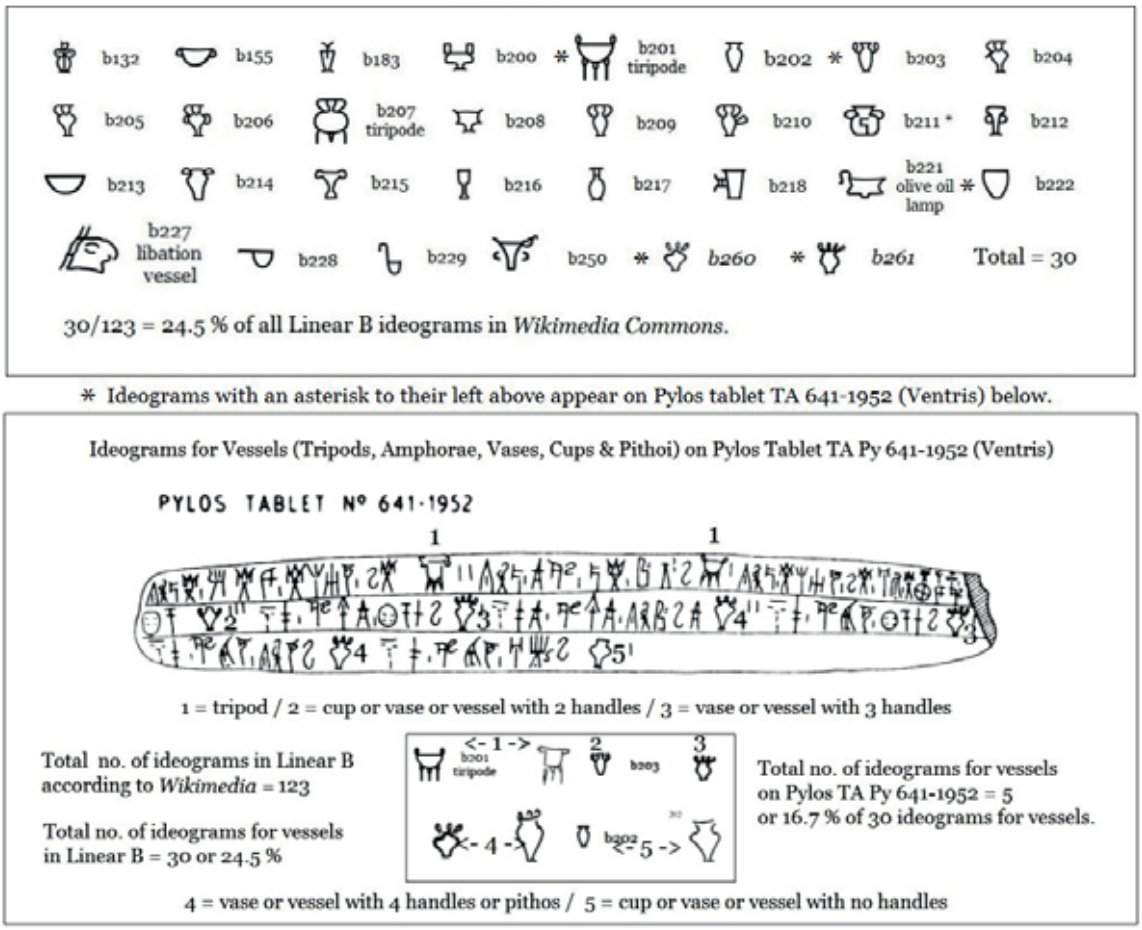


Table 1 Ideograms for vessels in general in Linear B and in particular on Pylos tablet TA 641-1952 (Ventris)

text I was referring to a phenomenon even more striking than the pervasive use of ideograms on Mycenaean Linear B tablets, notably, the device I have newly coined, which I refer to as *supersyllabograms*, this still remains precisely the point (*italics mine*). We shall be discussing the phenomenon of supersyllabograms in the last section of this article.

To illustrate in concrete terms what my meaning is, all we need do is take our cue from one of the most famous extant tablets in Mycenaean Linear B. I refer of course to Pylos tablet TA 641-1952 (Ventris), the very first tablet Michael Ventris ever translated from A to Z. To this day his decipherment stands as one of the high points in the translation of Mycenaean Linear B. While several cogent translations have followed, none have improved all that much on his highly competent decipherment, although all have contributed some new insight into particular aspects, certain words and specific phrases, and in addition, into some or all of the ideograms for vessels which appear on this tablet.

Some historical background is in order. Michael Ventris was not actually the first person to translate the *first word* on this tablet. It was his friend and professional colleague, the archaeologist Prof. Carl Blegen[2], who was in the process of unearthing a rich trove of tablets in Mycenaean Linear B at Pylos. He just so happened to stumble upon something truly intriguing about this particular tablet. Even at first glance, he could see that the very first *ideogram* on the first line was clearly one of a tripod. That was his first clue. With

2 Wikipedia: Carl Blegen https://en.wikipedia.org/wiki/Carl_Blegen

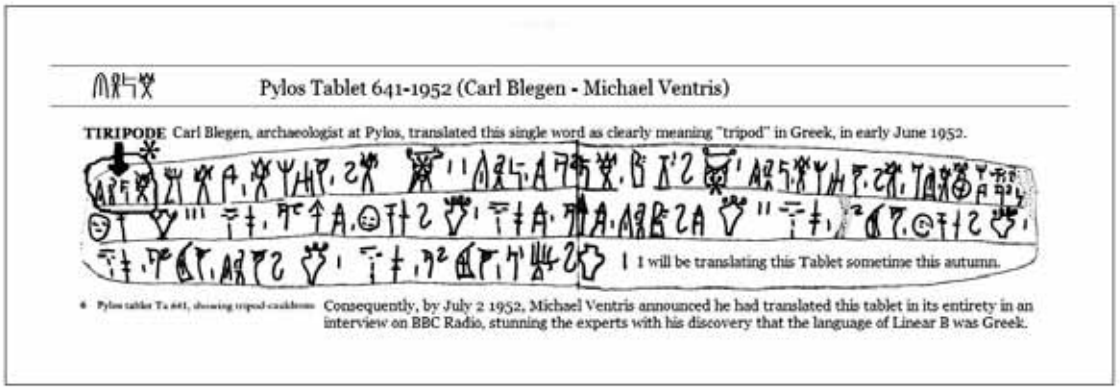


Table 2 Carl Blegen's decipherment of the first word "tiripode", meaning "tripod" on Pylos tablet TA 641-1952 (Ventris)

Michael Ventris' final grid in hand, he was able right off the bat to translate the first word only of the initial phrase on the tablet, on the hunch that, to accord with the ideogram, it just might be the Mycenaean for "tripod". And to his utter astonishment, it spelled out just that, appearing here in Latinized Linear B as "tiripode" in Table 2.

Blegen was beside himself with excitement. He wasted no time communicating his astonishing discovery to Michael Ventris, who in June 1952 immediately fired off a letter to Prof. Emmett L. Bennett Jr.[3], the American philologist who had already made significant contributions to the search for a convincing decipherment of Linear B through his systematic cataloguing of its characters (apparently *syllabograms,* given the small number of them, somewhat more than twice as many as in an alphabet) and of its scores of symbols – mark my word – clearly *ideogram*s, both of which this script had in common with its immediate predecessor, the as yet undeciphered script, Minoan Linear A. The mere fact that Minoan Linear A and Linear B both contained a substantial number of ideograms, a great many of which they held *in common*, was enough to convince Carl Blegen that any decipherment of the word which corresponded to the ideogram for "tripod" would simply have to clinch the matter. And he was right on the money. This wonderful news in hand, with uncharacteristic enthusiasm Ventris reported (Fig. 1)

3 Wikipedia: Emmett L. Bennett Jr. https://en.wikipedia.org/wiki/Emmett_L._Bennett,_Jr.

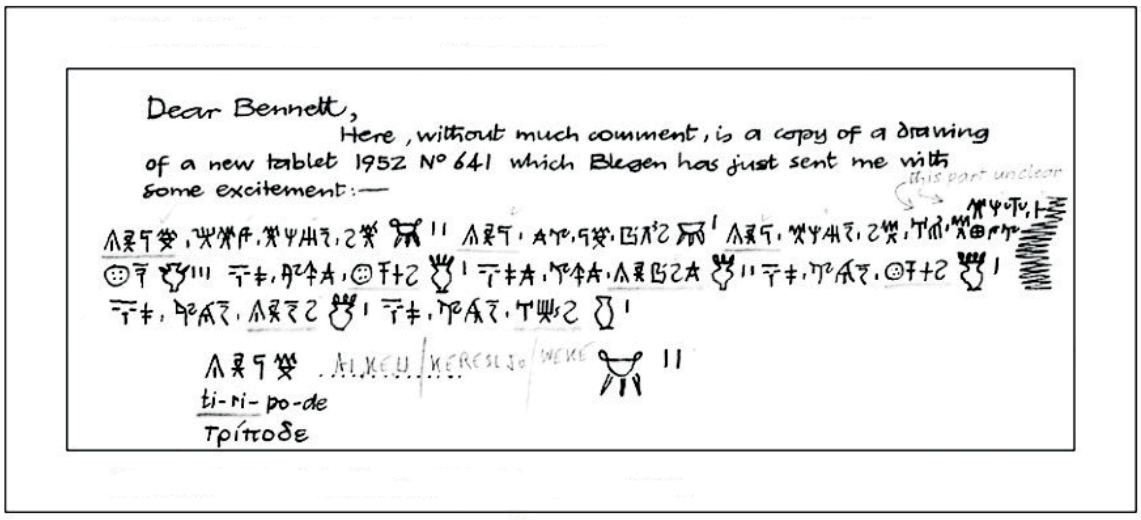
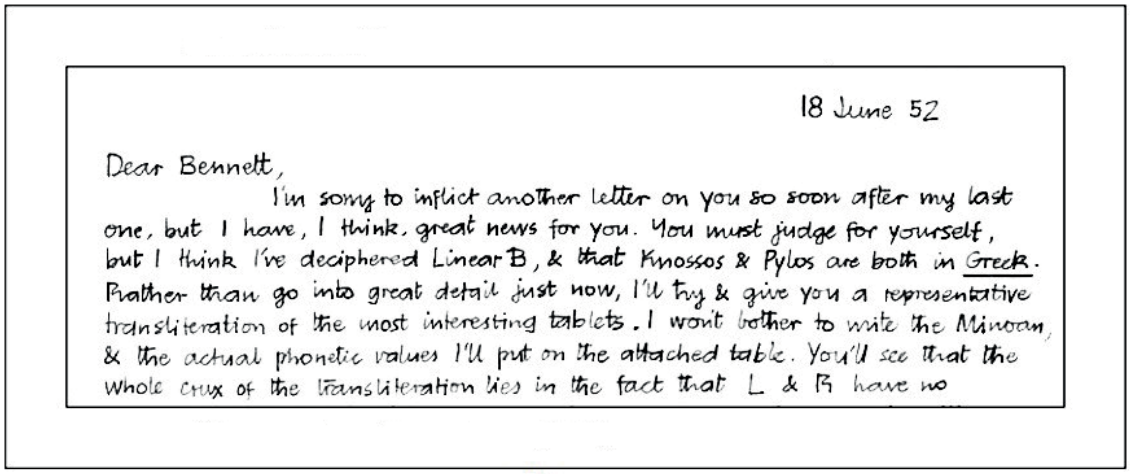


Fig. 1 Michael Ventris' letter to Emmett L. Bennett, 1952 in which he expands on Carl Blegen's decipherment of the first word on Pylos tablet TA 641-1952 (Ventris)



18 June 52

Dear Bennett,

I'm sorry to inflict another letter on you so soon after my last one, but I have, I think, great news for you. You must judge for yourself, but I think I've deciphered Linear B, & that Knossos & Pylos are both in Greek. Rather than go into great detail just now, I'll try & give you a representative transliteration of the most interesting tablets. I won't bother to write the Minoan, & the actual phonetic values I'll put on the attached table. You'll see that the whole crux of the transliteration lies in the fact that L & R have no

Fig. 2 Michael Ventris' letter to Emmett L. Bennett, June 18 1952, in which he claims he has finally deciphered the Mycenaean Linear B text on Pylos tablet TA 641-1952 (Ventris)

This was almost immediately followed by another letter, which effectively opened the flood gates, allowing for the impending decipherment of the entire tablet (Fig. 2).

The script had effectively been broken. To the equal astonishment of Michael Ventris himself and everyone else in the world then struggling to decipher Linear B, this was nothing less than earth-shattering news. No wonder. Ventris had been struggling for almost five years on the assumption that the language of Linear B was not Greek. For the previous fifty-two years since the first discovery of the ruins of Knossos by Sir Arthur Evans in March 1900, no one in the entire world could have imagined or seriously believed that a script so ancient, especially a syllabary, could conceivably represent either proto-Greek or potentially even the earliest ancient Greek dialect. However, even in the earliest days, immediately after the astonishing archaeological find of Knossos, perhaps the greatest archaeologist of the early twentieth century, Sir Arthur Evans himself, suspected that the syllabary could in fact at least be in proto-Greek, postulating in *Scripta Minoa*[4] that, in light of this passage from *The Odyssey* (Fig. 3),

Translation mine: There is a certain fair and fruitful land, Crete, in the middle of the wine-coloured sea, surrounded by it on all sides. It has an extensive population, and there are nine cities in it. The people speak a number of overlapping

4 Evans, Arthur J. 1952
Scripta minoa: the written documents of minoan Crete with special reference to the archives of Knossos (Band 2): The archives of Knossos: clay tablets inscribed in linear script B— Oxford: Cambridge University Press
http://digi.ub.uni-heidelberg.de/diglit/evans1952/0001/thumbs?sid=14339521ba1308ae2d5326fa9d88f789#/current_page
See pp. 66-68 http://digi.ub.uni-heidelberg.de/diglit/evans1952/0074?sid=14339521ba1308ae2d5326fa9d88f789

Discussion of the early language or languages of Crete must begin from the Homeric description (*Odyssey* XIX. 173–7):

Κρήτη τις γαῖ' ἔστι, μέσῳ ἐνὶ οἴνοπι πόντῳ,
καλὴ καὶ πίειρα, περίρρυτος· ἐν δ' ἄνθρωποι
πολλοὶ ἀπειρέσιοι, καὶ ἐννήκοντα πόληες·
ἄλλη δ' ἄλλων γλῶσσα μεμιγμένη· ἐν μὲν Ἀχαιοί,
ἐν δ' Ἐτεόκρητες μεγαλήτορες, ἐν δὲ Κύδωνες,
Δωριέες τε τριχάϊκες, δῖοί τε Πελασγοί.

Fig. 3 Homer's description of the early languages of Crete (Odyssey XIX. 173-177)

τῇσι δ᾽ ἐνὶ Κνωσός, μεγάλη πόλις, ἔνθα τε Μίνως
ἐννέωρος βασίλευε Διὸς μεγάλου ὀαριστής,

Fig. 4 The reign of god-like Minos, King of Crete, at Knossos (Odyssey XIX. 178-179)

languages. Among them are the Achaeans, the heroic Eteocretans, the fine Kudonians, the Dorians and their three tribes, and the Pelasgians of divine origin.

However, Evans fails to call attention to the next two lines, which are even more significant, and which run as follows (Fig. 4).

Translation mine: In their midst was Knossos, a great city, where Minos, king regnant, was on familiar terms with Zeus,...

With this (apparently mythological) information in hand, Evans goes on to assert: It seems certain, therefore, that *Greek* speech – and probably two or more dialects of Greek

– were introduced ready-made into Crete; that the *latest* arrivals, the Doric dialects, did not arrive much before the *eleventh* century..." (BCE) (*italics mine*)[5]

only to dismiss the notion as ludicrous,

It would seem, therefore, unlikely that the *language* of the Cretan scripts was any kind of Greek, and probable that *it* was related to the early language or languages of Western Anatolia – associated, that is, with the archaeological 'cultures' of Alaja Hüyük I ('proto-hattic') and of Hissarlik II and Yortan ('*Luvian*')...", and a little further,

5 pg. 67 http://digi.ub.uni-heidelberg.de/diglit/evans1952/0075?sid=14339521ba1308ae2d5326fa9d88f789

Κρητῶν δ᾽ Ἰδομενεὺς δουρὶ κλυτὸς ἡγεμόνευεν,
οἳ Κνωσόν τ᾽ εἶχον Γόρτυνά τε τειχιόεσσαν,
Λύκτον Μίλητόν τε καὶ ἀργινόεντα Λύκαστον
Φαιστόν τε Ῥύτιόν τε, πόλεις εὖ ναιετοώσας,
ἄλλοι θ᾽ οἳ Κρήτην ἑκατόμπολιν ἀμφενέμοντο.
τῶν μὲν ἄρ᾽ Ἰδομενεὺς δουρὶ κλυτὸς ἡγεμόνευε 650
Μηριόνης τ᾽ ἀτάλαντος Ἐνυαλίῳ ἀνδρειφόντῃ:
τοῖσι δ᾽ ἅμ᾽ ὀγδώκοντα μέλαιναι νῆες ἕποντο.

Now Idomeneus, a master at the spear, was in command of the Cretans,
who held Knossos * and well-fortified Gortyna *,
Lyctos, Miletus and Lycastus, with its chalk-white hills,
Phaestos * and Rhytion, cities a pleasure to live in,
plus the entire population of 100 cities * in Crete.
So Idomeneus, master spearsman, was their captain, 650
along with Meriones, a match for Enyalios *, slayer of troops.
There followed 80 black ships under their command.

Commentary:
According to Homer, Knossos, Gortyna and Phaestos were the major contributors to the Cretan contingent taking part in the Trojan War. It is astonishing that Homer attributes such a huge fleet from 100 (!) cities in Crete, especially in light of the historical fact that Knossos had fallen ca. 1400 BCE, while the Trojan War took place ca. 1200 BCE. How can modern historians reconcile this claim Homer makes, given that the very war everyone prior to Schliemann's discovery of Troy had believed was fictitious. If Homer is right about the War itself, is he possibly also right about a massive Cretan contribution to it? It is worthwhile considering, even if it results in an irreconcilable paradox.

Enyalios is an epithet fo Ares, god of War.

Fig. 5 The critical role Knossos and the 100 cities in Crete played in the Trojan War, according to Homer, in the Catalogue of Ships (lines 645-652), Book II of the Iliad

"Though many of the sign-groups are compounded from distinct elements, usually of two syllables each, there is little trace of an organized system of grammatical suffixes, as in Greek. At most, a few signs are *notably frequent* as terminals... (*italics mine*)[6] and this in spite of its great antiquity, given that it preceded the earliest known written Greek, *The Iliad* and *The Odyssey* of Homer by at least 600 years! It was a perfectly reasonable and plausible assumption, in view of the then understandable utter lack of evidence to the contrary. Besides, there were no extant tablets in either Minoan Linear A or Linear B with parallel text in another known ancient language, as had conveniently been the case with the Rosetta Stone[7], which would have gone a long way to aiming for a convincing decipherment of at least the latter script.

Yet Evans was nagged by doubts lurking just below the surface of his propositions. Though a brilliant archaeologist of the first order for his day and age – the dawn of modern archaeological methodologies and practices, with its the pervasive lack of any archaeological evidence, supportive or otherwise, of any views he might advance – he has contradicted himself more than once in spite of his clear capacity for remarkable linguistic insights. The contradictions in this passage alone are:

1. Based on the clues to the extreme antiquity of a proto-Greek society and language from the passage in *The Odyssey* cited above, Evans was tempted to take it at its face value. After all, he must have reasoned, Homer, in both *The Iliad* and *The Odyssey*, was closer than anyone in ancient Greece could get to the actual historical time frame in which the Linear B script held sway (ca. 1450-1200 BCE). Although he did not reference yet another strikingly similar passage from *The Catalogue of Ships* in Book II of *The Iliad*, Evans must have surely been aware of it. In the original and in my own translation, it reads as follows (Fig. 5).

If he did indeed take these two passages into account, one from *The Iliad* and the other from *The Odyssey*, Evans must have been hard-pressed *not* to believe the language of Linear B was some sort of (proto-) Greek.

2. He then goes on to affirm that the Dorian dialect was one of the very *last* arrivals in Crete, apparently implying that there was at least one (proto-) Greek dialect i*n situ* prior to it, i.e. before the eleventh century BCE.

3. Then, strangely, in a bizarre twist of logic, he suddenly asserts that both Linear A and Linear B share *the same language*. That is a bit of a stretch at best. Yet, even in this assumption, Evans offers a brilliant insight into one possible origin of Minoan Linear A, Luvian, a language which even to this day some researchers still consider to be its cognate. But you cannot have it both ways. Based on the assumption that the values traditionally assigned to each of the syllabograms in Minoan Linear A & Linear B are either *identical* or nearly equivalent, and given that words in the same context in these two syllabaries, Linear A and Linear B, even if both entirely undeciphered at that time (the early twentieth century) were completely *different*, it stood to reason that the language of Linear B could not have been that of Linear A, a perfectly plausible hypothesis which everyone at the time, including Evans himself, entirely overlooked. This is all the more mysterious, given that Evans did posit the entirely reasonable hypothesis that Linear A at least might have been a Luvian derivative. The significance of the clear distinction that should have been made even then between the language underlying Linear A and that of Linear B is of crucial import to our present study.

4. Last but far from least, Evans draws the implausible conclusion that the language of Linear B shows little evidence of an organized system of grammatical suffixes, such as occur in Greek, only

6 pg. 68 http://digi.ub.uni-heidelberg.de/diglit/evans1952/0076?sid=14339521ba1308ae2d5326fa9d88f789

7 Wikipedia: Rosetta Stone https://en.wikipedia.org/wiki/Rosetta_Stone

to flatly contradict himself yet again, asserting,

At most, a few signs are *notably frequent* as *terminals*; they seem to replace each other in the *same* grammatical *position* and are, therefore, *suffixes* adhering to the stem, like the substantival – especially agent – endings of the nominative in endings of the nominative in Greek -ηρ, -ωρ, -ίστης, -ίων, ανδ personal endings like -κλῆς ; ..." (*Scripta Minoa*, 68) (*italics mine*).

However, he is viewing the overall picture with his glass half empty rather than half full. I on the contrary interpret this particular finding as follows: even though there are only a few signs with terminals, given that these are *frequent* – and Evans makes a point of this – and are in all probability also suffixes and even agents, this is highly significant in and of itself. He has posited these terminals as plausible not only in context and precise word order, but also in their rôle as *suffixes* in an *inflectional language (italics mine)*. He has covered a lot of bases in such a brief statement. This is why I see his glass as half full. In this regard, the relevance of my cursive analysis of Evans' insights to our understanding of the apparent, even if partial, functionality of Mycenaean Greek grammar in the context of complementary ideograms is of great significance to the furtherance of our understanding of the actual meaning(s) of single words and even entire phrases on extant Linear B tablets, as you are about to witness in our analysis of two translations of Pylos tablet TA 641-1952 (Ventris) below.

5. He goes on to make another assertion highly relevant to our discussion of the Linear B syllabary, *with its frequent reliance on ideograms to replace what would otherwise have been discursive text*, for which there was precious little space on what are ostensibly very small clay tablets, the vast majority no wider than 15 cm., with the largest rarely exceeding 30 cm. wide by 60 cm. deep. He then abruptly cuts himself short by asserting, "The rarity, however, of continuous texts, even in the copious B series, makes all conclusions about grammatical structure precarious (*Scripta Minoa*, pp. 49-50)." Once again, in spite of himself, Evans is onto something big, though he can scarcely be blamed for not being consciously aware of the enormous implications of what he has just said here, given that he was after all the pioneer researcher in the field of Minoan-Mycenaean archaeology and linguistics. It would be too much to ask of him to have made more of what he had gleaned from the fragmentary and baffling evidence he had to work with. That he was able to make as much as he did of it is impressive enough.

Given the historical scenario I have just sketched, it certainly must have come as a shock, however pleasant, to Ventris and his esteemed colleagues, Carl Blegen, Emmett L. Bennett, Prof. John Chadwick *et al*, that the language of Linear B was a (proto-) Greek dialect. But it was. And that single revelation changed the entire time line of ancient Greek history beyond recognition. Such was the immense impact on linguistic research into ancient Greek of the astounding decipherment of Pylos tablet TA 641-1952. Prof. Chadwick himself, in his laudatory biographical study of Michael Ventris, has this to say[8]:

One afternoon in May 1953 the telephone rang in my flat in Cambridge. Michael Ventris had called me from London in a great state of excitement — he rarely showed signs of emotion, but for him this was a dramatic moment. The cause was a letter he had received from Professor Blegen, the excavator of Pylos. We knew that Blegen had found more tablets in 1952, but no one had yet examined them carefully; they had been cleaned during the winter and only the next spring were they ready for study. Blegen's letter ran:

Since my return to Greece I have spent much of my time working on the tablets from Pylos, getting them properly ready to be photographed. I have tried your experimental syllabary on some of them.

8 Chadwick, John. 1970
The Decipherment of Linear B. Cambridge, U.K.: Cambridge University Press x, 164 pp. (I)SBN 521-09596-4 (pbk.) *See* pg. 81

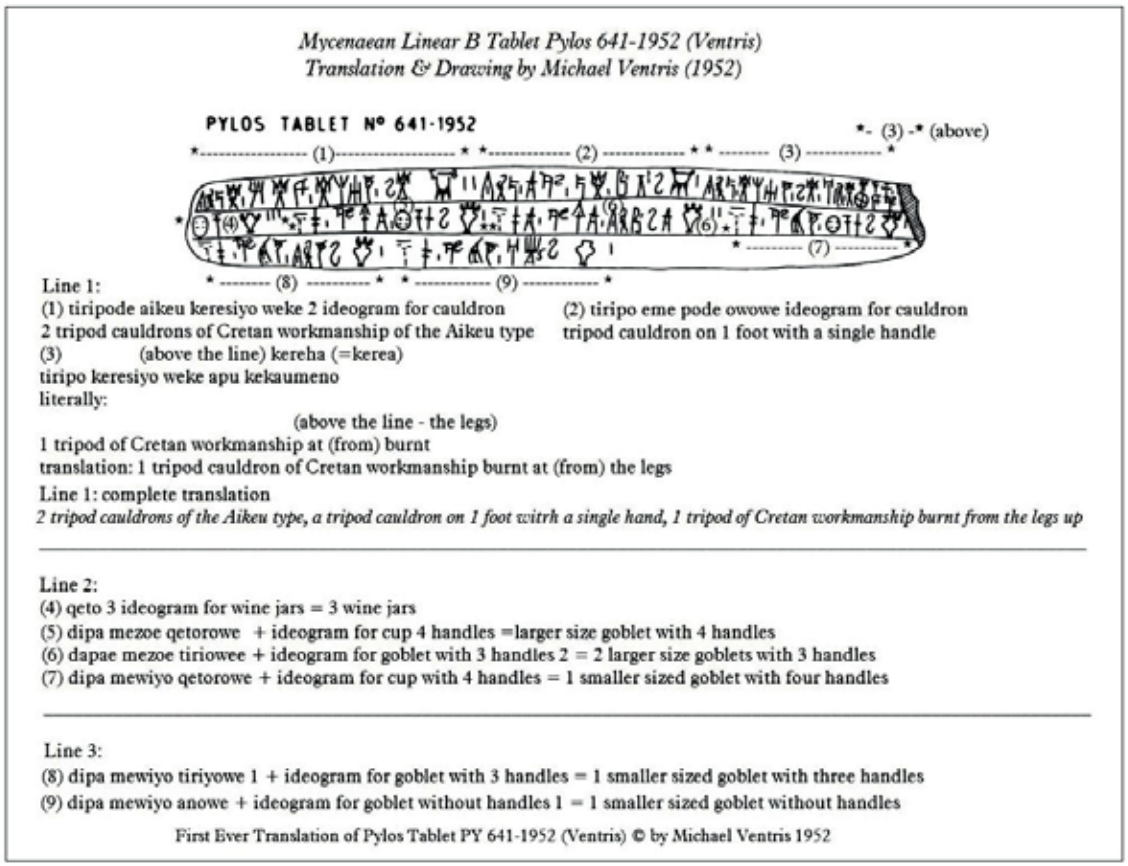


Fig. 6 Drawing and translation of Pylos tablet TA 641-1952 by Michael Ventris (1952)

Enclosed for your information is a copy of Pylos tablet TA 641-1952 (Ventris), which you may find interesting. It evidently deals with pots, some on three legs, some with four handles, some with three, and others without handles. The first word by your system seems to be *ti-ri-po-de* and it recurs twice as *ti-ri-po* (singular?). The four-handled pot is preceded by *qe-to-ro-we*, the three handled by *ti-ri-o-we* or *ti-ri-jo-we*, the handleless pot by *a-no-we*. All this seems too good to be true. Is coincidence excluded?

You can see for yourself that he can scarcely contain his excitement in actually being able to spell out the entire text of the tablet, which he had no choice but to interpret as being in Greek, however clumsy or archaic.

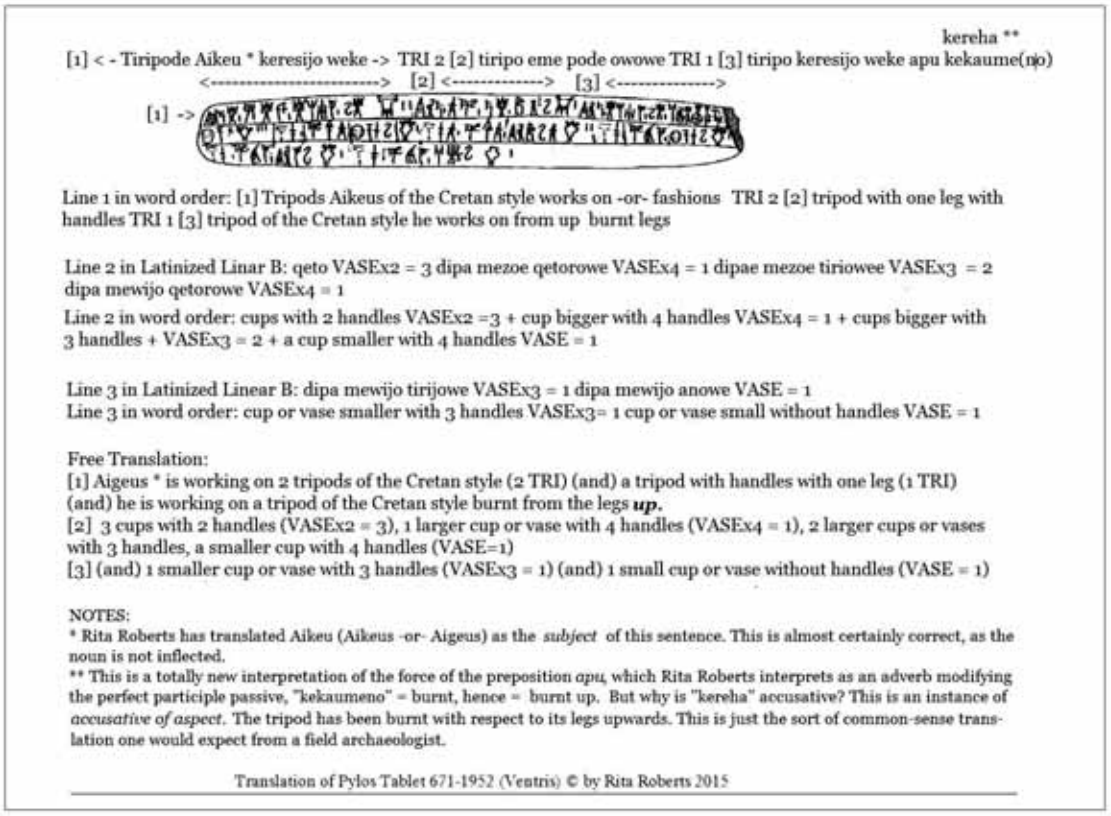
The Decipherment of Pylos tablet TA 641-1952:

Armed with this running text in Mycenaean Greek, Michael Ventris was then able to forge ahead with his truly remarkable decipherment of the tablet, which reads as follows (Fig. 6).

His translation was so convincing that he immediately won over the support of the vast majority of linguistic researchers then struggling to decipher the syllabary[9]. They simply had to admit its authenticity. He had cracked the script. It was Greek, at the very least proto-Greek, or perhaps even the earliest known ancient East Greek dialect, which in effect it soon proved to be. It was promptly dubbed Mycenaean for the great civilization which it was representative of.

Ventris' own translation, the very first ever of this justly famous tablet, is highly revelatory.

9 These included Carl Blegen himself, Prof. John Chadwick, who was utterly convinced of the authenticity of Ventris' decipherment, Emmett L. Bennett, Prof. M.S. Ruipérez, Prof. P. Chatraine (Paris) & the Hellenic Society, now known as the Society for the Promotion of Hellenic Studies (U.K.) http://www.hellenicsociety.org.uk/ See 8. above, pp. 84-85



kereha **

[1] < - Tiripode Aikeu * keresijo weke -> TRI 2 [2] tiripo eme pode owowe TRI 1 [3] tiripo keresijo weke apu kekaume(no)

<----------> [2] <----------> [3] <---------->

[1] ->

Line 1 in word order: [1] Tripods Aikeus of the Cretan style works on -or- fashions TRI 2 [2] tripod with one leg with handles TRI 1 [3] tripod of the Cretan style he works on from up burnt legs

Line 2 in Latinized Linar B: qeto VASEx2 = 3 dipa mezoe qetorowe VASEx4 = 1 dipae mezoe tiriowee VASEx3 = 2 dipa mewijo qetorowe VASEx4 = 1

Line 2 in word order: cups with 2 handles VASEx2 =3 + cup bigger with 4 handles VASEx4 = 1 + cups bigger with 3 handles + VASEx3 = 2 + a cup smaller with 4 handles VASE = 1

Line 3 in Latinized Linear B: dipa mewijo tirijowe VASEx3 = 1 dipa mewijo anowe VASE = 1

Line 3 in word order: cup or vase smaller with 3 handles VASEx3= 1 cup or vase small without handles VASE = 1

Free Translation:

[1] Aigeus * is working on 2 tripods of the Cretan style (2 TRI) (and) a tripod with handles with one leg (1 TRI) (and) he is working on a tripod of the Cretan style burnt from the legs ***up.***

[2] 3 cups with 2 handles (VASEx2 = 3), 1 larger cup or vase with 4 handles (VASEx4 = 1), 2 larger cups or vases with 3 handles, a smaller cup with 4 handles (VASE=1)

[3] (and) 1 smaller cup or vase with 3 handles (VASEx3 = 1) (and) 1 small cup or vase without handles (VASE = 1)

NOTES:

* Rita Roberts has translated Aikeu (Aikeus -or- Aigeus) as the *subject* of this sentence. This is almost certainly correct, as the noun is not inflected.

** This is a totally new interpretation of the force of the preposition *apu* which Rita Roberts interprets as an adverb modifying the perfect participle passive, "kekaumeno" = burnt, hence = burnt up. But why is "kereha" accusative? This is an instance of *accusative of aspect*. The tripod has been burnt with respect to its legs upwards. This is just the sort of common-sense translation one would expect from a field archaeologist.

Translation of Pylos Tablet 671-1952 (Ventris) © by Rita Roberts 2015

Fig. 7 An archaeologist's thoroughly researched translation of Pylos tablet TA 641-1952 (Ventris) (2015)

Even with reference to it alone, we can draw the following conclusions with confidence.

1. On this Linear B tablet alone there appear no fewer than 5 ideograms for vessels (tripods, cups, vases, amphorae and pithoi), which is to say 16.7 % of all 30 ideograms for vessels in Linear B (*see* Table 1 *supra*). That is an impressive showing for just one tablet!

2. The *diversity* of the ideograms for vessels on this tablet alone is equally striking. All five are different, while those for vessels other than tripods, i.e. amphorae, cups, vases or pithoi (for the storage of olive oil or wine) reveal marked differences from one another. Ventris' decipherment makes this plain.

3. The emphasis which the scribe places on the varying *sizes* of the cups, vases, amphorae or pithoi as expressed through the ideograms inscribed on this tablet is of great significance. It certainly mattered at lot, not only to him, but to *all* Mycenaean scribes, regardless of site, because these distinctions were critical with reference to items in inventories of vessels which all Minoan/Mycenaean palatial establishments kept strict close track of.

4. It is quite clear from even this single tablet focusing on vessels in Linear B that the scribe, and indeed all the scribes indentured to their respective palatial administrations, were experts duty-bound to classify all vessels they kept such close track of by (a) size (b) class & (c) type. The distinctions made by size overlap with those made by class and type, and in fact are a function of the latter two. From the evidence drawn from extant tablets at Knossos and Pylos alone, their palace administrations demanded a strict account of all transactions related to the measurement by size, classification and typology of all vessels and pottery of any description whatsoever in their manufacture, dissemination and trade (export and import) and in their rôle in commercial and religious transactions in the Minoan/Mycenaean

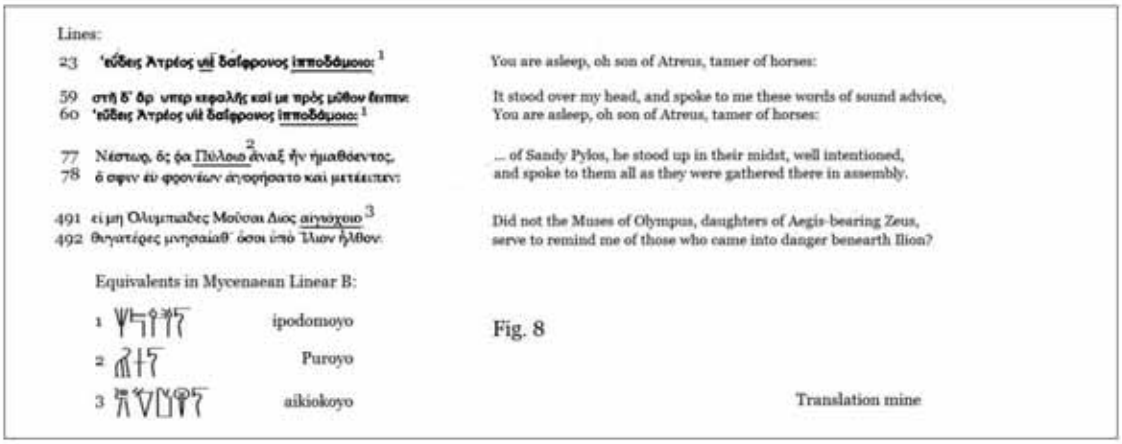


Fig. 8 The archaic Mycenaean genitive in -oio- in The Catalogue of Ships, Iliad, Book II

social economy. Records abound. And what was true for Knossos and Pylos must have also been the case for Chania, Phaistos, Zakros, Mycenae, Tiryns, Orchomenos, Boeotian Thebes, Athens and all other centres of Minoan/Mycenaean economic intercourse.

But if Ventris' decipherment of Pylos tablet Py 641-1952 is revelatory, that of Rita Roberts (2014)[10] is considerably more so. Let's take a good close look at her translation, and see what further significant conclusions we can draw from it. In Ventris' first translation, occasional errors were made, but these are understandable, given that his was the first attempt ever at decipherment of such a long tablet in Mycenaean Linear B. In fact, under the circumstances, it is amazing that Ventris did not make more errors, or perhaps not so amazing at all, Ventris being the genius he was. Later translations attempted to recast the opening phrase of the tablet, but they too are not truly satisfactory. Rita Roberts' translation sets out to rectify such errors, as illustrated here (Fig. 7).

NOTE: In this translation, the designations TRI, VASE, VASEx2, VASEx3 & VASEx4 signify tripod, vase with no handles, kylix vase with two handles, kylix vase with three handles & a large vase or vessel with *multiples of* four handles (pithos).

Her translation makes eminent sense. An earlier translation which would have it that Aigeus the Cretan would *bring* the tripods makes little or no sense. To whom and more to the point, why on earth would he be bringing any vessels to anyone, unless he were a middleman in the economic infrastructure of the pottery production industry? Yet in so far as I am aware, there is no direct evidence in research literature drawn from extant tablets in Linear B of middlemen in any sector of the Mycenaean economy. Additionally, the second translation interprets *keresiyo* as nominative, which is patently impossible, since the most archaic form of the genitive, terminating with *iyo* (or *ijo*) in Mycenaean Greek, is still relatively

10 Rita Roberts is an archaeological ceramicist whose overall pottery analysis studies range from the Neolithic period to the Bronze Age, Iron Age, and from the Roman to the Medieval to post Medieval. She was first employed in England by the Hereford and Worcester County Council 'Archaeology Section' from 1981 to 1992, assisting with finds from archaeological sites in Droitwich, Hanbury Street, Friar Street and Upwitch, where she was involved from the beginning of the excavation with analysis of all the pottery which ranged from the Iron Age to Roman and Medieval, and with other material finds such as flint, bones and Roman glass. After retiring to Crete, Greece, she worked on Minoan pottery from the archaeological sites of Mochlos, Petras and Gournia and in conservation at the laboratory of the Institute for Aegean Prehistory Study Center for East Crete from 2003 to 2014. She has also assisted with finds of skulls and bones from the cave burial site at Charalambos. Mrs. Roberts learned to master Mycenaean Linear B from the present author.

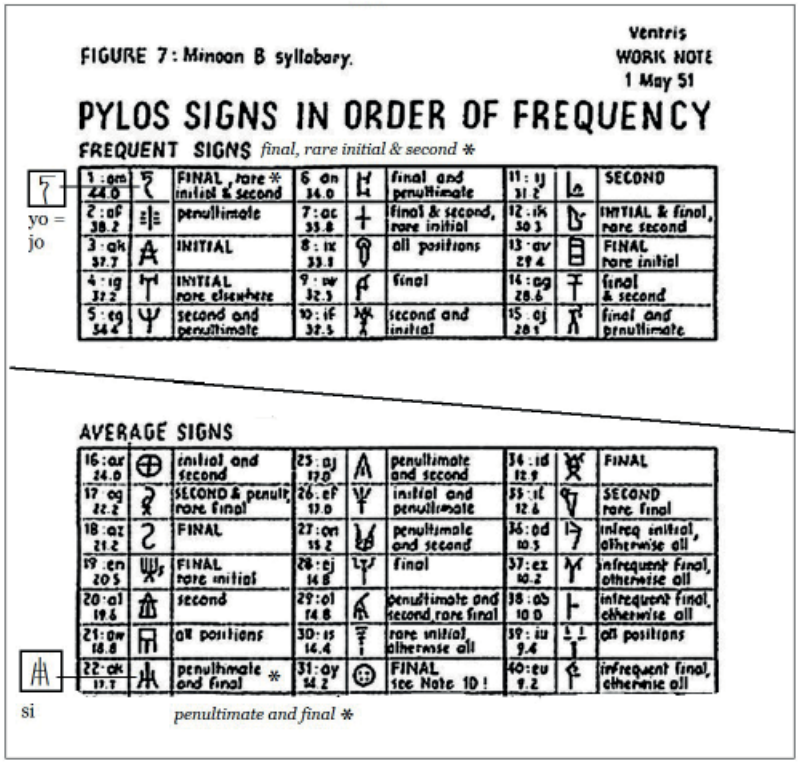


Table 3 Pylos signs (syllabograms) in order of frequency, Ventris Work Note 1 May 1951

commonplace in *The Catalogue of Ships* of Homer's *Iliad*, some six to seven centuries later, as illustrated in these instances from my own translation here (Fig. 8)

It is extremely unlikely *keresiyo* modifies *Aikeu*. But there still remains another possible rendition of the opening phrase. It could be set in the *genitive absolute*. If this is the case, then the phrase might mean something like, "Aigeus (the potter) has 2 tripods of the Cretan style *in stock*." Linear B tablets frequently cite the name of the agent (subject), but rarely supply the verb connecting it with the object, although in this somewhat exceptional case the object is specified *tiripode* (accusative plural). As I discovered in my thorough-going research into some 3,000 extant tablets from Knossos which I carefully read throughout the latter half of 2013 and all of 2014, this phenomenon is particularly striking on scores of tablets on some 700 agricultural tablets from Knossos citing sheep alone as livestock. Unfortunately, the present study does not offer us the scope to focus on the requisite in-depth contextual analysis of those tablets, however significant the implications of such research are... as they most certainly are.

Nevertheless, the difficulty here is that there is no way of our knowing whether or not the genitive absolute was in common or even occasional use in the Mycenaean Greek dialect, given its great antiquity. I for one remain doubtful. For this reason and this reason alone, Rita Roberts and I have decided to settle for the translation you see above. And here we recall the point I made earlier over Sir Arthur Evans' fortuitous insight: "At most, a few signs are *notably frequent* as *terminals*; they seem to replace each other in the *same* grammatical *position* and are, therefore, *suffixes* adhering to the stem, ..." Instead of downplaying this momentous discovery of his, we can readily make the following sound observations firmly based on Michael Ventris' own meticulous statistical compilation of the frequent repetition of two highly significant terminations in Mycenaean

		Description	Qty.
Carriage bolt		<--- 0 ---> Carriage bolts are used to fasten metal to wood. The undercut of the bolt is square to hold the bolt in place. 2a 1 2c	2,250
Elevator bolt		Bolt with a flat, plain or countersunk head with a squared undercut to hold the bolt in place. Common in conveyor systems. 2b 2c 2c	1,500
Flange bolt		<--- 0 ---> 3 2c Flange bolts have an integral washer on the undercut of the bolt head. Also known as frame bolts. 1	2,750
Hex or Tap bolt		<-- 0 --> 3 Hex bolts have six-sided heads. Tap bolts are threaded the entire length of the shank. 1	3,750
Lag bolt		<-- 0 --> Lag bolts are also called lag screws, with their own mating thread. 2b	1,400
Machine bolt		<---- 0 ----> Machine bolts are meant for assembling metal components through pre-drilled holes with an accompanying screw. These are more commonly called machine screws. 2b	2,800
Plow bot		2b 2b With a countersunk head, a square shank, and a unified thread pitch, plow bolts are durable and common in construction devices. 2b 6 2c	1,350
Square head bolt		<------ 0 ------> A square head bolt is a four-sided bolt with a machine screw. 2b	2,575
T- head bolt		<---- 0 ----> 3 A T-head bolt has a T-shaped head which can fit into a slot or can be gripped easily with a wrench. 2a 2b	1,250

NOTES re. grammatical relations: 0 = nominative 1 = genitive 2a = dative 2b = instrumental 2c = locative 3 = accusative. *If* this inventory were in an *inflected language* with any or all of these cases, the inflections would be clearly identified. Modern inflected languages include German, Greek & Russian.

Table 4 Richard's Hardware, Ottawa, Ontario, Canada: Inventory of bolts in stock

Linear B on the tablets at Pylos alone, these being the *genitive singular* and the *dative plural*, as illustrated here in Table 3, an excerpt from Ventris' "Figure 7: Minoan B Syllabary: Ventris WORK NOTE 1 May 51": (Table 3)

One glance at Ventris' grid of 1 May 1952 lends full and unequivocal credence to Evans' own observations. The termination **j**o *genitive singula*r, *yo* or if you like *jo (Linear B Latinized),* accounts for no less than 44.0 % of all syllabograms on all extant tablets from Pylos! That is a staggering frequency. Evans had it bang on. Now take the syllabogram *si (Linear B Latinized)*, which is the standard Mycenaean (as well as Homeric) termination for the *dative plural*. While tagged as a sign of average frequency, it still accounts for 19.7 % of all syllabograms on all extant tablets from Pylos. Just what am I driving at? These statistics are astonishingly revealing. On the one hand, Evans is entirely on the money when he asserts that "there is little trace of an organized system of grammatical suffixes, as in Greek." But then he misses the point entirely, failing to recognize the extreme significance of the fact that these two syllabograms alone account for 63.7 % of all syllabograms on extant tablets from Pylos! Just what can this imply? A very great deal. It just so happens that these two terminations, i.e. *these two cases predominate over all others on all extant tablets in Mycenaean Linear B, inclusive of all verbal endings*. Why so? We need only turn to examples of modern inventories to glean the reason. Modern inventories in *inflected* languages such as Greek, German and Russian, usually in the form of spreadsheets or itemized lists, place all serialized items in the nominative singular or plural only. The two *oblique cases* which figure prominently and often exclusively on inventories in inflected languages, ancient and modern, are the *genitive singular* and *dative/instrumental/ locative singular* (sometimes) and *plural* (often). Table 4, a standard inventory of bolts in a fictitious Canadian hardware store in Ottawa illustrates my point unequivocally.

Even though this small inventory is in English, the first thing we notice is that, with the exception of 2 entries which have a direct object, each bolt is itemized as subject with the copulative verb "to be". This is *the* prime characteristic of all inventories, ancient and modern. Items either stand alone, falling quite outside of the structural imperatives[11] underlying sentence or phraseological constructs, or they are simply complemented by the copulative "to be". Hence, in any inflected language, ancient or modern, itemized elements are almost always *uninflected* (nominative singular or plural). We must keep this point firmly mind at all times if we are to accurately grasp the essential underlying structure inherent in all inventories, ancient or modern.

Secondly, all of the prepositional constructs in this English language inventory make it abundantly clear that if it were compiled in any ancient or modern inflected language, such as German, Greek or Russian, the 2 cases which would appear with the greatest frequency are in fact the genitive and dative/instrumental/locative. In other words, even in those instances where cases enter into the equation in inflected languages, ancient or modern, the words or phrases are in almost all cases inflected solely as a function of the main entries in the nominative which they modify, and nothing more. So the nominative is dominant over all inflections, without few or no exceptions. All this boils down to one fundamental point: inventories are *not* sentences, because they are never meant to be. Hence, complex inflectional constructions are the exception rather than the norm. Certainly, the highly refined and elegant grammatical structuralism so typical of ancient classical Greek, as attested in the prolific prose of the Attic dialect, is utterly absent from Mycenaean Greek inventories in Linear B. It cannot be otherwise.

In the almost total absence of sentence structure in Linear B, what then are the predominant characteristics of Mycenaean Greek inventories in

11 Wikipedia: Structural Linguistics https://en.wikipedia.org/wiki/Structural_linguistics

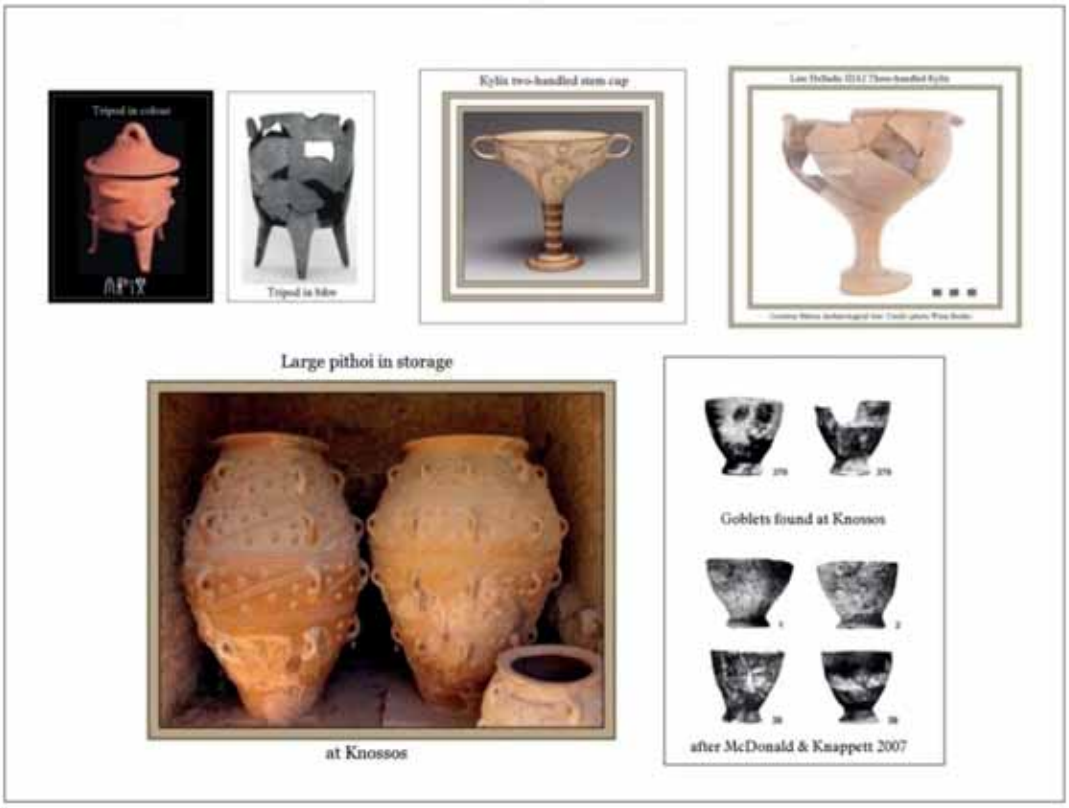


Table 5 Types of vessels mentioned on Pylos tablet TA 641-1952 (Ventris)

Linear B? To summarize, these are, to a fault,

1. extremely repetitious text, characterized by highly *formulaic* stock phrases;

2. the presence of the uninflected nominative in almost all entries, with exceptions being extremely rare;

3. the relatively frequent presence of the genitive and dative/instrumental/locative singular and plural, but *only as adjuncts* to the uninflected nominative of their primary itemized elements;

4. the rarity of the accusative case, for lack of direct objects on the vast majority of extant tablets.

These observations serve to underscore the fact that *the accusative* in Mycenaean Linear B comes close to being absent from the inventories on extant tablets, regardless of provenance. This goes along way to clarifying why it is so damnably difficult to reconstruct declensions in Mycenaean Greek. Inventories are not concerned with who did what to whom (singular), in other words, they are unconcerned with the notions of the inflectional syntactical constructs, nominative-verb-accusative-dative singular as posited by structural linguistics[11*bis*] of the twentieth century. They are merely itemized lists *of* objects or commodities where the numerical count is nominative singular (units) or plural (multiples) of the aforementioned objects *of* commodities (*genitive*), with the additional proviso that such commodities may serve a useful purpose *for* something *to* (both *dative*) certain agents or sectors of the Minoan/Mycenaean economic infra- and superstructure. To expect otherwise is to ask for pie in the sky.

Pylos tablet TA 641-1952 serves a perfect example illustrative of the repetitive use of the genitive singular in an itemized inventory.

Yet Mrs. Roberts' perspicacious decipherment brings a great deal more to bear on the decipherment. As an archaeologist, she has succeeded at

last in doing what no one has done before: she has specifically identified the types of each and every one of the vessels inventoried on this tablet viz: (Table 5)

It is worthwhile noting it this regard that Mrs. Roberts has cited the ground-breaking findings of McDonald and Knappett (2007)[12] since they were the first to pointedly draw attention to the fact that they were explicitly interested in unearthing the simple, unadorned earthenware handle-less goblets no archaeologists prior to them could even bothered with a major oversight unworthy of the field of professional archaeology. It is after all these selfsame goblets which Pylos Tablet PA 641-1952 (Ventris) itemizes as *anowe*, meaning *without* handles.

Her well-honed investigative skills as an archaeologist have thus facilitated a ground-breaking translation, the first ever which clearly reflects the actual meanings the scribe assigned to each vessel. It cannot come as any surprise that the scribes, who after all were assigned the sole task of inventorying down to the very last detail the palatial assets at each Mycenaean centre of any economic import, must not have stinted in their efforts to ensure that their inventories, regardless of sector, rendered a totally accurate account of all items in the local economy. So the text can now be translated with significantly greater accuracy as:

Aigeus is working on 2 tripod cauldrons of the Cretan style, a tripod with handles on one *remaining* * leg, on a tripod of the Cretan style burnt from the legs up, on 3 *kylix* cups with 2 handles, on 1 (olive oil or wine) pithos **, on 2 larger kylixes with 3 handles and one small *goblet* with *no handles*.

The first observation we should make here is that of the deliberate insertion I have made of the word "remaining". It is there in the English to make it quite clear that the other two legs are missing... two legs because the tripods unearthed at Knossos all had three (*see* illustration above). Next, it is obvious to an observant reader that this is a translation into a version of Greek much later than Mycenaean, possibly even as late as classical Ionic or Attic, since the word for *pithos*, which is nowhere attested on any extant tablet in Linear, almost certainly did not exist in Mycenaean Greek. However, it is apparent to anyone who is an archaeologist that a *pithos* **, such as any of those found at Knossos, as illustrated above is by default "a (much) larger vase with 4 handles". Or is it just 4 handles? More to come on that sticking point.

Likewise, the 2 and 3 handled vases are almost certainly kylixes. Again, the word kylix (a type of drinking vessel) would likely not have been in use in Mycenaean Greek. Finally, no fewer than 6 small drinking vessels or goblets were unearthed at Knossos, after McDonald and Knappett (2007) (*see supra*). So as for the small vessels with no handles, we can pretty much rest assured that the appropriate translation is "small goblets", with the emphasis on small, because the text on the tablet makes this *explicit*. In the final analysis, Mrs. Roberts' translation would surely read as we have given it here. However, it still is incumbent upon us to render it as an accurate reflection of the original Mycenaean, and in that context it reads as follows:

Aigeus is working on 2 tripod cauldrons of the Cretan style, a tripod with handles on one leg, on a tripod of the Cretan style burnt *from the legs up*, on 3 smaller cups with 2 handles, on 1 larger vase with 4 handles, on 2 larger cups with 3 handles and one small goblet with no handles.

This is effectively the original Mycenaean Greek version of the classical translation I have given above. For all intents and purposes they say exactly the same thing.

Yet, there still remains one outstanding difficulty, and it is a real stickler. Why does the ideo-

12 Knappett, Carl, Mathioudaki, Iro & Macdonald, Colin F. 2007
Stratigraphy and ceramic typology in the Middle Minoan III palace at Knossos, document in preparation: 9-19 https://www.academia.edu/2950003/Stratigraphy_and_Ceramic_Typology_in_the_MM_III_Palace_at_Knossos (Note: Apparently this paper has never been published in print)

gram for a pithos, which has not four, but *multiples of four* handles on its sides, show only 4 handles on top? If we take a good hard look at the photographic illustration above, what do we see? – not one but two giant pithoi from Knossos, one sporting 24 and the other 32 handles! In other words, we have 6 and 8 multiples of four. To date, there is not a single reference to this actuality anywhere in the archaeological literature on Minoan-Mycenaean vessels, because no one has bothered to pay any attention to it. But there we have it, staring us squarely in the face. I specifically had to make a request to my colleague, Rita Roberts, in Crete, to verify my calculations. They in fact turn out right on the money[13].

This might pose a problem for those archaeologists and linguists in Mycenaean studies who take ideograms to *literally* represent the objects they portray, but such is scarcely the case, neither in Mycenaean Greek nor in any other ancient syllabary or hieroglyphic script, where great liberties were taken for the sake of practical functionality and standards of formulaic uniformity enforced by the scribal guilds. It would have been downright impossible for the scribes to portray a multiple series of handles in *three dimensions* on the side of a pithos calqued onto a *two-dimensional ideogram*. In other words, the ideogram for pithos is not only standardized, it is *formulaic*, just as *all* ideograms are, and in addition, as the vast majority of Mycenaean Greek *texts* are. To ram the point home, we clearly observe on this single tablet that the text "of the Cretan style" is serially repeated, as are its attendant ideograms, twice in a row. Such a solution was not only practical but clear cut to themselves, as scribes. It does not matter one jot whether we, in the twenty-first century, find this strategem counter-intuitive. My point, the very same I made in my presentation, "The Rôle of Supersyllabograms in Mycenaean Greek" at The Third Interdisciplinary Conference, "Thinking Symbols", June 30-July 1 2015, at the Pultusk Academy of the Humanities, simply is this, and I quote:

They (supersyllabograms) are there because the scribes, as a guild, all understood perfectly well that each and every supersyllabogram always meant one thing and one thing only to them in its proper context. The very notion of future interpretations of what was obvious to them as accountants would have never entered their minds. But we owe it to ourselves to decipher as many supersyllabograms as we can. Otherwise we learn nothing of value to the field of historical linguistics in Mycenaean Linear B.

And what applies to supersyllabograms (see *infra*) equally applies to formulaic Mycenaean *text* and to *ideograms* in all sectors of the Mycenaean economy and society. In effect, the Mycenaean scribes carried these 3 formulaic practices to the extreme on some 800 of 3,500 (22.86 %) extant tablets from Knossos alone, and on *all* of the extant tablets concerned with pottery from Pylos. To summarize, Mycenaean Greek texts in Linear B are formulaic on at least four counts:

Mycenaean *text* on extant tablets is routinely formulaic to the extreme.

Mycenaean *ideograms* are likewise formulaic in in all instances, completely standardized, which is to say, invariable, on all tablets at all sites regardless of provenance (Knossos, Pylos, Mycenae and Thebes)

Linear B homophones, a.k.a. *logograms*, are also practically invariable, with very few minor exceptions.

Supersyllabograms, which are rampant on extant tablets from Knossos, appearing on some 700 out of 3,500 relatively intact tablets (exclusive of fragments), are also *invariably standardized*. I shall address the massive key rôle supersyllabo-

13 Mrs Roberts asserts, "Our librarian at Knossos has seen them (the pithoi) *in situ* and as she remembers there were *three more rows of handles* at the back so that makes 32 handles in all. So many handles were there for ropes to be passed through for ease of transportation." Mrs. Roberts is referring to the fact that the librarian was able to see 1 set of 4 handles from the front, but that by looking all the way around the largest pithoi, she saw 3 more sets of 4, hence, the total of 32. Moreover, slightly smaller, but still quite large, pithoi, have 3 sets of 4 handles, for a total of 24.

grams play in Mycenaean Linear B tablets in the last section of this article. Supersyllabograms are my own definition for what previous researchers have all tagged as "(surcharged) adjuncts". While most supersyllabograms appear to be mere "adjuncts", none really are, and many are not adjuncts at all. This discovery of mine is nothing short of revolutionary to the field of decipherment of Mycenaean Linear B, as we shall shortly see.

But there is more. Ideograms, which frequently appear on the vessels tablets from Pylos and Knossos alone, and which proliferate on tablets in all sectors of the Minoan-Mycenaean economy, are quite often more than mere ideograms. Just as photographs of each line item often appear in any modern inventory such as our fictitious hardware inventory of bolts, as we have already seen, ancient inventories, at least those in Mycenaean Linear B, used ideograms as markers or *subject headings* to unequivocally flag the contents of each tablet on which they appeared. These ancient ideograms are *two-dimensional* images superimposed as elemental constructs on the tablets. They are equivalent to the *three-dimensional* (digital) photographs serving the same purpose in modern inventories. In this light, it becomes easier for us nowadays to understand why the Linear B scribes were forced to resort to depicting a maximum of 4 handles on the ideograms for the largest vessels they inventoried. In the absence of three-dimensional constructs, they had no other choice. An ideogram with 8, let alone 16, 24 or 32 handles, would have looked messy at the very least, and would have been totally unwieldy in any case. But this still leaves us with one final question. Why did the scribes superimpose the 4 handles on top of the largest vessels they wished to portray via ideograms? I can see at least three reasons: (a) since they did so for kylixes with 2 and 3 handles, even though these too sometimes also had handles on their sides, then why not for pithoi as well? (b) to ensure that the agreed upon ideograms were as simple and streamlined as possible so that all scribes could incise them with relative ease and (c) for the sake of formulaic uniformity, all of which practices are common in almost all ancient hieroglyphic scripts, and in syllabaries sporting ideograms.

To summarize, the commonplace functionality of ideograms as subjects speaks a great deal to the sophistication of Mycenaean Linear B, a syllabary considerably more complex than most other ancient scripts, even the later alphabetic, such as Greek and Latin. That this is the case becomes even more obvious as we turn our attention to the most striking phenomenon of them all on so many hundreds of Linear B tablets. I speak of the widespread presence of supersyllabograms.

An introduction to supersyllabograms in the vessels and pottery sector of Mycenaean Linear B:

Recent research leading to the discovery of supersyllabograms in Mycenaean Linear B:

As far as I can tell, Enriqueta and Tina Martinotti[14] are the sole researchers who have, to date, come to the very brink of isolating and defining supersyllabograms. It is expedient to review the real substance of their findings, through the excerpts in their study which follow (my English translation follows the original French text):

Commençons par analyser «l'axiome» selon lequel le Linéaire B est une «écriture double» utilisée pour écrire des listes comptables. Il s'agit d'un axiome que (*sic - qui*) n'a de correspondance dans aucun autre système syllabaire... *passim*... D'autres signes, par groupes de deux à sept, qui précédent (*sic - précèdent*) ces idéogrammes, furent interprétés comme des «mots»... *passim*... Aujourd'hui on considère que le Linéaire B est une écriture tout à fait différente des autres systèmes syllabaires – *elle utiliserait des signes phonétiques et des signes «idéographiques», ensemble ou séparément, pour écrire deux fois la même chose, l'une étant la «chose», l'autre étant un «aide mémoire» qui répète ce qu'est la «chose» (en italiques selon moi-même)*. Un sys-

14 Martinotti, Enriqueta et Tina. 2008
Linéaire B; le préjugé comptable et pictogaphique d'un syllabaire logographique, phonologique et polysémique, hal 00311652, version 3. 10 Sept., 2008: unpaginated

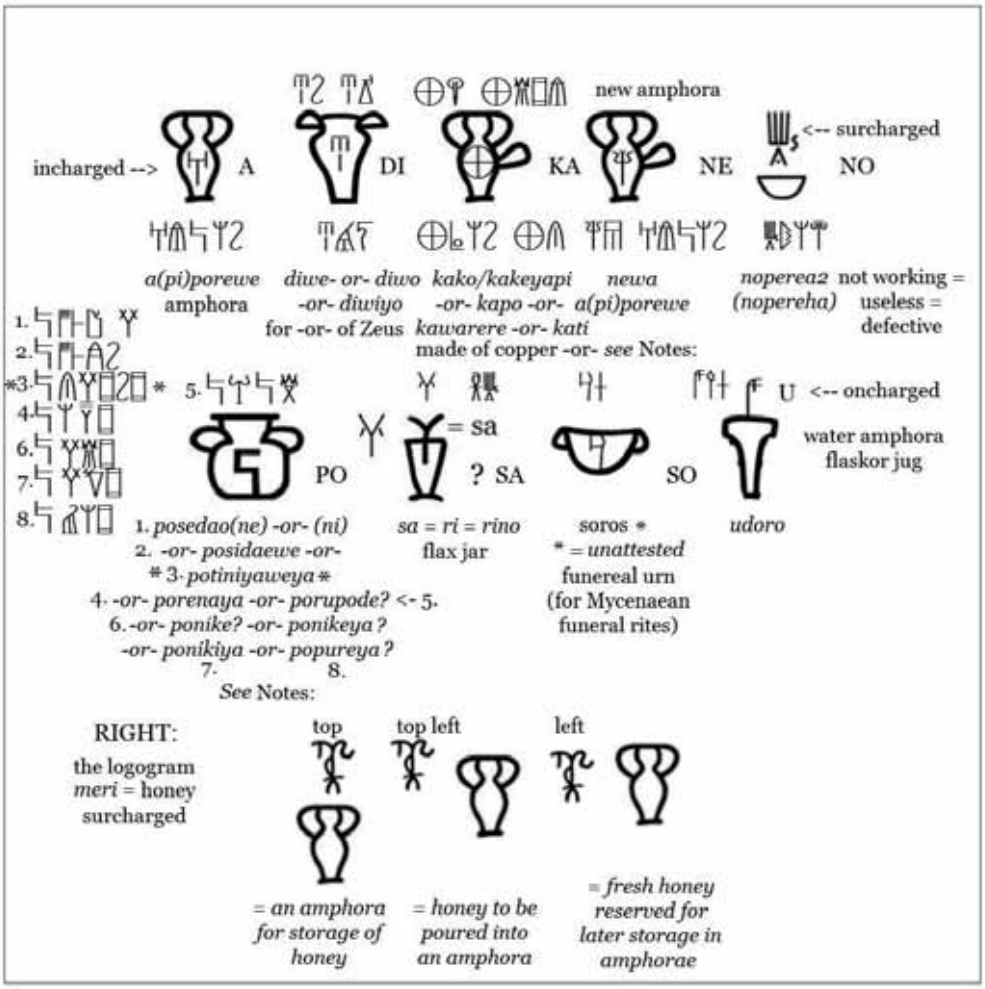


Table 6 Supersyllabograms in the vessels sector in Mycenaean Linear B

tème donc de type «double», unique au monde. Et qui, en outre, serait la seule écriture connue à usage exclusivement administratif et comptable... *passim*... L'idéogramme est susceptible d'une lecture par ce qu'on peut appeler rébus, par lequel on signifie un mot en se servant d'un logogramme dont la lecture phonétique révèle ce qu'on veut faire entendre. Le rébus peut engendrer aussi des variantes polysémiques ou homophoniques... *passim*... Lorsque des syllabogrammes paraissent en série, cela ne conduit pas nécessairement à un mot de manière absolue. *Chaque syllabogramme est aussi un mot (en italiques selon moi-même)*. Pour les distinguer il faut chercher les significations de chaque signe en tant que lexème, en se servant de la polysémie comme cela se fait dans l'interprétation des autres systèmes syllabaires.

Let us begin by analyzing the "axiom", according to which Linear B is defined as a "double script" used to write accounting inventories. As this axiom would have it, this phenomenon corresponds in no way to any other syllabary system... *passim*... Other signs, preceding ideograms in groups ranging from two to seven, have been interpreted as being "words"... *passim*... Today, we usually consider Linear B as a script totally unlike other (ancient) syllabic systems – *it alone would appear to employ phonetic and "ideographic" signs, both in conjunction and separately, to write out the same item twice, one instance being the "item" in and of itself, the other serving as an "aide-mémoire" to it, which essentially recounts what the "thing" means (italics mine)*. So we have here a "double" system, unique in the world (past

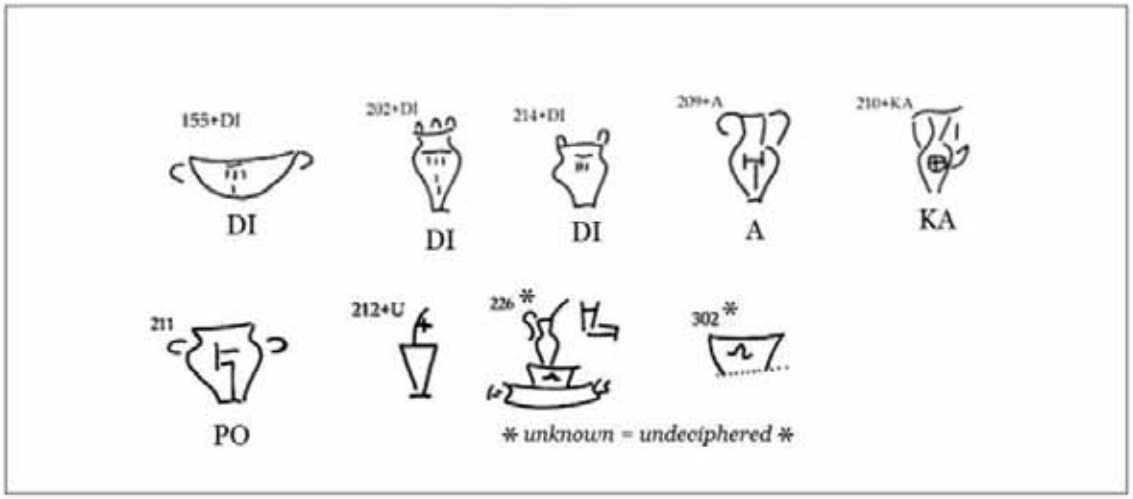


Table 7 Facsimiles of supersyllabograms for vessels in Mycenaean Linear B (mostly from Knossos)

and present), which besides would appear to be the only script ever known for use in the administrative and accounting sector exclusively... *passim*... Each ideogram is subject to a reading which we can typify as being what is commonly called a rebus, a procedure whereby we utilize a logogram to signify a word. The logogram facilitates a phonetic reading revealing what the scribe wishes to convey. A rebus is also able to give rise to polysemic and homophonic variations... *passim*... The mere fact that syllabograms do appear in series does not necessarily imply absolute reference to a single word. *Each syllabogram is also a word (italics mine)*. In order to draw distinctions among them, it is necessary to ferret out the meanings of each sign as a lexeme in and of itself, with reliance on polysemics as they apply equally to the interpretation of other syllabary systems[14].

So now the burning question is, what on earth are supersyllabograms? Although the Mycenaean scribes never called them that, any more than they referred to syllabograms as such, they were perfectly aware at the conscious level what both of these phenomena constituted. This excerpt from our presentation at the Pultusk Academy of the Humanities, July 1, 2015, provides a succinct definition of supersyllabograms.

Now to the question of supersyllabograms. What are they, and what rôle do they play in Mycenaean Linear B? Some of the tablets I examined had *single* syllabograms *only* on them, and *no text whatsoever*. The question was, I had to wonder – and I mean I really had to wonder – why on earth was there no text and what did all these single syllabograms mean? The answer was not long in coming.... this syllabogram (*ze*), which is the first syllable of the word *zeukos* (a pair)... *passim*... is paired with the ideogram for, guess what, a chariot wheel! So the syllabogram *ze* is the first syllable of the Mycenaean Linear B word or phrase it symbolizes. That is exactly what a supersyllabogram is, *a syllabogram symbolizing an entire Mycenaean Linear B word or phrase*.

By default and without exception, *all* supersyllabograms are the *first syllabogram*, in other words, *the first syllable*, of one particular Mycenaean Linear B word or phrase only and *none other*, which is always *strictly dependent on the specific context of the economic sector of the Minoan-Mycenaean economy* in which it appears (*all italics mine* throughout this entire section). Change the context of the economic sector, for instance from the agricultural to the military or the vessels sector, and you *automatically* change the meaning of the supersyllabogram, with very few exceptions (the syllabogram ne *(*Linear B Latinized), invari*ably* meaning *newo* (masc.) newa (fem.) (Linear B Latinized) or "new" in all sec-

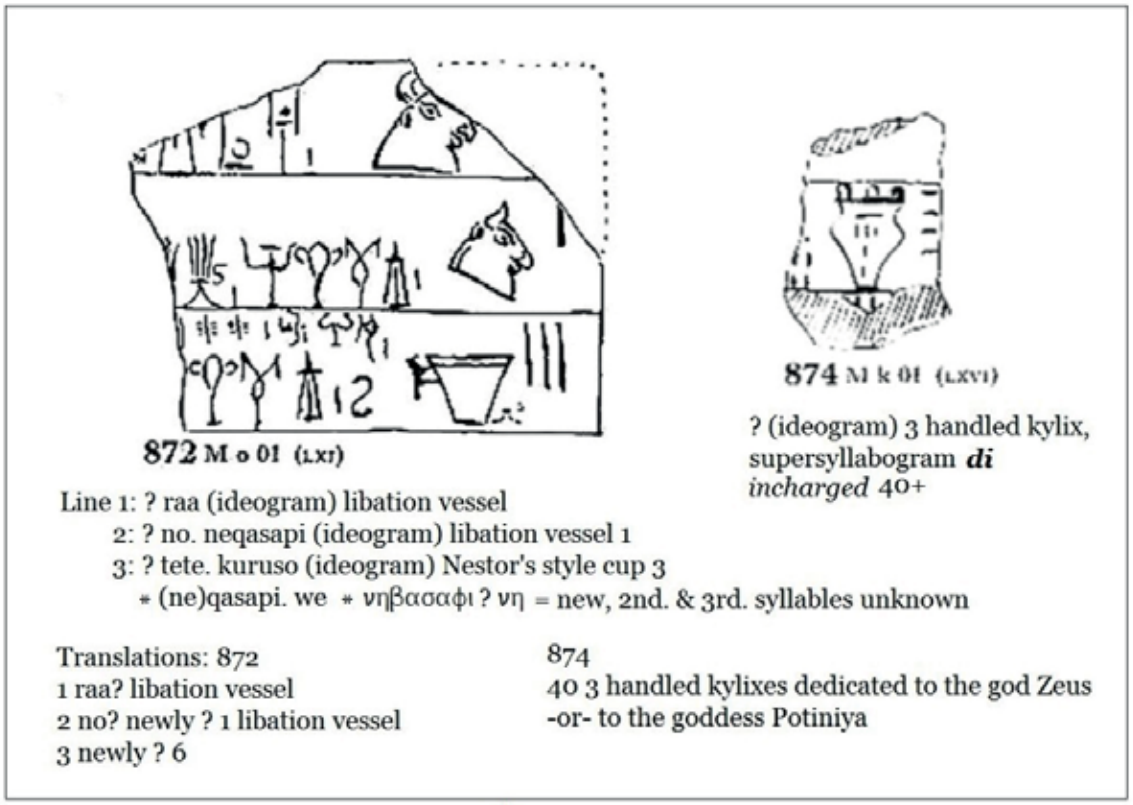


Fig. 9 The supersyllabogram DI in the vessels sector of the Mycenaean economy

tors being the most conspicuous). All such single syllabograms, without exception, appear either (a) a*djacent to* the ideogram or (b) *inside* the ideogram they qualify, and (c) they repeat themselves over and over, like clockwork. Supersyllabograms which appear adjacent to their ideograms are invariably *associative*, while those which appear inside their ideograms are invariably *attributive*. Associative supersyllabograms, which appear primarily and in droves in the agricultural sectors of the Minoan-Mycenaean economy, are either *surcharged,* appearing to the top right or occasionally to the top left, or *supercharged*, appearing right on top of the ideogram they qualify. Attributive supersyllabograms are invariably *incharged*, bound inside the ideogram they qualify. In this article introducing the phenomenon of supersyllabograms in Mycenaean Linear B, we shall be dealing primarily with incharged supersyllabograms, which are characteristic of the pottery and vessels sector of the Minoan-Mycenaean economy.

In 2014, extrapolating my findings to the vessels sector alone of the Minoan-Mycenaean economy, I wasted little time in identifying and classifying the supersyllabograms-cum-ideograms in the vessels sector alone of the Minoan-Mycenaean economy. There are 10 of them (See Table 6 above).

Two supersyllabograms in particular call for clarification.

The first of these is ka *(Linear B Latinized)*, to which I have assigned four (4) possible variant meanings. The most obvious of these is the first, kako χαλχόν ,then *kako* χαλχόν + *kakeyapi* χαλείαφι = copper. The SSYL (supersyllabogram) *ka* (supersyllabogram) *(Linear B Latinized)* could also possibly refer to *kapo* καρπός = fruit, *kararewe* κλαρεύς = stirrup jar or even kati κάρτις = a kind of (water) vessel or flask. Since the last possibility obviously overlaps with the incharged SSYL *u (Linear B Latinized)*, which clearly designates a water jug, flask or flagon, I am

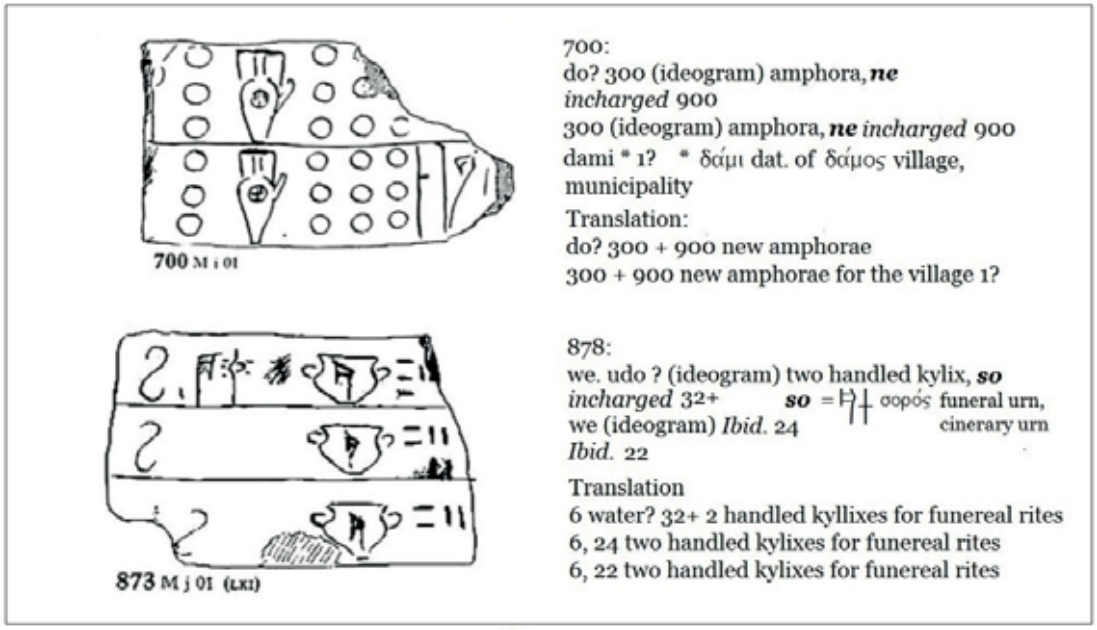


Fig. 11 The supersyllabogram U in the vessels sector in Linear B

strongly inclined to dismiss it. While the vessel could be of copper, it is also quite likely that the scribes were referring to the stirrup jar as a vessel type. These latter two possibilities strike me as the most cogent, the last being the most convincing.

Next we have p*o (Linear B Latinized)*, which could mean any of the following: *posedao(ne)* -or- *(ni)* = Posedaon i.e. Poseidon (god's name), *posidaewe,* referring to a cult probably associated with Poseidon, *potiniyaweya* (adjectival), referring to a priestess or follower of the Minoan-Mycenaean/ Homeric goddess, Potnia, *porenaya*, attendants in sacrificial ceremonies, *porupode*, an octopus, generally on a vase or amphora, *ponike*, decorated with a griffin or *ponikeya*, crimson, and finally, *popureya*, purple. I felt obliged to account for all of these possibilities, since we are confronted yet again with the conundrum, what did the scribes themselves intend it to mean? However, in light of the literature on religious and sacrificial rites in the Minoan and Mycenaean societies, it would appear that the most tenable translation is likely to be *potiniyaweya* (adjectival/ attributive), referring to a priestess or follower of the Minoan-Mycenaean/Homeric goddess, Potnia, since not only is their religion predominantly matriarchal, but this goddess in particular is frequently referenced. The literature on this subject is abundant (Table 7).

These supersyllabograms as inscribed on numerous tablets on vessels appear here in facsimile. The following 3 illustrations of several tablets in the vessels sector, all from Knossos, more than amply illustrate the power of supersyllabograms. (Fig. 9, Fig. 10, Fig. 11**)**

Supersyllabograms in the pottery and vessels sector (let alone all others) are so *information rich* that they call for considerable clarification.

1. Although previous researchers, without exception, have tagged supersyllabograms as "adjuncts" to ideograms, they are in fact far more than merely that. Careful examination of a small cross-section of pottery and vessels from Knossos alone confirms that this is the case, as illustrated above.

2. My translations of even these few tablets reveals this astonishing find: supersyllabograms *replace not only single words but often entire phrases* in Mycenaean Linear B (*see* Martinotti[14] *supra*). In effect, they telescope what would have otherwise been discursive and space-wast-

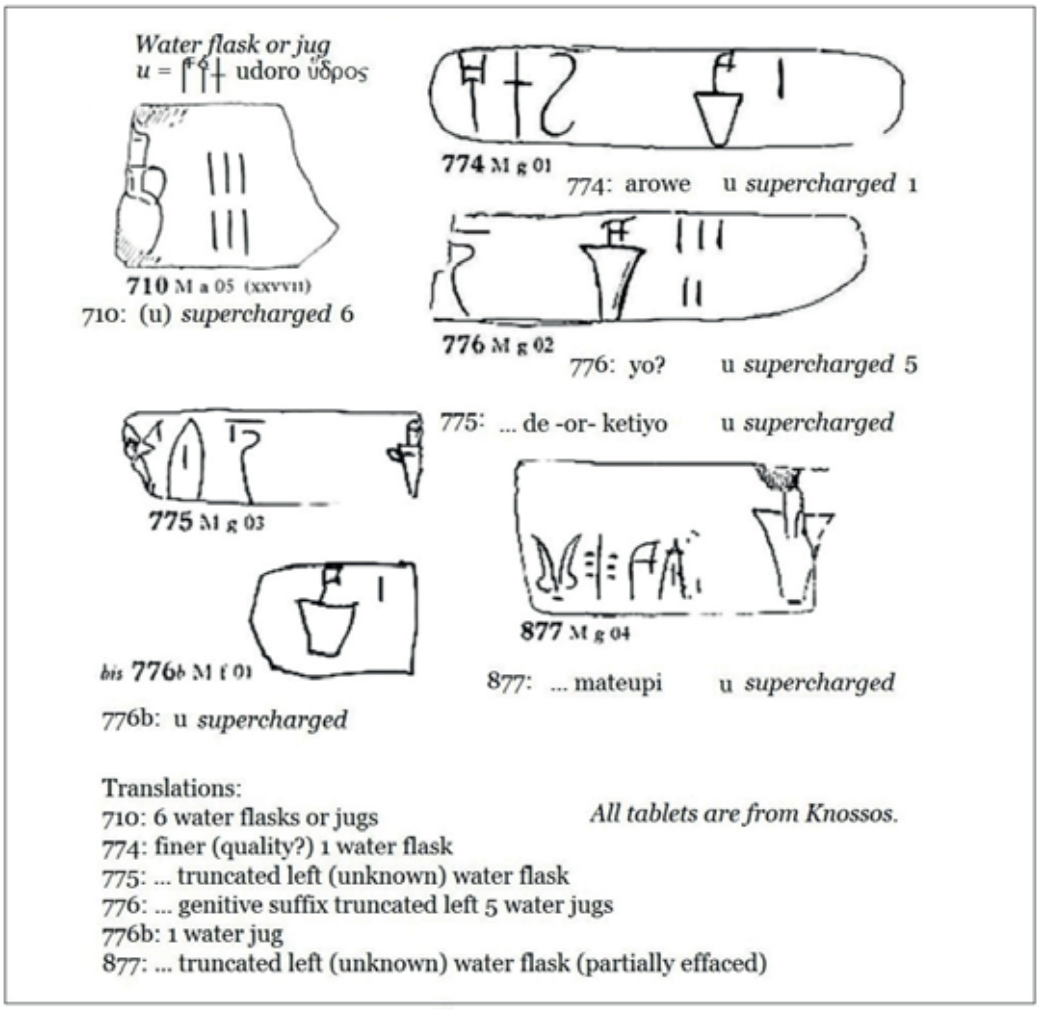


Fig. 11 The supersyllabogram U in the vessels sector in Linear B

ing text on such small tablets into one *single element*, namely, *themselves*. In this sense, the supersyllabogram, as a phenomenon, functions as a sort of linguistic *ouroboros* or *uroboros* (from the Greek οὐροβόρος, tail-devouring snake), an ancient symbol depicting a serpent or dragon eating its own tail.

3. This reveals yet another key characteristic of Linear B tablets which deploy supersyllabograms to replace Mycenaean words or phrases. Supersyllabograms in the pottery and vessels sector alone (as in every other sector of the Minoan-Mycenaean economy) effectively operate as *shorthand*. This startling discovery sets back the time frame for the *first* known use of shorthand some 3,300 years from the late nineteenth and early twenti-eth centuries. Once again, Mycenaean Linear B attains a high degree of versatility and sophistication virtually unknown to other contemporaneous scripts, hieroglyphic or syllabogrammatic, inclusive of Arado-Cypriot Linear C, which entirely abandoned ideograms.

4. Yet the most astonishing characteristic of supersyllabograms in the pottery and vessels sector of the Minoan-Mycenaean economy is this: the majority of them are *attributive,* and *dependent on the ideograms they qualify*. Attributive dependent supersyllabograms always appear *inside* the ideogram which they qualify, never adjacent to it. They always describe an *actual attribute* of the ideogram. For instance, the syllabogram ***a*** inside the ideogram for a vessel with 2 handles is the first

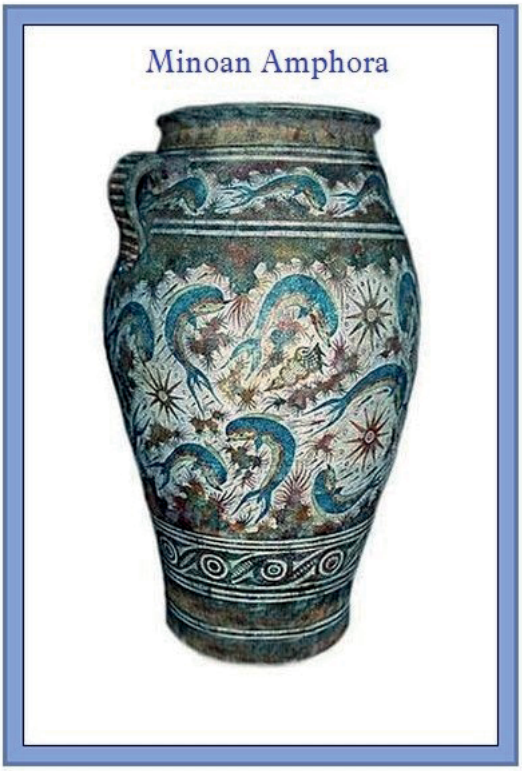


Fig. 12 a Minoan dolphin vase – 2nd Millennium BCE – marine style, the most distinctive of all Minoan pottery with naturalistic depictions of dolphins, octopuses and other sea creatures
(Minoan Art and civilization, Pinterest)

syllabogram, i.e. the first syllable of the Mycenaean word *apiporewe,* unequivocally identifying the vessel as an *amphora*. But why even bother noting this, when it is obvious that the ideogram in question is in fact that for an amphora? Again, I repeat, the Mycenaean scribes never used any device without a reason. In this particular case, the reason, I believe, is apparent. Any scribe who places the syllabogram *a* inside the ideogram for what is probably an amphora anyway, does so on purpose to draw our attention to the fact that he is tagging said vessel as a highly valuable and very likely ornate *specialty amphora* fashioned specifically for the palace elite, and not any old amphora at all, as we see illustrated below: (Fig. 12)

The distinction is crucial. I can conceive of no other reason why any Mycenaean scribe would resort to such a ploy other than to identify the vessel in question as a *precious commodity*. Similarly, the simplified and streamlined syllabogram *sa* inside the ideogram for a vessel on a stand is, in my estimation, almost certainly the supersyllabogram for an unknown pre-Greek, possibly Minoan word for *raw flax,* the agricultural crop the ancient Greeks called *rino* λίνον, from which linen (being the selfsame word in both Mycenaean and ancient alphabetical Greek) is derived. Both of these supersyllabograms are *incharged*, a term I have had to coin to describe the presence of syllabograms *inside* ideograms, given its complete absence in previous research on so-called "adjuncts" to Linear B ideograms, in other words, supersyllabograms.

Yet the twinning of supersyllabograms in the vessels sector of the Minoan-Mycenaean economy is even more complex in some instances. For instance, the supersyllabogram *no (Linear B Latinized)* issuperimposed (*supercharged*) onto the ideogram for a (soup) bowl. What can this mean? In this position, *no* is the first syllable of the Mycenaean word *noperea2* = *nopereha* νωφελέα, meaning "useless", in other words "defective" for inventorial purposes. The syllabogram *no* is *not* incharged because it does not represent an innate characteristic of the vessel in question. The bowl just so happens to be broken, hence, "useless". Any supersyllabogram playing this rôle is said to be *associative*. The factor the supersyllabogram represents is merely associated with the object in question. It does *not* inherently define it. While associative supersyllabograms are relatively rare in the pottery and vessels sector of the Minoan-Mycenaean economy, they proliferate in the agricultural sector. But that is a topic for another time and place. I shall necessarily address this attendant phenomenon in a future article, which will serve to extrapolate, define and classify all 35 supersyllabograms I have isolated to date in every single sector of the Minoan-Mycenaean economy in a syllabary of 61 syllabograms. The incidence of so many supersyllabograms, accounting for fully 57 % of all syllabograms, is statistically so prevalent and so significant that we simply cannot afford to ignore it. As it so happens, neither type of dependent supersyllabogram, associative or attributive,

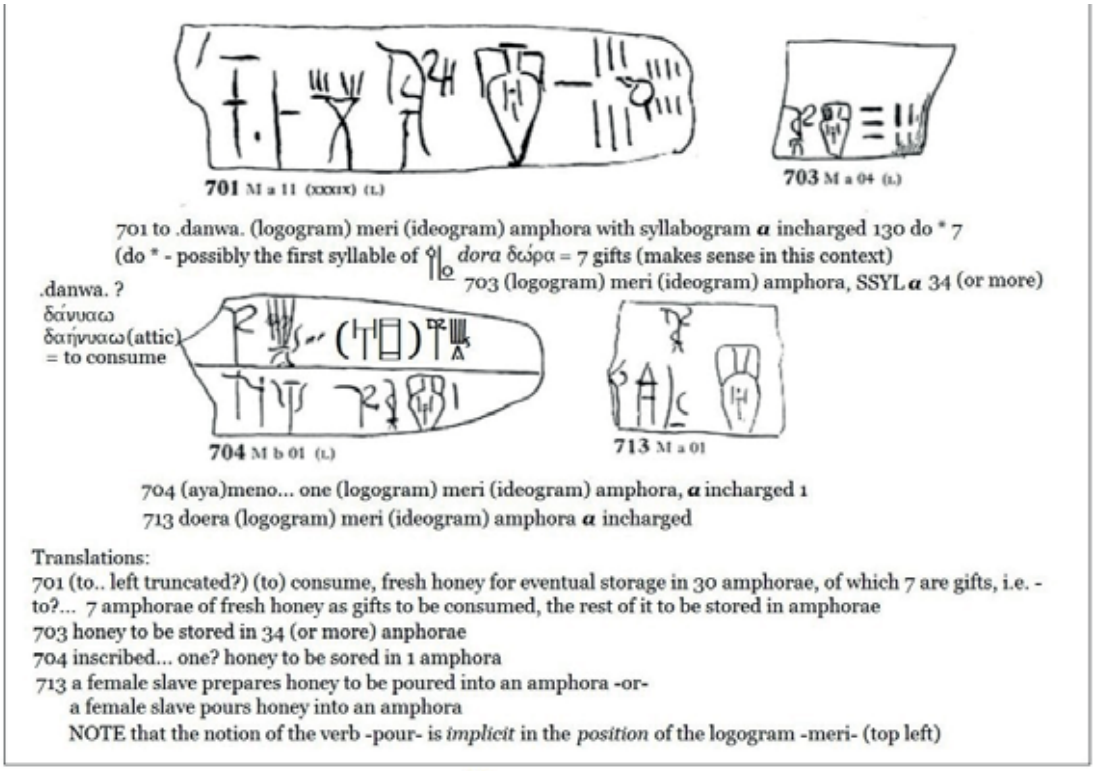


Fig. 13 Mycenaean Linear B tablets from Knossos sporting
the supersyllabogram A for – amphora – and the logogram MERI for – honey –

was ever systematically isolated and tabulated in Mycenaean Linear B until I took it upon myself to do so last year, in 2014. To date, I have discovered, identified & classified some twenty-five (25) *attributive* supersyllabograms alone in all sectors (exclusive of associative).

In the case of vessels concerned with the production, manufacture, distribution and consumption of honey, things get downright complex. As we readily ascertain from the ideograms for vessels intended for honey, the supersyllabograms are not only not merely syllabograms, but *logograms*, in so far as they superimpose the syllabogram *ri* on top of that for *me.* The resultant logogram is then *surcharged* onto each vessel, *functioning in one of three possible ways.* Once again, we are faced with a non-hypothetical real world question. Why do the scribes surcharge the logogram for honey, sometimes to the left of the vessel, sometimes to the top-left, and sometimes on top? Although we can never really know why, given that we were not there when the scribes deployed this strategy, we owe it to ourselves to try and pinpoint precisely what each of these 3 positions for the logogram meri = μέλι must have meant *to the scribes themselves*. I have ventured my own tentative explanations in my translations of 4 tablets concerned with honey from Knossos: (Fig. 13)

I urge readers to consult Carlos Varias García's textual analysis of these and a few other tablets relative to the production of honey at Knossos and Pylos[15].

CONCLUSIONS

As it turns out, in a syllabary of 61 syllabograms, at least 35 (at my last count) or fully 57 % are supersyllabograms. That is a staggering return for the scribes' deliberate and eminently practical investment in what is a remarkably clever stock

15 García, Carlos Varias. 1979
The Word for 'honey' and Connected Terms in Mycenaean Greek, MYCAc: 403-418. (illustrated with these and other Knossos tablets surcharged with MERI on pp. 417-418)

technique to *shortcut* lengthy text, which would have otherwise simply cluttered up the very small Linear B tablets they routinely worked with (rarely more than 15 cm. Wide). Supersyllabograms are therefore one of the most significant standard key components of the Mycenaean Linear B syllabary, and as such must be fully accounted for as a unique and discrete phenomenon, without which any approach to the interpretation of the Linear B syllabary is at best incomplete, and at worse, severely handicapped. I would even go so far as to claim unequivocally that it is impossible to effectively translate a great many Linear B tablets — and by this I mean well in excess of 800 (22.86 %) in an extant repository of some 3,500 intact tablets at Knossos alone. Scribal use of supersyllabograms is, curiously enough, almost exclusively, but not completely, restricted to Knossos. There are a few exceptions, most notably at Pylos.

Why then did the entire collegiate of scribes so often resort to this strategy? Since it was critical for the scribes to consume as little space as possible on what are ostensibly extremely small tablets, the use of supersyllabograms as a substitute for wasteful text is illustrative of just how far the scribes were willing to go to save such invaluable space. They did not do this only occasionally. They did it a great deal of the time, and they always followed the exact same formula in so doing. Thus, any attempt at the decipherment of the in excess of 800 extant Linear B tablets which have at least one and often as many as five supersyllabograms incised on them, some of which have no text whatsoever on them, is bound to result in meaningless gibberish, or in nothing so much as a reductio ad absurdum. No such phenomenon exists on the Linear B tablets. They are all pregnant with meaning. It is up to us as specialists in Mycenaean Linear B to extract that meaning, text or no text.

ABBREVIATIONS

THE FOLLOWING ABBREVIATIONS ARE ALWAYS USED FOR THE SOURCES THEY REPRESENT:

- AJA *American Journal of Archaeology*
- ANCL *L'Antiquité classique*
- CAMB *Proceedings of the Cambridge Colloquium on Mycenaean Studies*. Palmer, R.L.
- & Chadwick, John, eds. Cambridge: Cambridge University Press, © 1966. First
- paperback edition, © 2011. vii, 309 pp. ISBN 978-1-107-40246-1 (pbk.)
- CMLB Duhoux, Yves and Morpurgo Davies, Anna, eds. *A Companion to Linear B: Mycenaean Greek Texts and their World*. Vol. I. Bibliothèque des Cahiers de l'Institut de Linguistique de Louvain 120). Louvaine-la-Neuve, France: Peeters, 2014. 292 pp. ISBN 978-2-7584-0192-6(France)
- ECR *Economic History Review*
- JHS *Journal of Hellenic Studies*
- KADM *Kadmos: Zeitschrift für Vor- und Frühgriechische Epigraphik*
- MIN *Minos: Revista de Filología Egea*. ISSN: 0544-3733
- MINR *Minerva: Revista de Filología Clasíca*
- MYCAa Risch, E. & Mühlestein, H., eds. *Colloquium Mycenaeum. Actes du sixième colloque international sur les textes mycéniens et égéens tenu à Chaumont sur Neuchâtel du 7-13 septembre 1975*, *Neuchâtel. Genève* : Librairie Droz. 1979
- MYCAb Olivier J.-P., éd. *Mykenaïka: Actes du IXe Colloque international sur les textes mycéniens et égéens, organisé par le Centre de l'Antiquité Grecque et Romaine de la Fondation Hellénique de l'École française d'Athènes (sic) (Athènes, 2-6 octobre 1990)*. Paris: BCH, Suppl. 25. © 1992
- MYCAc Carlier, P., de Lamberterie, C., et al. *Études Mycéniennes 2010. Actes du XIIIè colloque international sur les textes égéens, Sèvres, Paris, Nanterre, 20–23 septembre 2010*. Pisa et

Roma, 2012

- PALM Palmer, L. R. *The Interpretation of Mycenaean Texts. Oxford: Oxford University Press.* 1963. Special Edition for Sandpiper Books Ltd., © 1998. xiii, 488 pp.
- PASR *Pasiphae: Rivista di filologia e antichità egee*

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REZIME

ARHEOLOŠKI PREVOD TABLE SA PILOSA TA 641-1952 (VENTRIS), SA PRIKAZOM SUPERSILABO-GRAMA U MIKENSKOM LINEAR B PISMU

U saradnji s Asocijacijom za istorijske studije, *Koryvantes* (Atina), organizacija, Linear B Knosos i Mikena (Wordpress), sprovodi kontinuirano istraživanje mikenske arheologije i u sklopu toga mikenskog grčkog dijalekta. U ovoj studiji centar pažnje smo usmerili na nedavno dešifrovanu tablu sa pilosa TA 641-1952 (Ventris). Istraživač Rita Roberts sa Krita je po svemu sudeći svojim dešifrovanjem ostvarila najprecizniji prevod ovog zapisa do sada. Uveden je novi termin u Mikenskom Linearu B, supersilabogram, što predstavlja prvi silabogram ili prvi slog bilo koje reči ili fraze u Linearu B. Supersilabogrami su pogrešno nazivani "dodaci" u ranijim lingvističkim istraživanjima Mikenskog pisma Linear B. U ovom prilogu smo pokušali da doprinesemo boljem razumevanju Linear B pisma, pokazujući da funkcionalnost supersilabograma znatno prevazilazi ranija ograninečenja i da supersilabogram predstavlja jedinstven fenomen bez kojeg bi bilo kakav pokušaj tumačenja linear B pisma bio nepotpun ili još gore pogrešan.

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902.2:572.7(497.11)
904:726.8”652”(497.11)
COBISS.SR-ID 219294988

Original research article
Received: January 14th 2015
Accepted: November 15th 2015

RESULTS OF ARCHAEOLOGICAL-ANTROPOLOGICAL STUDIES OF MASS BURIALS IN VIMINACIUM – GRAVE IN THE SHAPE OF A WELL IN THE HANDICRAFT CENTRE / THE PEĆINE NECROPOLIS*

ABSTRACT

This paper is the second of its kind, about archaeological-anthropological analyses of mass burials excavated in Viminacium during the 20th century. It includes burials in graves in the shape of a well, originally intended for the handicraft centre that was used for making pottery vessels and bricks. In the well itself, the remains of 29 individuals were discovered. There were five burial layers. According to the stratigraphical and anthropological analyses, the authors have tended to give the most plausible explanation about the usage of the well as for burial purposes. The finds discovered within the well indicate that the burials were possibly performed during the second half of the 3rd or at the beginning of the 4th century.

KEYWORDS: VIMINACIUM, NECROPOLIS, GRAVE, MASS BURIAL, CRAFT CENTRE.

During the protective excavation in 1982/1983, within square VII of the handicraft centre in Viminacium, a cylindrical well was excavated, its sides built of green stone bound with lime mortar containing lots of sand. It had a round cross-section, with its outer diameter measuring 1.90 m and its inner one 1.10 m. It was partly destroyed during mechanisation works, making it impossible to determine the depth from the top of the well.[1]

Since it was the area of the handicraft centre, a well was to be expected in this location. Its presence is explained with the production of pottery vessels and its necessity within a handicraft centre had already been mentioned by ancient authors (Vitruvije 2006:40). The material discovered within the well gives testimony to its long usage, not only while it was being used for the purposes of the handicraft centre, but also in the long period after the pottery production, when it was used for burials. Five burial layers with the osteological remains of 29 individuals were discovered.[2]

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

2 As mentioned in the original field documentation, during the excavation, sixteen burial levels were

* This paper is the second of its kind, about archaeological-anthropological analyses of mass burials excavated in Viminacium during the 20th century.

The stone used for building was square shaped. The quality of the construction was maintained, even in the lower part, although close to the bottom, fragmented sandstone was noticed, while the pieces of green stone were roughly shaped. After each 0.90 m of green stone squares, they were levelled with two rows of bricks bound with mortar. The width of the levelling layer was 0.18 m, while the width of the mortar was 2 to 3 cm. This construction method was applied down to a depth of 8.35 m. From that depth downwards, the well was plastered only with pieces of carved green stone without mortar. Down to a depth of 9.40 m, the well was built with large green stone blocks, while from this depth downwards, there was no construction and it was dug directly into the soil. Flooding prevented further research of the lower levels.

STRATIGRAPHY OF THE WELL (Table 1, Pl. I, II, III, IV)

THE STARTING LEVEL (CROSS-SECTION I)

Down to a depth of 1.05 m there was a layer of brown soil with fragmented bricks, tegulae and imbreces, as well as fragments of different pottery vessels. Several fragments of animal bones and teeth were also discovered.

THE FIFTH BURIAL LAYER

1.05 m – G 2282 A and B (CROSS SECTION II) –The deceased was laid on its right side in a crouching position. The skull and long bones remained preserved. The legs were bent. The preserved skeleton length measures 0.87 m. Laboratory anthropological analysis revealed that there were two skeletons of male individuals, which, due to the bones inclining through the layers and their poor state of preservation, remained unclear during the field research.

1.20 m – G 2303 (CROSS SECTION III) – In the north-west part of the well, under the feet of deceased G 2282, there was a damaged skull deposited on fragmented bricks and tegulae. Beneath it, were the long bones of the deceased.

1.70 m – G 2357 (CROSS SECTION IV, V) – Situated in the south-eastern part of the well, the deceased was laid on its left side in a crouched position. Its head was placed on its left cheek, facing south-east. The right arm was bent, hand on the pelvis, while the left arm was also bent, with the hand next to the head. The preserved skeleton length measures 0.90 m. It was orientated SW-NE. Next to the skull and the right knee there was a horse skull.

1.95 m – G 2377 (CROSS SECTION VI) - The deceased was laid on its right side in a crouched position, on pieces of green stone and fragmented bricks. Its left arm was bent and placed under the pelvis, while its right arm was placed next to the pelvis. The preserved skeleton length measures 0.80 m. It was orientated NW-SE.

THE FILLING LAYER

2.10 – 2.60 m (CROSS SECTION VII) – after removing G 2377, at a depth 2.10, a soil level was discovered with fragmented bricks and tegulae.

THE SECOND BURIAL LAYER

2.60 m – G 2433 (CROSS SECTION VIII) – Situated in the SE part of the well, the deceased was placed on its right side, in a crouched position. Its arms were bent and the hands placed close to where the missing skull would have been. The preserved skeleton length measures 0.70 m. It was orientated E-W.

2.70 m – G 2434 (CROSS SECTION VIII) – Situated in the NW part of the well, the deceased was placed on its right side, in a crouched position. The preserved skeleton length measures 0.97 m. It was orientated N-S, with a deviation of 35^0 of the northern part towards the east.

2.80 m – G 2478 (CROSS SECTION IX) –Situated in the NE part of the well, the deceased was placed on its left side. The head was resting on its left cheek. Its arms were bent at the wrists, which

discovered, although, after a detailed stratigraphical study, it was concluded that there were five burial layers and five filling layers.

were probably tied and placed under the pelvis. The preserved skeleton length measures 0.92 m. It was orientated E-W.

2.90 m – G 2479 (CROSS-SECTION IX) - The deceased was placed on its left side with the head is resting on the right cheek, facing west. Its right arm is slightly bent and placed next to the body, while the bones of the left arm were dislocated. Its left leg is slightly bent, while the right one is also bent, with the lower leg pointing backwards. The preserved skeleton length measures 0.93 m. It is orientated NW-SE.

2.90 m – G 2480 (CROSS-SECTION X)-It is situated in the NW part of the well. As well as the fragmented skull, the chest and arm bones remained preserved, with the arms bent and placed on the stomach. The preserved skeleton length measures 0.70 m. It is orientated NW-SE.

2.90 m – G 2525 (CROSS-SECTION X)–It is positioned to the SE of G 2480. As well as the fragmented skull, the chest and arm bones also remained preserved.

3.10 m – G 2526 (CROSS-SECTION X)-Some 40 cm from G 2525, two femurs were discovered and, to the south of them, a skull, while the remaining long bones were discovered within the southern part of the well.

THE FILLING LAYER

At a depth of 3.20 m (CROSS-SECTION XI), a layer with fragmented bricks was discovered. During the cleaning of this surface, a fragmented bronze nail was unearthed. In the NW corner of the well, an iron nail with wood remains was discovered. Over the whole surface, red fired shards of different pottery vessels were discovered. As well as fragmented bricks, smaller fragments of tegulae with the stamp LEG VII CL were also found.

THIRD BURIAL LEVEL

3.30 m – G 2711 (CROSS-SECTION XII)-The deceased was placed on fragmented bricks and tegulae, on its right side, in a crouching position. Its head was resting on the right cheek, facing south. Its bones were partially placed under the head of the deceased. Its left arm was bent, with the hand next to the skull, while the bones of its right arm were placed under the skull. The preserved skeleton length measures 0.69 m. It is orientated N-S.

3.50 m – G 2712 (CROSS-SECTION XII) – It was placed to the south of G 2711. It is an infant skeleton placed on fragmented bricks and tegulae. The skull and leg bones were partly preserved and dislocated. The preserved skeleton length measures 0.30 m. It is orientated E-N.

3.70 m – G 2727 (CROSS-SECTION XIII) – It was situated in the northern part of the well. The deceased was found in a soil layer with a small number of fragmented bricks. The skull, placed on a brick pillow, remained preserved, while the remaining bones (long and corporal bones) were discovered to the south-east of the skull and the pelvis next to the north-eastern side of the well. It partially covers skeleton G 2728.

3.70 m – G 2728 (CROSS-SECTION XIII) – It was placed to the north-west of the skull G 2727 and was a female individual, laid on her back, with her legs bent and facing backwards. The arms were bent, hands on the pelvis, while her head was laid on several brick fragments. It was orientated NW-SE.

3.70 m – G 2729 A and B (CROSS-SECTION XIII) – It was situated in the southern part of the well. The head was positioned face downwards. Under the mandibula, there was an iron nail. The skull, as well as all the other preserved bones, was fragmented. The leg bones were sharply bent, placed close to the chest and, therefore, discovered below the skull of the deceased. The skeleton was orientated W-E. Anthropological analysis revealed that there were two skeletons, one belonging to a woman aged between 30 and 35 years, while the other was a child aged between 12 and 15 years. Due to the bones inclining through the layers and their poor state of preservation, this remained unclear during the field research.

3.80 m – G 2744 (CROSS-SECTION XIV) – It was placed in the northern part of the well. It

is a child aged between 6 and 8 years. The head was placed facing upwards. Next to its left side, was the upper left arm, while to the north were the bones of the right arm. To the east, on a brick, were the long leg bones. Across the femurs, were two bones of the lower arms, on which there were two fragmented bronze arm rings (C 7653, C 7654). On a bronze cover made of thin sheet, there were visible traces of textile. A fragment of a round iron object with traces of wood was also unearthed (C 7655).

4.00 m – G 2745 (CROSS-SECTION XIV, XV) – It was situated in the eastern part of the well. The head was resting on its right cheek, facing NE. The leg bones were placed next to the eastern side, while the arm bones were placed to the south of the skull. Next to the skull, were the small bones of the deceased female individual.

4.00 m – G 2746 (CROSS-SECTION XIV) – The head of the deceased, a female individual, was resting on the left cheek, facing east. To the west of it, a deformed fragmented bronze needle (C 7656) was discovered.

4.00 m – G 2754 (CROSS-SECTION XIV) – It was positioned in the south-eastern part of the well. The head was placed facing upwards. Next to it, close to the western edge, were the vertebrae and fragmented lower arm bones, while further to the west of these, there were parts of the pelvis and femurs. It was a male individual. Between the bones, a bronze belt-ring with a thorn in very poor condition was unearthed (C 7657).

4.00 m – G 2755 (CROSS-SECTION XIV) – It was situated to the west of G 2744, next to the western edge of the well. The head was placed facing downwards. The bones of the left arm were next to the skull, while to the east of this there were the pelvis bones and a femur. It was a female individual.

4.20 m – 2784 (CROSS-SECTION XV) – A skull remained preserved, placed on a fragmented brick and facing upwards, while the remaining bones were discovered in the northern part of the well, to the west of the fragmented brick. It is male individual. Between the bones were the following finds: a bronze ring (C 7658), a fragmented bronze arm-ring (C 7659) and part of an arm-ring with a bronze coating (C 7669).

4.40 m – G 2760(CROSS-SECTION XV)–To the south of G 2745 there was a fragmented tegula and, next to it, were parts of a skull and arm bones. It was a child aged between five and six years.

4.40 m – G 2761 (CROSS-SECTION XV) –Next to a fragmented skull calotte, there were several parts of the mandibula. Next to the skull, there were fragmented arm bones. It was a child aged between five and six years.

THE FILLING LAYER

At a depth of 4.60 m (CROSS-SECTION XVI), a layer made of fragmented bricks and tegulae was discovered.

THE FOURTH BURIAL LAYER

4.80 m – G 2779 (CROSS-SECTION XVII) – The deceased was placed on its left side, on a base made of fragmented tegulae, bricks and pieces of green stone. Its head was placed on its left cheek, facing west. The right arm was sharply bent and placed next to the skull, while the left arm was slightly bent. Over it, there were two bigger tegula fragments. The right leg was bent at a right angle, while the left arm was also bent and pulled towards the pelvis. It was an female adult individual. The preserved skeleton length measures 0.85 m. It is orientated SE -NW.

5.00 m – G 2790 (CROSS-SECTION XVIII) – The deceased was placed on its left side, on a base made of fragmented tegulae and bricks. Its head was placed facing upwards and tilted to the left. The right arm was slightly bent and placed on the knee of the left leg, while the left arm was sharply bent, with the hand next to the skull. The legs were sharply bent. It was a female individual. The preserved skeleton length measures 0.90 m. It is orientated SW-NE, with a deviation of 10^0 of the south-western part towards the south.

In this burial layer, there were fragments of bigger pottery vessels, mostly fired red, as well as

one hexagonal floor brick.

THE FILLING LAYER

At a depth of 5.10 m (CROSS-SECTION XIX), under G 2790 and the base made of fragmented bricks and tegulae, a skeleton of a dog was unearthed. The dog's bones were discovered in the middle of the well, placed in a N-S direction. They were laid on a base made of densely packed fragmented bricks, tegulae and pieces of green stone. The skull was discovered in the northern part of the well and placed on the base. To the south of it were the scapulae and the bent leg bones. The preserved skeleton length measures 0.65 m. At the southern wall of the well, next to the dog's bones, were four small fragments of a human skull. To the NE of the dog's skull, there was a fragment of a cow's long bone. Under the layer consisting of fragmented bricks and tegulae, there is a layer of dark soil. In this layer, there were several pottery shards.

5.50 – 5.70 m (CROSS-SECTION XX) – Layer of fragmented tegulae, bricks and imbreces. In the southern part of the surface, there was green stone with traces of mortar.

5.70 – 6.20m (CROSS-SECTION XXI) – Layer consisting of pieces of green stone, fragmented bricks and tegulae. In the northern half of the well, bigger pieces of green stone and mortar were discovered.

6.20 – 6.30 m (CROSS-SECTION XXII) – Layer with fragmented bricks and tegulae. At this depth, in the southern half of the well, there was a dog's burial, while in the northern part, there were several sandstones. The skeleton was orientated W-E with a deviation of 15^0 of the western part towards the north. Only the skull was not preserved. The preserved skeleton length measures 1.00 m. Numerous fragments of red and light red fired pottery were discovered.

6.30 – 6.60 m (CROSS-SECTION XXIII) – Layer consisting of large brick and tegula fragments, as well as smaller pieces of green stone. Pottery shards of red fired vessels, mostly parts of the belly, rims and handles, were discovered. It is a layer of brown soil with many pottery shards.

6.60 – 7.00 m (CROSS-SECTION XXIV) – Layer of fragmented bricks and tegulae with traces of mortar, under which there is a layer of brown soil with pottery shards and fragments of bricks, burned tegulae and slag.

7.00 – 7.40 m – Layer of fragmented bricks and tegulae. The bigger brick fragments were discovered next to the well's edge, while the smaller ones were in the middle. In the central part, a human long bone was discovered. In the soil layer beneath the surface there was a large amount of pottery shards of red fired clay.

7.40 – 7.65 m (CROSS-SECTION XXV) – Layer of fragmented bricks and tegulae. In the SW half of the well, on a surface made of bricks, there was an animal skeleton orientated approximately NE-SW. The preserved skeleton length measures 0.75 m. Next to its legs, there was a fragment of thin bronze sheet.

7.65 – 8.25 m (CROSS-SECTION XXVI) – Layer with brick and tegula fragments, as well as shards of different red fired vessels. The bases of the vessels were either pierced in the middle or bulged and mostly burned. Beneath the forelegs of the animal skeleton in the NW part of the well, there was an iron object – C 8543 – probably the blade of a knife. In the layer of brown soil with fragmented bricks and tegulae, an animal mandible was also discovered.

8.25 m (CROSS-SECTION XXVII) –Layer of fragmented bricks and tegulae – next to the side of the well there were fragmented human and animal femurs. Next to the western well edge, there were several human bones and next to the other walls, there were also some bones..

8.35 -8.85 m (CROSS-SECTION XXVIII) – From a depth of 8.35 m downwards, the well was not built of green stone bound with mortar, but only of green stone. The layers consist of soil with fragmented bricks, tegulae and pieces of green stone with traces of mortar.

THE FIFTH BURIAL LAYER

8.85 m – G 3022 (CROSS-SECTION XXX) – On a base of fragmented bricks and tegulae, bones of a dislocated skeleton were discovered – skull fragments next to the western edge and the chest and arm bones orientated N-S. Some bones were also discovered in the middle of the well. Whilst lifting the skeleton, next to the eastern well edge, a bronze nail with a calotte shaped head was found. In the SW part of the well, next to the arm bones, a bigger iron nail was unearthed.

9.00 – 9.40 m – Beneath the basie made of bricks and tegulae, in the western well part, the lower pelvis of a cow was discovered. In the soil layer, pieces of green stone, fragmented bricks, pottery vessels and animal bones were found.

9.40 – 9.70 m – In the middle of the well, apart from bigger tegulae and green stone fragments, a human femur was also discovered. Since the well was not sturdily constructed beyond this point, the archaeological excavation was stopped at a depth of 9.70 m.

In the well itself, 1,267 pottery shards were discovered, out of which 58 were typologically determinable. Ten types could be distinguished: two bowl types, two pot types, four plate types and two amphorae types (Plates V and VI). The types which were discovered only within this complex are the bowl type I/62 and the plate type III/9. (Raičković, 2007: 17). Generally, the types discovered here can be dated into the period from the middle of the 2nd to the beginning of the 4th century. Parallels were discovered mostly among the pottery types from Singidunum.

The anthropological content of this grave built in the shape of a well was examined directly after the archaeological excavation. After the excavation in 1982, twelve skeletons were examined. Their archaeological and, therefore, also their anthropological numeration is as follows: 2282(A and B), 2303, 2357, 2377, 2433, 2434, 2478, 2480, 2525 and 2526. In 1983, another eighteen skeletons were examined: 2711, 2712, 2727, 2728, 2729 (A and B), 2744, 2745, 2746, 2754, 2755, 2760, 2761, 2779, 2784, 2790 and 3022. It should be mentioned straight away that 27 skeletons were excavated and examined. During the anthropological analysis, next to skeletons 2282 and 2729, the remains of another two skeletons were detected and were, thus, numbered 2282 (A and B) and 2729 (A and B). Yet another question emerges and that is how to treat those skeletons which were detected only later. Should they be interpreted as double or single burials? In the context of this mass burial, we consider it impossible to speak of double graves, but only of one single mass burial with 29 people of different genders and ages, including infant age. Moreover, we also consider that the numeration should not be changed or re-numerated; meaning that skeletons numbers 2282A and 2282B, as well as 2729A and 2729B will remain in use.

After the archaeological excavation in 1982, the anthropological content of this grave in the shape of a well was ready for osteological examination. It was the same in 1983. After mechanical cleaning, washing and drying, anatomic-morphological units were formed, which also allowed numbers 2282B and 2729B to be established.

The main feature of this group of skeletons is its poor state of preservation, resulting in the fact that only five skeletons could be examined, even in the slightest detail. Their skulls were anthropologically analysed in detail and illustrated (using standardised projections).

The recommendations of several authors (Ferembach, Schwidetzky and Stloukal 1980, Brothwell 1981, Lovejoy 1985 and Buikstra and Ubelaker 1994) were used for determining gender and the individual biological age of the adult individuals, including some corrections. When it comes to infant age, tooth growth was used (Ubelaker, 1978), along with the length of the long bones (Sundick 1978).

All of the anthropological measurements were taken according to methodological rules systematised by R. Martin (Martin and Saller 1957), further re-defined by V. Bass (1995).

DEPTH (m)	BURIAL LAYER	FILLING LAYER	ANTHROPOLOGICAL DATA	ZOOLOGICAL DATA
0.00 – 1.05		LAYER OF BROWN SOIL WITH FRAGMENTS OF BRICKS, TEGULAE AND POTTERY VESSELS		SEVERAL FRAGMENTED ANIMAL BONES AND TEETH
1.05 – 2.10	FIFTH BURIAL LAYER 4♂ + 1♀		5 SKELETONS 4♂ + 1♀	NEXT TO G 2357, TWO HORSE SKULLS
2.10 – 2.60		LAYER OF BROWN SOIL WITH FRAGMENTS OF BRICKS AND TEGULAE		
2.60 – 3.10	FOURTH BURIAL LAYER 6♂ + 1♀(?)		7 SKELETONS 6♂ + 1♀(?)	
3.10 – 3.30		LAYER OF BROWN SOIL WITH FRAGMENTED BRICKS, TEGULAE AND POTTERY VESSELS		
3.30 – 4.60	THIRD BURIAL LAYER 2♂ + 4♀ + 7N + 1N(?)		14 SKELETONS 2♂ + 4♀ + 7N + 1N(?)	
4.60 – 4.80		LAYER OF BROWN SOIL WITH FRAGMENTED BRICKS AND TEGULAE		
4.80 – 5.10	SECOND BURIAL LAYER 2♀		2 SKELETONS 2♀	

5.10 – 8.85		LAYER OF BROWN SOIL WITH FRAGMENTED BRICKS AND TEGULAE, IMBRECES, GREEN STONE, SANDSTONE AND POTTERY VESSELS		LAYER WITH CANINE BURIALS (4 INDIVIDUALS) AND COW BONES
8.85 – 9.00	FIRST BURIAL LAYER 1♂(?)		1 SKELETON 1♂(?)	
9.00 – 9.40		LAYER OF BROWN SOIL WITH FRAGMENTED BRICKS AND TEGULAE IMBRECES AND POTTERY VESSELS		COW'S PELVIS AND VERY FRAGMENTED ANIMAL BONES

Table 1 – Synchronised table

Paleodemographically observed, the following results listed in Table 3 were gained for the 29 skeletons.

As seen, twelve male, seven female and eight infant skeletons were anthropologically identified, while for two individuals it was not possible to determine their gender (Table 2). It is interesting that the infant age moves within the span of several months to the end of the first decade of life. The only exception is skeleton number 2784, belonging to an older infant (not subadultus). The age of the male skeletons ranges within the span from the beginning of the third decade to the end of the sixth decade of life, while the age of the female skeletons spans to the end of the fifth decade of life. Since one is here dealing with a "selected part of a certain population", it is considered that further paleodemographic nuancing would be pointless.

The results of the paleo-pathological examination were not extensive. It is important to stress that no traces of traumas were discovered in this group of 29 skeletons of different genders and ages. Most of the observations refer to the jaws and teeth. Irregular abrasion was noticed, cavities of different degrees and locations, along with periodontitis and cysts. Tooth loss was either intravital or postmortal.

Senile osteoporosis was discovered only on the oldest skull of this group – number 2754, a male skull, aged about 60 years. As the illustrations show (see Fig. 3), this senile osteoporosis is symmetrically and equally present in the zone of both parietal tori, so that it can be named Osteoporosis senilis simetrica parietalis (Mikić 1977).

As for the morphostructure of this group of skulls, one can only speak about its one part that was sufficiently preserved for this kind of examination. As already stated, five skulls were suitable for a detailed examination. These are the skulls numbered 2729, 2745, 2754, 2779 and 2790 (Figs. 1-5). Their primary skull measurements are given in Table 3. As its content shows, all five

Grave No.	Gender	Age	Comments
2282A	male	up to 21/23 years	
2282B	male	up to 45 years	
2303	male	adult	
2357	male	adult	
2377	female	around 30 years	
2433	male	adult	
2434	male	up to 21/23 years	
2478	male	up to 45 years	
2479	male	up to 45 years	
2480	female (probably)	up to 30 years	
2525	male	up to 40 years	
2526	male	between 30 and 40 years	
2711	infant	between 3 and 4 years	
2712	infant	early months of life	
2727	infant	between 6 and 8 years	
2728	female	up to 21/23 years	
2729A	female	between 30 and 35 years	skull illustrated (Fig. 1)
2729B	infant	between 12 and 15 years	
2744	infant	between 6 and 8 years	
2745	male	30 to 40 years	skull illustrated (Fig. 2)
2746	female	up to 21/23 years	
2754	male	over 45 years	skull illustrated (Fig. 3)
2755	female	between 30 and 35 years	
2760	infant	between 5 and 6 years	
2761	infant	between 5 and 6 years	
2779	female	over 45 years	skull illustrated (Fig. 4)
2784	gender undetermined, probably an older infant		
2790	female	up to 45 years	skull illustrated (Fig. 5)
3022	male (probably)	up to 40 years	

Table 2 – Viminacium /Pećine – grave in the shape of a well in the handicraft centre – paleodemographic results of the skeletal analyses.

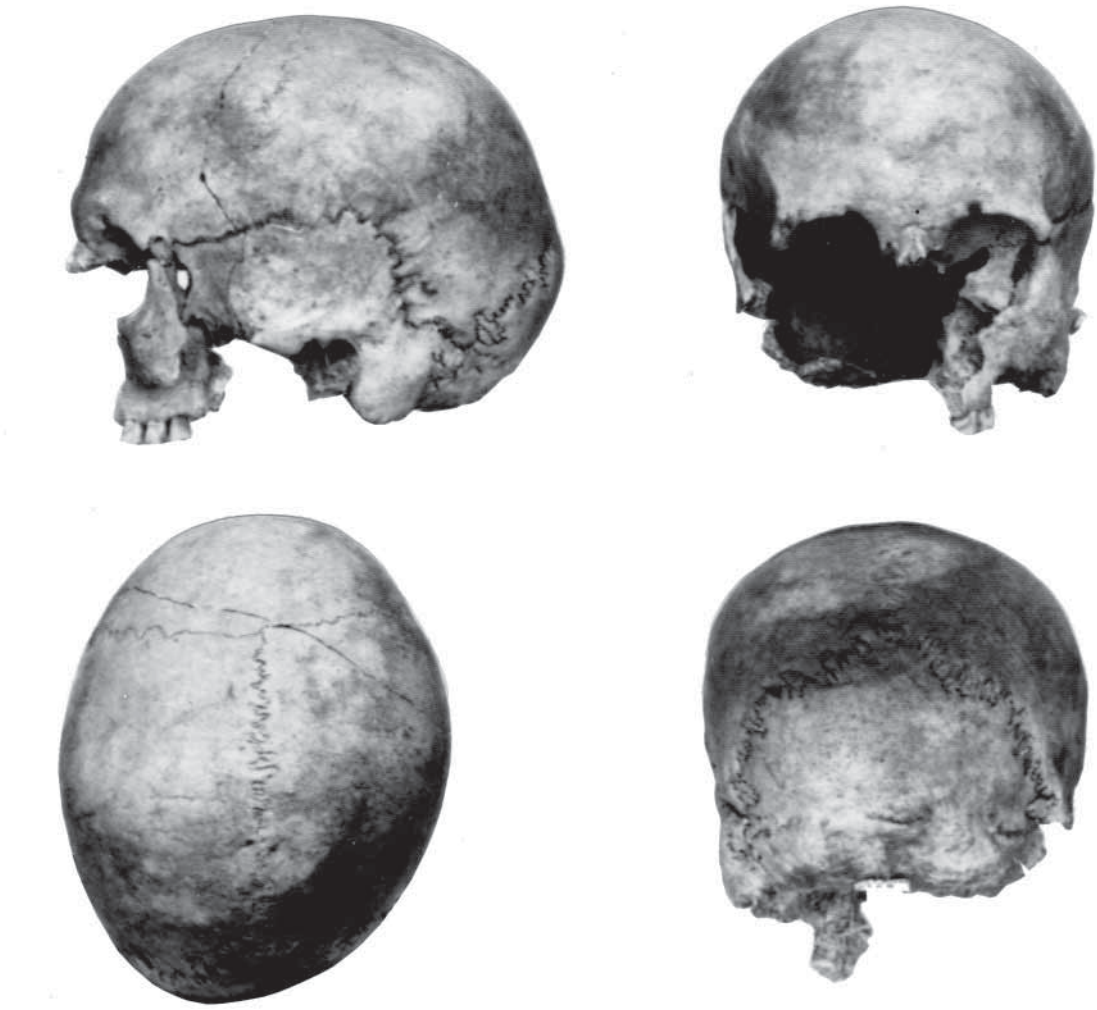

Fig. 1 Skull G-2729

of the skulls were not entirely anthropologically measured and the primary skull measurements were only partially obtained. The cerebral part was omitted, which was the best preserved part on all of the skulls.

What is, visually, most striking is their differences, despite the small number of the preserved samples (less than 20% of the whole group). This heterogeneity is best illustrated with the length-width index of the cerebral skull part. The values of this index showed diametric results, according to the gender specification. Male skulls belong to the meso-cranial group (from 77.8 to 79.4), while the female ones belong to the brachi-cranial group (from 80.6 to 84.6). However, the results gained from thirty identified skeletons are very difficult to interpret morphologically. The presence of brachi-cranial skulls affords special attention, as it could possibly indicate the movements of the local population (with female skeletons).

As far as the post cranial skeleton parts from this group are concerned, their poor state of preservation must be underlined. Basically, during their preparation, the proximal and distal parts of the long bones were so damaged that none of the anthropological dimensions could be obtained. Due to this, no data about corporal growth was obtained. Furthermore, the reason for such a poor state of preservation is most likely the permanently high humidity level inside the well.

skull number	2729	2745	2754	2779	2790
gender	female	male	male	female	female
individual age	30-35 years	30-40 years	about 60 years	over 45 years	up to 45 years
maximum length (G-OP)	185	180	175	176	170
maximum width (EU-EU)	147	140	137	149	137
min. forehead width (FT-FT)	96	96	98*	95	92
height BA - B	138	138	-	131	130
height PO - B	123	118	126	112	110
facial width (ZY – ZY)	-	126	-	122	117
height of the upper face (N – PR)	-	69	-	75	63
height of the eye-socket	-	38	-	39	35
width of the eye-socket	-	30	-	34	30
width of the nasal opening	-	25	-	25	22
nose height (N – NS)	-	47	-	54	45
mandibular width (GO – GO)	-	-	-	101	99

* Anthropological measurement obtained through reconstruction.

Table 3 – Viminacium / Pećine – grave in the shape of a well in the handicraft centre – primary anthropological measurements of the preserved skulls.

CONCLUSION

It is obvious that one is here dealing with a well that originally served the handicraft centre for pottery and brick production and not as a so-called grave in the shape of a well, similar to those excavated at the southern Viminacium cemeteries and belonging to the Celtic funerary tradition (Golubović 2008). The necropolis is situated only several hundred meters away and the building material either for the graves (bricks) or for the funerary cult (different vessel types) was produced in the handicraft centre.

There are no doubts regarding the primary function of the well, but when it comes to its usage for funerary purposes, we can only speculate on the most plausible explanation. Since it was discovered during the excavations conducted in the 1980's, the material did not undergo any physical-chemical analyses which could have been performed in more recent times. Furthermore, human osteological material from over 13,000 in-

Fig. 2 Skull G-2745

humation and cremation graves could not be completely stored and, as a result, some data has been partially lost. Based on to what we currently have at our disposal, the entire osteological material examined here does not show any traces of deliberate traumas, therefore indicating that there was no sacrificing. The idea of an epidemic emerges spontaneously, given that although it is close to the necropolis, an object like this well ensures isolation. If we consider burial levels and the buried individuals, the first burial level would be the most difficult one to explain. The question is if it is actually a burial or an accident that occured while the well still possessed its original function. Was it known that somebody fell into the well, thus making it unusable, since it became infected (with polluted water), or the "unfortunate" individual disappeared in the well with no one suspecting that he/she fell inside? This can, certainly, only be presumed. The fact that between the first and the second burial level there is a filling level of almost four metres indicates that the well was used as a rubbish-pit. Unfortunately, the material found in the filling level is not chronologically sensitive and does not, therefore, give any indication of the length of the period in which the filling took place. However, above it the burial levels are much denser and with a demographic content of the buried individuals that makes for the possible hypothesis that there might have been an epidem-

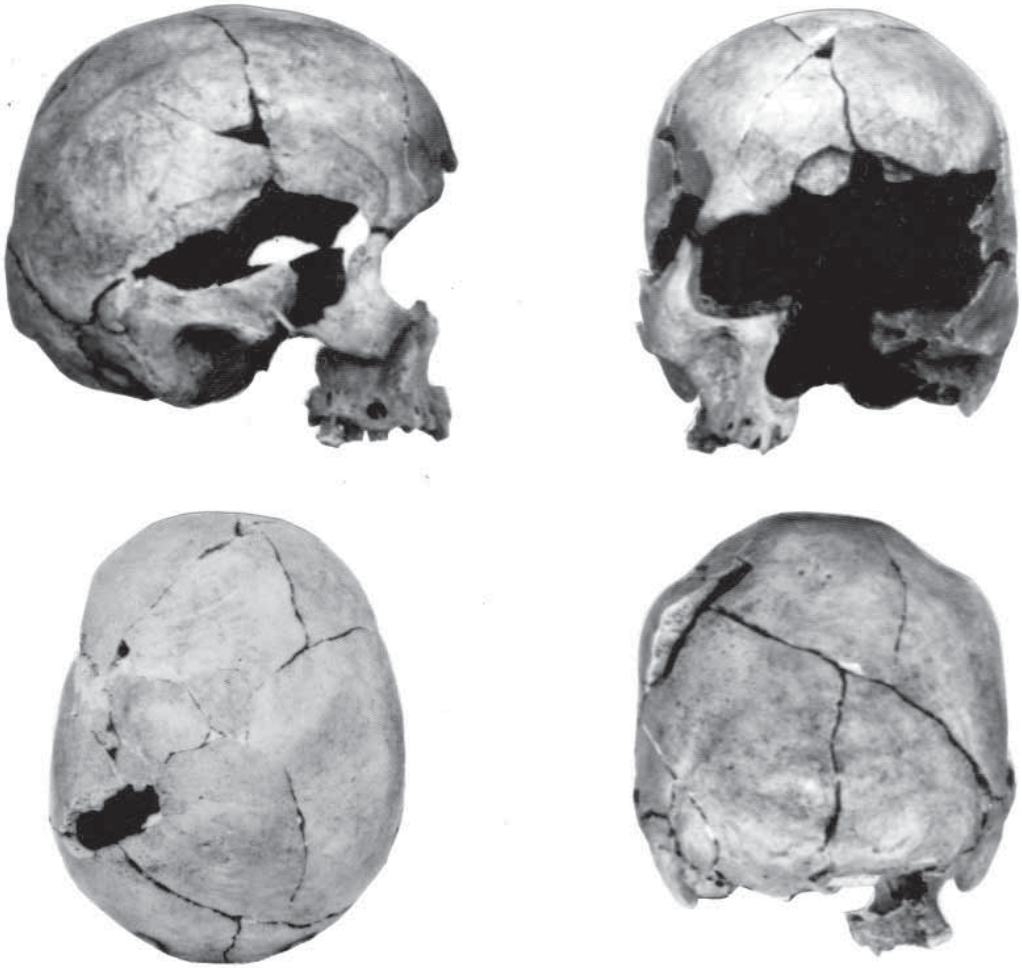

Fig. 3 Skull G-2754

ic. Even here, the material does not offer the possibility of a more precise chronological determination, although it might be indirectly concluded that it was the second half of the 3rd and the beginning of the 4th century. The buried individuals were carefully laid down in the well, but when it comes to personal belongings and possible gravegoods, one is still dealing with only a few simple objects. This indicates that they most likely belonged to the lowest social stratum, with limited material means. The discovery of a new, similar well used for burials would possibly resolve at least some of the doubts which remained after the research was concluded at the end of the 20th century. Since Viminacium was the capital of Upper Moesia and, therefore, possessed the largest necropolis, it is not impossible to expect a similar discovery, which would offer more answers to the postulated questions.

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Fig. 4 Skull G-2779

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Fig. 5 Skull G-2790

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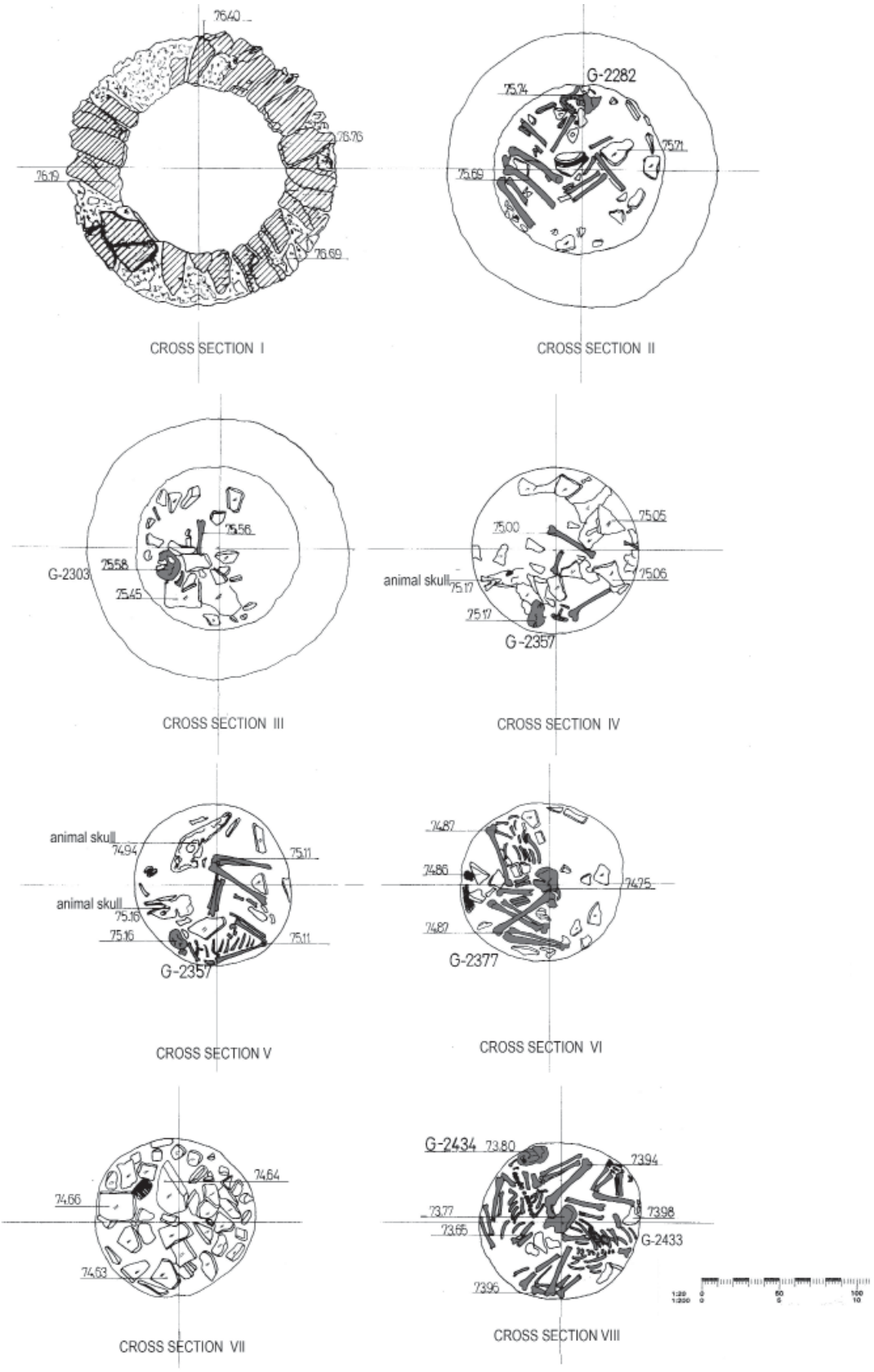

Plate I - Cross-sections of the well I-VIII

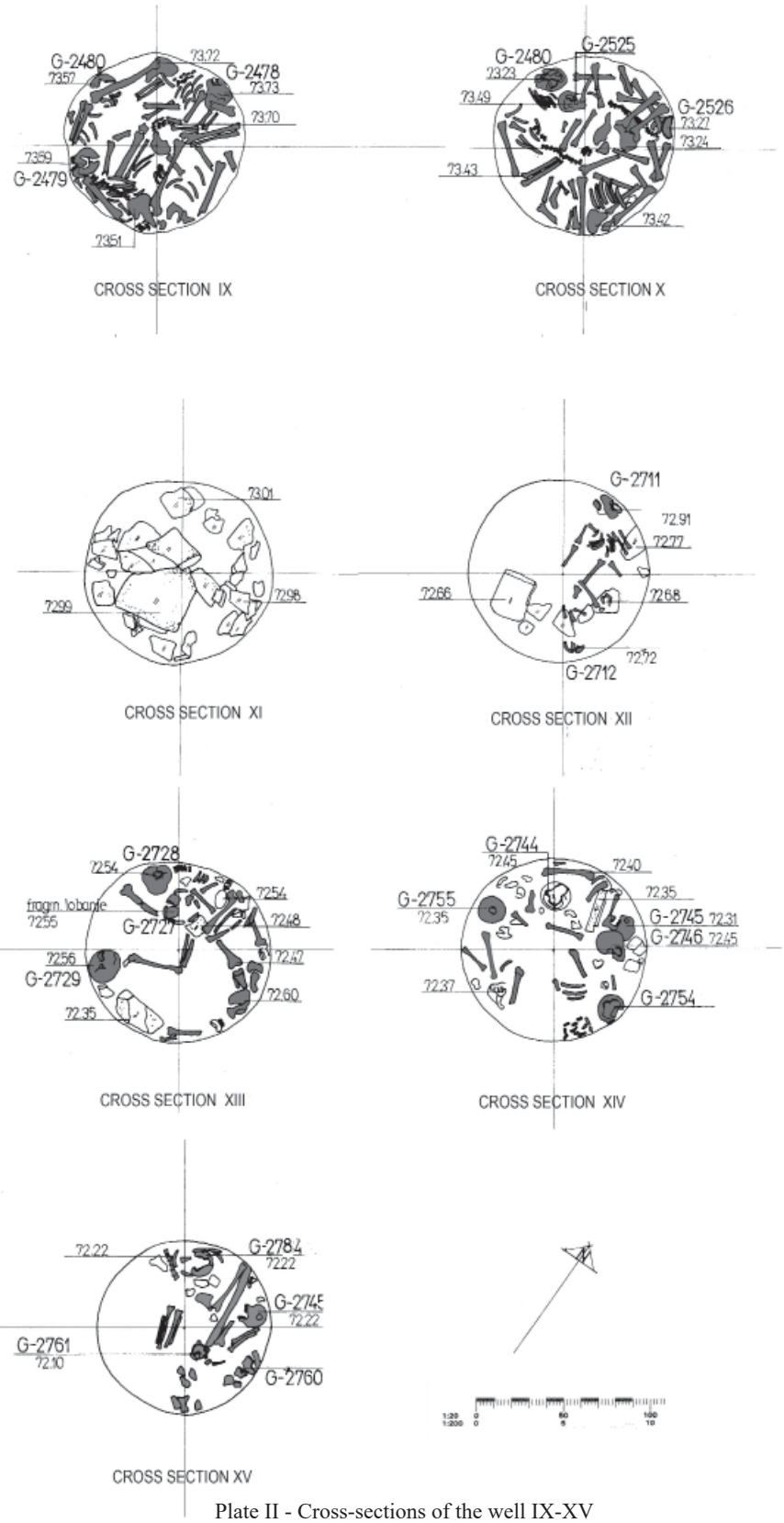

Plate II - Cross-sections of the well IX-XV

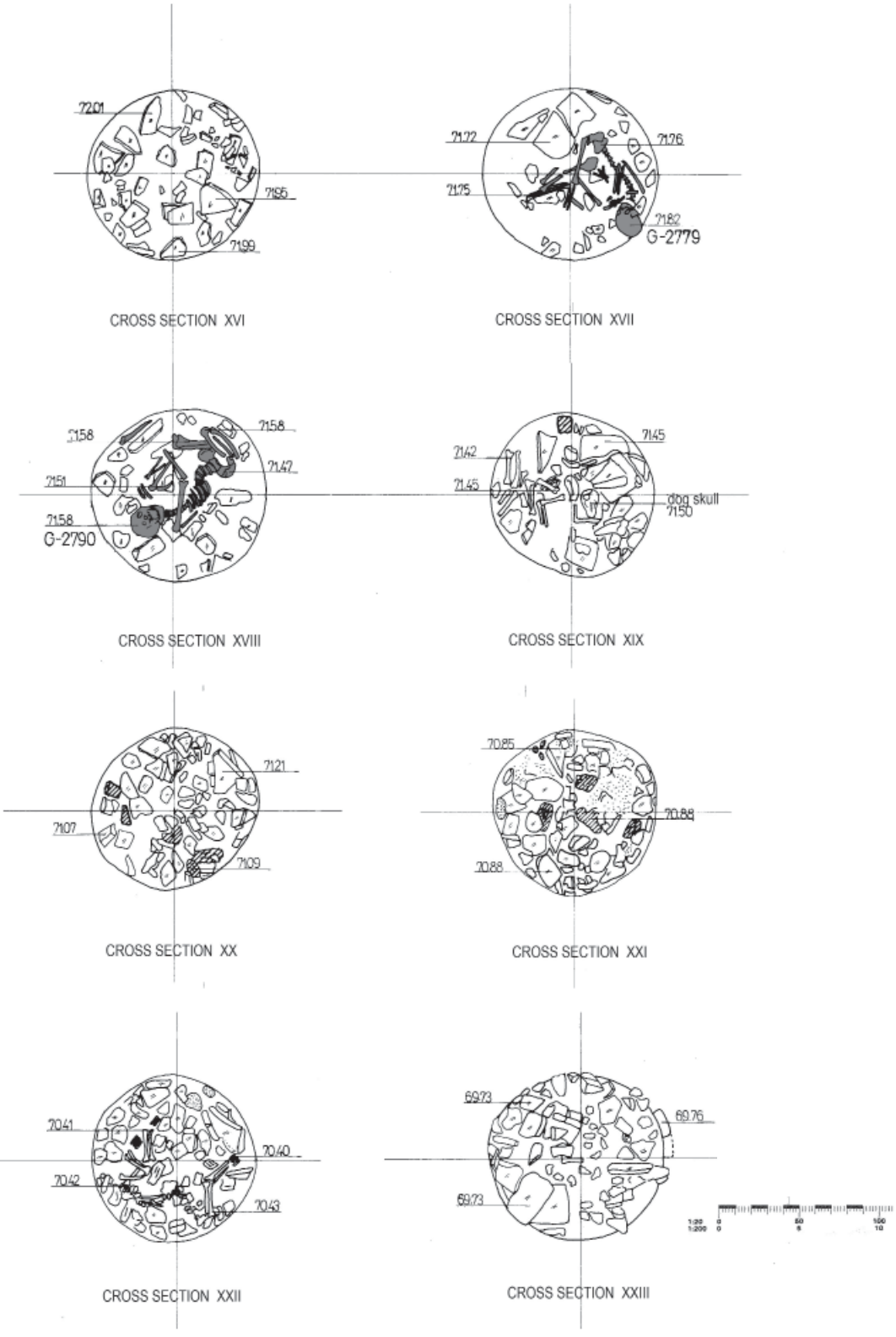

Plate III - Cross-sections of the well XVI-XXIII

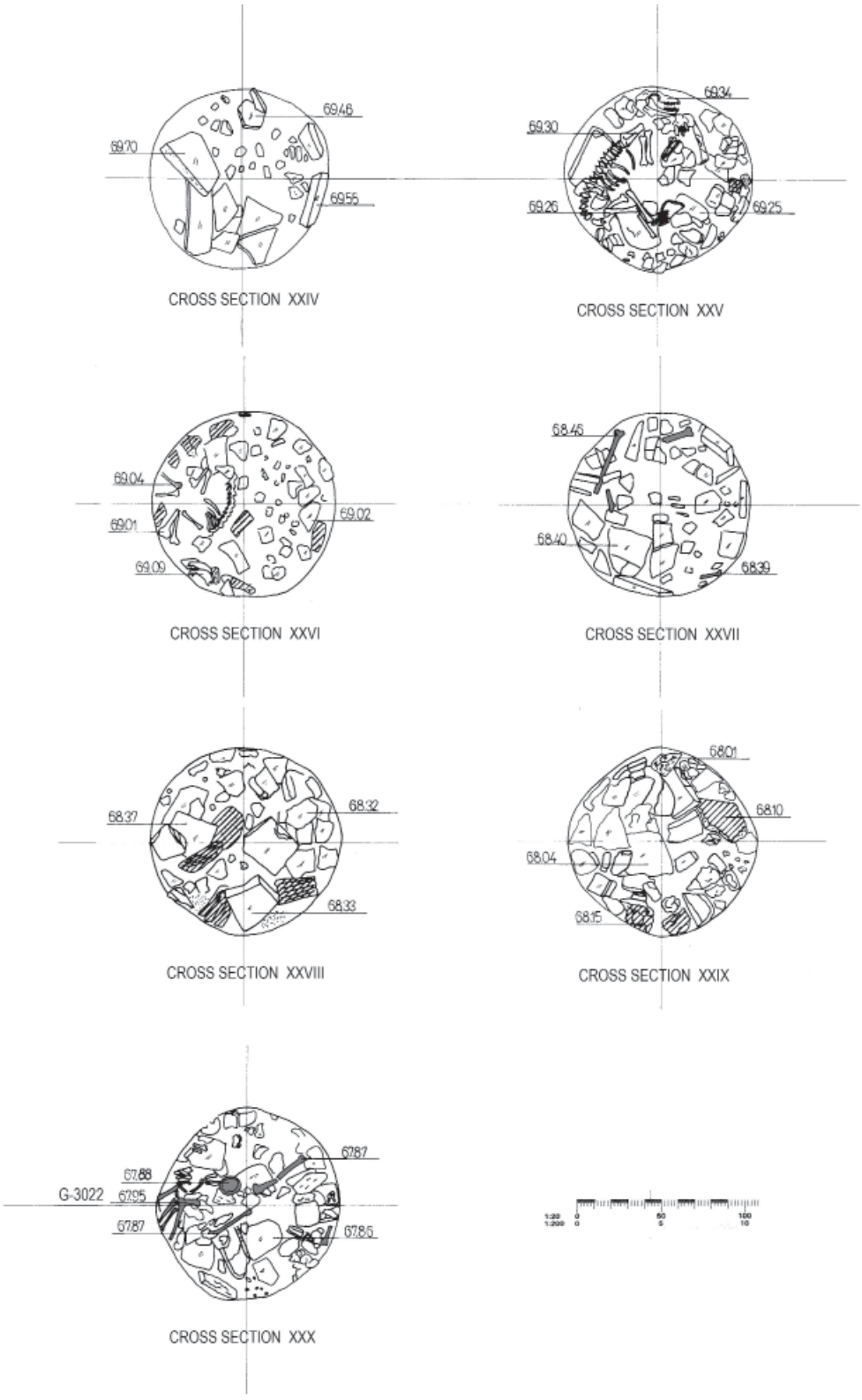

Plate IV - Cross-sections of the well XXIV-XXX

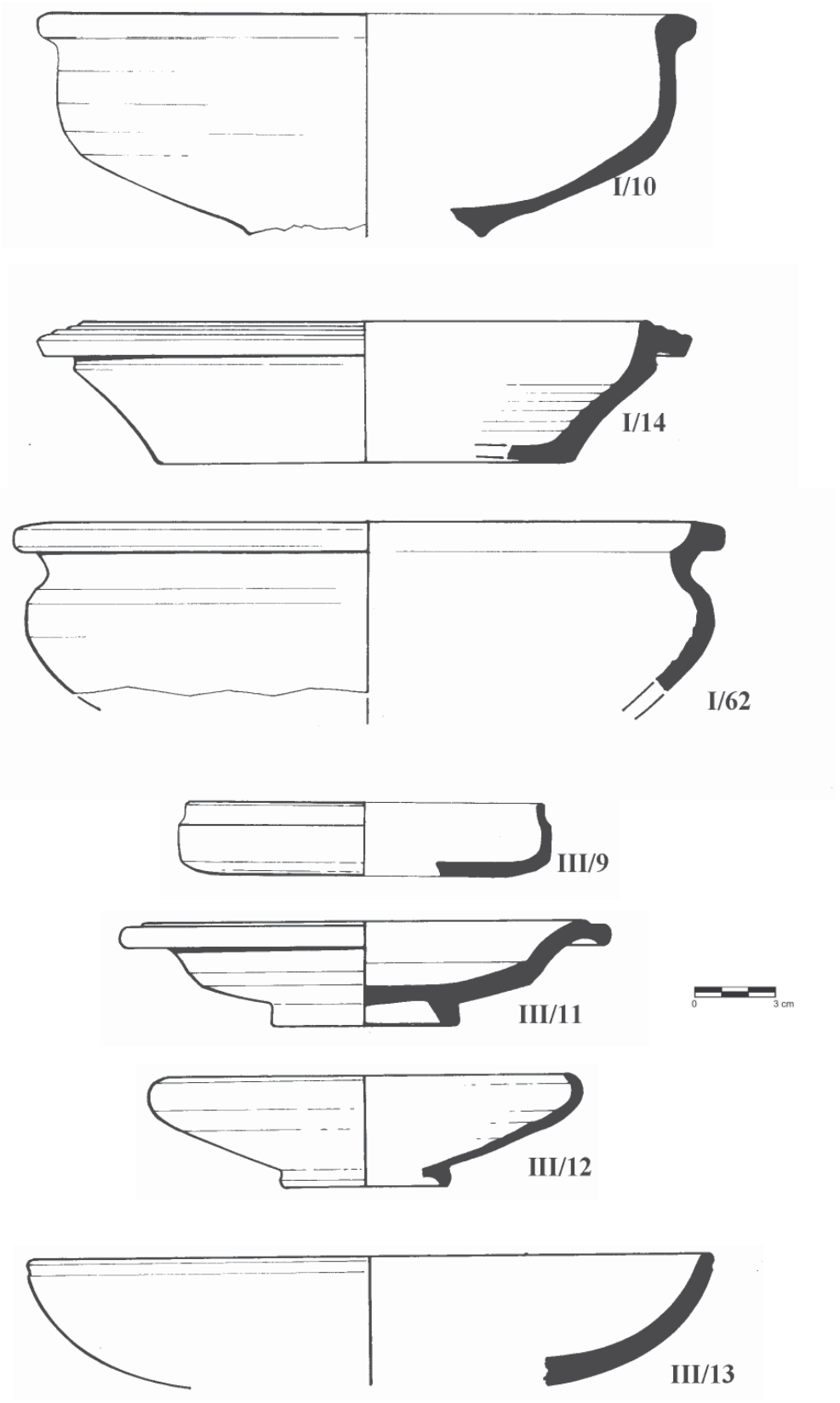

Plate V - Bowls and plates types found in the well

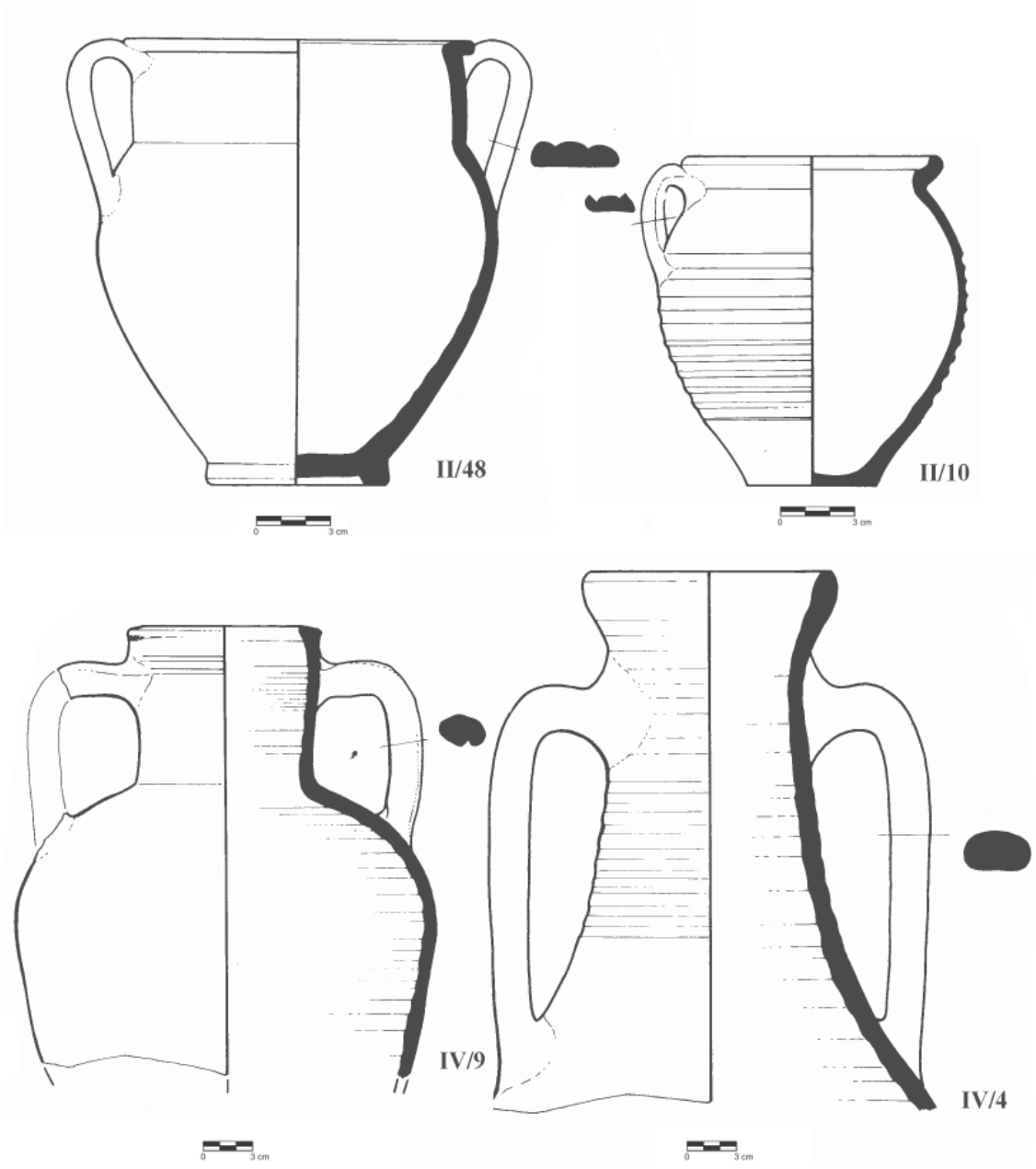

Plate VI - Pots and amphorae types found in the well

REZIME
REZULTATI ARHEOLOŠKO-ANTROPOLOŠKIH STUDIJA O GRUPNOM SAHRANJIVANJU U VIMINACIJUMU – GROBNI BUNAR U ZANATSKOM CENTRU / NEKROPOLA PEĆINE

KLJUČNE REČI: VIMINACIJUM, NEKROPOLA, GROB, GRUPNO SAHRANJIVANJE, ZANATSKI CENTAR.

Rad predstavlja drugi u nizu arheološko-antropoloških analiza grupnih grobova istraženih na Viminacijumu tokom XX veka i obradjuje sahrane u bunaru koji je prvobitno služio za potrebe zanatskog centra, odnosno izradu keramičkih posuda i opeka. U samom bunaru su nađeni skeletni ostaci 29 osoba. Ustanovljeno je pet slojeva sahranjivanja. Autori su na osnovu stratigrafskih i antropoloških analiza pokušali da daju najprihvatljivije tumačenje o upotrebi bunara u pogrebne svrhe. Materijal nađen u bunaru ukazuje na to da su sahrane mogle biti izvršene u drugoj polovini III ili početkom IV veka.

Bunar je bio cilindričnog oblika, zidan od komada zelenog škriljca vezanih krečnim malterom sa dosta peska. Bio je kružnog preseka, spoljnjeg prečnika 1.90 m, a unutrašnjeg 1.10 m i delimično oštećen radom mehanizacije, tako da nije moglo biti ustanovljeno na kojoj dubini bunar počinje. Istražen je do dubine 9.40 m od koje se javlja zdravica. Pojavljivanje vode je onemogućilo dalje istraživanje. Materijal nađen u bunaru svedoči o njegovoj dužoj upotrebi ne samo u vreme kada je korišćen za potrebe zanatskog centra, već i u dužem periodu nakon prestanka keramičke proizvodnje kada su u njemu vršene sahrane. Ustanovljeno je da postoji pet slojeva sahranjivanja u kojima su nađeni osteološki ostaci 29 individua.

Na osnovu antropoloških analiza može se zaključiti da na celom pregledanom osteološkom materijalu nisu konstatovani tragovi namernih trauma iz čega proizilazi da nije bilo nikakvih žrtvovanja. Ideja o epidemiji se tako spontano nameće. Iako blizu nekropole, objekat kao što je bunar obezbeđuje izolaciju. Ako bi posmatrali nivoe sahranjivanja i sahranjene individue, prvi nivo sahranjivanja bi bio najproblematičniji za tumačenje. Pitanje je uopšte da li se radi o sahrani ili nesrećnom slučaju koji se možda odigrao još u doba kada je bunar bio u primarnoj funkciji. Da li je bilo poznato da je neko upao u bunar i time ga izuzeo iz upotrebe jer je postao infektivan (sa neupotrebljivom vodom), ili je nesrećni čovek nestao u bunaru, a da niko nije posumnjao da je upao u njega? Naravno, možemo samo da pretpostavljamo. Činjenica da je između prvog i drugog sloja sahranjivanja sloj ispune skoro 4 m ukazuje na to da je u tom periodu bunar korišćen kao otpadna jama. Nažalost, materijal nađen u ispuni nije hronološki osetljiv i ne daje indicije o tome koliko je period punjenja mogao biti dug. Ali nakon njega slojevi sahranjivanja su mnogo gušći i sa takvim demografskim sastavom sahranjenih da nam dopušta hipotezu da se možda radilo o epidemiji. Naravno, ni ovde nam materijal ne daje mogućnost preciznijeg hronološkog opredeljenja, ali mogli bi posredno zaključiti da se radi o drugoj polovini III veka ili početku IV. Sahranjene individue su pažljivo spuštane u bunar, ali što se tiče ličnih stvari i eventualnih grobnih priloga, opet su u pitanju skromni predmeti. To ukazuje na to da se moralo raditi o najnižem socijalnom sloju stanovništva, veoma slabe materijalne moći. Verovatno da bi nalaz nekog novog, sličnog bunara iskorištenog za sahrane, mogao da razjasni bar neke od nedoumica koje su ostale nakon istraživanja ovog tokom prošlog veka. S obzirom da je Viminacijum bio najveći grad Gornje Mezije i samim tim morao imati i najveću nekropolu, nije nerealno očekivati još neki sličan nalaz koji bi uspeo da nam pruži više odgovora.

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902.2:572.7(497.11)
904:726.8”652”(497.11)
COBISS.SR-ID 219296268

Original research article
Received: April 25th 2015
Accepted: November 15th 2015

VIMINACIUM – CEMETERIES AND BURIAL LOCATIONS DURING THE GREAT MIGRATION PERIOD

ABSTRACT

Although there have been several papers published on the inhabitants of Viminacium during the Great Migration, in this paper, the number of their cemeteries will be considered. According to the archaeological categorisation, four cemeteries have been distinguished: Viminacium I, the BURDELJ necropolis, Viminacium II, the older and the younger cemetery at the VIŠE GROBALJA site, and finally Viminacium III – the necropolis excavated at the LANCI site.

According to anthropological finds, consisting of two artificially deformed skulls, during the Great Migration, the inhabitants of Viminacium were buried at the “mixed” necropolis of PEĆINE, as well as at the site of NJIVE KOD MLAVE.

KEYWORDS: THE GREAT MIGRATION, INHABITANTS, VIMINACIUM CEMETERIES, NECROPOLIS SITE, ANTHROPOLOGICAL CONTENT OF NECROPOLIS.

INTRODUCTION[1]

In previous publications (Mikić 2007), the anthropological features of the Viminacium inhabitants during the Great Migration were considered. The data was obtained from the anthropological content of three cemeteries at the sites of Burdelj and Više Grobalja (the older and the younger necropolis). A fourth necropolis from the same period, at the site of Lanci (Ivanišević et al. 2006), was also excavated, but suitable conditions did not exist for the examination of the skeletons and the data has now been lost.

During the Great Migration, in Viminacium, burials also took place at a fifth location – Njive kod Mlave. During excavation, a female skeleton was discovered, with a skull displaying a typical artificial (parietal) deformity, caused by carrying weight secured with a band over the head. As a grave-good, there was a typical Germanic fibula, which, according to archaeological-chronological criteria, belonged to the period of Great Migration. All these elements were recently published (Mikić 2014). Since only a single, so-called top-sondage, was excavated, the question remains regarding the size of the necropolis.

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

This paper concerns an artificially deformed skull, discovered at the Pećine site, in sondage number 159. Its specific morphology was documented using an X-ray image, positively indicating that there was also a sixth location, a necropolis, at which the Viminacium inhabitants were buried during the Great Migration.

MATERIAL AND METHOD

Even as an isolated find, an artificially deformed skull represents conclusive proof that during the Great Migration, in Viminacium, within the Roman cemetery of Pećine, burials took place. The skull is from grave number 1542, discovered within an extension of sondage 159 (M. Korać conducted the excavation of the entire sondage). Field diary pages 1,533 and 1,534 reveal the following data: "G-1542 is positioned in the eastern extension of the profile 3 – 4, at a depth of 0.48. The skull of the deceased was in the profile, therefore requiring an extension. The extension begins at 3.70 m from T.3 towards the south. The extension measures 3.30 x 1.40 m. The skeleton is orientated west-east, with a deviation of 27^{o} of its western part towards the south. It was a simple grave pit, while the deceased was placed on its back, in an outstretched position. The skull reached the spine with its chin, therefore being positioned almost vertically. The right arm was bent and placed slightly outwards, with the hand under the pelvis. The left arm was preserved up to the elbow. The ankles were placed almost one next to the other. Above the right elbow, on the inner side, a red fired oil-lamp was discovered (C 4661). The preserved skeleton length is 1.72 m". The discovery of the oil-lamp must certainly be considered, but we will come back to it later.

In the field diary, it is also stated that this grave, actually the skeleton, was technically documented in sketch number 712, as well as on films 224 (photo numbers 7, 8 and 9) and 225 (photos 11 and 12).

Since our analysis is based on the anthropological find, the artificially deformed skull from grave number 1542 of the Pećine necropolis, it had to be presented in detail. The method of examination needed to be much more detailed compared to skulls without artificial deformities, in order to ascertain that it belonged to the period of the Great Migration. Consequently, its anthropological measurements had to be more numerous and more detailed. We could not only use the primary cranial measurements, but also more specific ones had to be obtained, those that were the best indicators for an artificial deformity. However, these had to include only standardised anthropometric values. An analysis such as this also required a life-size X-ray.

For determining gender and individual age, there was no need to abandon the usual anthropological criteria. Recommendations have been used, which in Europe (as well as in the USA) have been applied ever since 1980 (Ferembach, Schwidetzky and Stloukal 1980). These are the criteria which, regardless of their later publication, remain a standard and only differ in modalities.

Nevertheless, the morphometry of artificially deformed skulls reaches beyond the choice of primary measurements. Primary, together with specific, skull measurements were used (a total of 39). Since, on the skull considered, neither the facial bones nor the jaws were preserved (see images), the choice of anthropological measurements had to be based only on the cerebral part. The reduced number includes the following measurements (based on marks and numeration by Knussman, 1988, s. 161-189):

For all the performed measurements, the instruments used were GPM Anthropological Instruments for Somatology and Osteology by Siber Hegner Maschinen AG from Zurich (performed in the Department of Archaeology at the Philosophical Faculty in Belgrade). Photographs and X-ray snapshots were made at the J. Gutenberg Anthropological Institute at the University in Mainz.

TYPE OF MEASUREMENT	MEASURE INDEX	NUMERATION	VALUE FOR SKULL 1542
Length measurements			
Maximum cranial length	G – OP	1	167 mm
nasio-opisthocranion	N – OP	1d	-
nasion-inion	N – I	2a	-
glabella-lambda	G – L	3	162
cranial base length	N – BA	5	-
foramen magnum length	BA - O	7	-
Width measurements			
maximum cranial width	EU – EU	8	151
minimum frontal width	FT – FT	9	102
maximum frontal width	CO – CO	10	118
biauricular width	AU – AU	11	-
maximum biasterionic width	AST – AST	12	107
bimastoid width	MS – MS	13	102
foramen magnum width		16	-
Height measurements			
basion-bregma	BA – B	17	-
porion-bregma	PO – B	20	132
Perimeters and vaults			
horizontal perimeter	G – OP – G	23	-
transversal vault	PO – B – PO	24	-
mediosagittal vault	N – O	25	-
mediosagittal frontal vault	N – B	26	-
mediosagittal parietal vault	N – L	27	150
mediosagittal occipital vault	L – O	28	132
Distances			
mediosagittal frontal	N – B	29	105
mediosagittal parietal	B – L	30	108
mediosagittal occipital	L – O	31	-

RESULTS

According to the criteria defined by D. Ferembach, I. Schwidetzky and M. Stloukal (1980), the gender of the individual to which skull number 1542 from the Pećine necropolis belonged was easily established as male. Regardless of the incomplete state of preservation and the lack of the post-cranial part, the preserved constitutional and morphological elements indicated male gender exclusively (see illustrations on T. I).

When it comes to individual biological age, the state of preservation of the cerebral skull part presented some problems. Basically, out of all of the criteria only an adequate scheme for determining age according to obliteration of the skull joints could be applied, published separately by several authors (Acsadi i Nemeskeri 1970; Olivier i Demoulin 1976). Since this scheme is not completely reliable, especially when no other scheme is being used, we consider that the age of the male individual buried in grave number 1542 from the Pećine necropolis should be determined within a time span, most likely between 30 and 40 years of age.

The measurements of the cerebral part of the skull most usually considered with artificially deformed skulls have already been shown. In order to avoid repetition, the values for skull number 1542 have been shown next to the typical anthropological marks. This refers only to the preserved skulls, those where the measuring points were available. Accordingly, of the 24 chosen measurements, only twelve skull parameters were obtained, due to the level of preservation.

Skull number 1542 from the necropolis at Viminacium – Pećine is presented using standardised anthropological projections on T. I, while its lateral radiographic image is presented on T. II.

Apart from the usual photographic images, an X-ray snapshot (life-size) was necessary due to the specific profile of the skull. It indicates that its cerebral part does not show the usual and intact morpho-structure. The anthropological documentation doubtlessly indicates that it was an artificial deformation made using bandaging during the lifetime of the deceased. In other words, traces of artificial deforming are apparent. This deformity shows on all of the big bones of the cerebral part. Due to artificial deformation, the shapes of the frontal and occipital bones were altered, along with those of the parietal bones. Based to their configuration, we can define the bandaging zones, of which there were certainly two. One of them was frontal-occipital, while the other was parietal-occipital. The effects of such bandaging on this skull are still very striking, although it is known that, in cases of artificial deforming during lifetime, each skull tends to return its natural shape (Mikić 2007/a). Generally speaking, this is why artificial deformations are much more striking at a younger, rather than at an older age.

DISCUSSION AND CONCLUSION

The sondage CLIX was opened on the 18th of June 1980, as shown on page 741 of the field diary for the site of Viminacium – Pećine. Further on, it is indicated that it was a so-called block-sondage, measuring 10 x 5 m. As a result of its size, it was sub-divided into blocks, sectors and extensions.

Due to its specific content, the excavation of this sondage lasted for several years. For example, grave number 1542 is mentioned in the field diary on pages 1533 and 1534, written on the 17th of May 1982.

Now we will return to the find of the oil-lamp, discovered close to the right elbow of skeleton number 1542. Since this grave was excavated within the group of graves with numbers 1507 and 1514, both without grave-goods, the oil-lamp should first be regarded outside the archaeological context. This would indicate that it was discovered in a secondary position, since sondage 159 was densely filled with graves and skeletons, even in its extensions, and was excavated for several years.

Another consideration refers to the possible pathology of the cerebral part of skull number 1542, requiring a completely different interpretation. After comparisons with other skulls from the Više Grobalja necropolis and comparing it with data from a variety of papers (eg. Buikstra i Ubelaker 1994; Freiss i Baylac 2003), it can be ascertained that this skull was artificially deformed, therefore ascribing it to the populations younger that the Roman one, which inhabited Viminacium after the 5th century.

The third conclusion, actually our general conclusion, regards the discovery of the group of skeletons (graves 1507, 1514 and 1542), archaeologically identified as having a definite co-relation.

As already known, the names for the Viminaciumu cemeteries were taken according to the cadastre of the CU Požarevac. The Pećine and Više Grobalja cemeteries belong to the so-called southern Viminacium cemeteries, and are positioned one next to the other. The Više Grobalja cemetery is located to the south-east of the Pećine necropolis. The graves discussed were discovered in the eastern appendix of sondage 159 at Pećine. – It transpires that these graves should then belong to the north-western part of the necropolis from the period of the Great Migration (Više Grobalja II). This conclusion is based on the discovery of skull 1542 with its specific morphology.

Finally, our research does not affect the archaeological interpretation of the cemeteries from the Great Migration period in Viminacium (Ivanišević et al., op. cit.), since in those graves there were no grave-goods. The only exception is the area of the cemetery itself, which was slightly enlarged. On the other hand, when considered anthropologically, the younger cemetery from the period of the Great Migration, Viminacium – Više Grobalja, possessed one more artificially deformed skull (along with five others, previously discovered and published), with at least two more adult skeletons.

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RESUME

VIMINACIJUM – NEKROPOLE I LOKACIJE SAHRANJIVANJA TOKOM VELIKE SEOBE NARODA

KLJUČNE REČI: SEOBA NARODA, STANOVNIŠTO, NEKROPOLE VIMINACIJUMA, LOKACIJE SAHRANJIVANJA, ANTROPOLOŠKI SADRŽAJ NEKROPOLA.

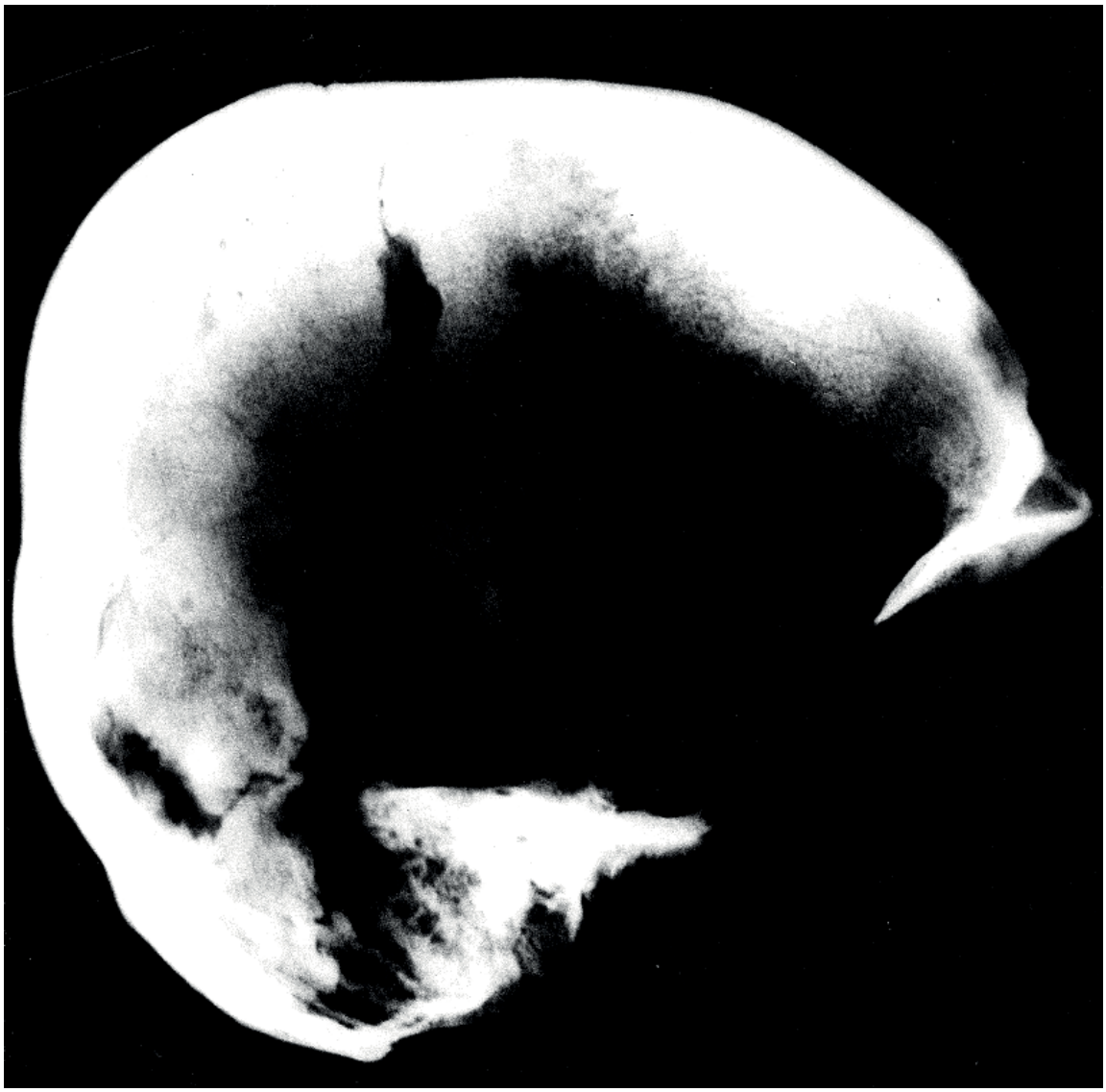
Od ranije je poznato da su nekropole Burdelj, Više grobalja I i II i Lanci, zapravo četiri lokacije na kojima se vršilo sahranjivanje tokom velike seobe naroda. Te četiri lokacije su već ušle u arheološku literaturu, što ne želimo da osporavamo. Cilj ovog priloga je da se postojećim saznanjima pridodaju i podaci dobijeni antropološkim kriterijumima.

Na lokaciji Njive kod Mlave ranije je u tzv. top-sondi otkrivena jedna specifična ženska lobanja koja je kao grobni prilog imala jednu tipičnu germansku fibulu. Lobanju tog skeleta karakterišu tragovi usled nošenja tereta trakom preko glave tokom dužeg perioda života, ali što je kao pojava i ranije bilo konstatovano na ovim prostorima. Nedavno je publikovana kao treći ovakav nalaz, svakako iz perioda velike seobe naroda. Međutim, u ovom slučaju ostaje otvoreno pitanje, da li se radi o usamljenom nalazu ili pak nekropoli, koja je mogla biti identifikovana samo pomenutom sondom na lokaciji Njive kod Mlave, ali gde detaljnija arheološka istraživanja nisu mogla biti nastavljena.

Ovaj prilog je baziran na nalazu jedne veštački deformisane lobanje na lokaciji Pećine, u sondi broj 159 (čijim iskopavanjima je rukovodio M. Korać). Posle svih potrebnih upoređivanja, kako sa tridesetak artificijalno deformisanih lobanja sa lokacija Više grobalja, što predstavlja izuzetno velik broj i u najširim okvirima, tako i sa odgovarajućom literaturom, sigurni smo da se ona hronološki mora vezati za veliku seobu (videti T. I i T. II). Nalaz keramičkog žiška u blizini skeleta broj 1542, koji je u okruženju nekoliko grobova bez priloga (1507, 1514) u inače najkomplikovanijoj sondi na Viminacijumu, imamo razloga da smatramo da je zatečen u sekundarnom položaju. Prioritet smo dali morfologiji prikazane lobanje, što se svakako ne može osporavati.

S obzirom da je nekropola Više grobalja locirana jugoistočno u odnosu na nekropolu Pećine, posmatrana grupa grobova pronađena u istočnom proširenju sonde 159 (na Pećinama), pokazuje da se oni nadovezuju na severozapadni deo mlađe nekropole (na lokaciji Više grobalja). Ali, kako se lokacije Pećine i Više grobalja katastarski graniče, a obe pripadaju tzv. južnim nekropolama Viminacijuma, naš zaključak bi glasio: Naše istraživanje nije osporilo arheološku interpretaciju o nekropolama seobe naroda, nego je samo proširilo antropološki sadržaj mlađe nekropole Više grobalja, i to za jednu artificijalno deformisanu lobanju i dva skeleta odraslih individua.

T. I
Viminacium / Pećine No 1542
1 - Norma frontalis; 2 - Norma occipitalis; 3 - Norma lateralis sinister;
4 - Norma lateralis dexter; 5 - Norma verticalis



T. II
Viminacium / Pećine No 1542
Rö - Norma lateralis dexter

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902.2:572.7(497.11)
904:726.8(497.11)"01/03"
COBISS.SR-ID 219297036

Original research article
Received: June 4th 2015
Accepted: November 15th 2015

ATTEMPT OF SOCIAL STRATIFICATION OF THE SOUTHERN VIMINACIUM CEMETERIES ACCORDING TO PALEOPATHOLOGICAL CATEGORIES

ABSTRACT

An attempt to compare the number of anthropologically studied skeletons and the number of paleopathological diagnoses noted on them from the cemeteries of Pećine and Više Grobalja, which both actually represent a common, southern Viminacium cemetery, offered actual data in the sense of society's social stratification. From the Pećine cemetery, 4,312 skeletons have been studied and 149 diagnoses established (3.36%). The Više Grobalja cemetery showed a different ratio: 1,574 skeletons with 219 diagnoses (13.91%). These results indicate that the individuals buried in the eastern part of the southern cemetery were in worse health compared to those from the western part of the same cemetery.

KEYWORDS: VIMINACIUM, SKELETONS FROM THE ROMAN PERIOD, PALEOPATHOLOGICAL CATEGORIES, PERCENTUAL RELATION OF DIAGNOSES, HEALTH PROFILE, ELEMENTS OF THE SOCIETY'S SOCIAL STRATIFICATION.

INTRODUCTION[1]

During the archaeological research and according to the cadastre books, the southern Viminacium cemeteries were divided into two sites: Pećine and Više Grobalja. In 1977, the Pećine excavation started and ended in 1988. During that period, 5,440 graves were unearthed.

Between 1984 and 1986, the site of Više Grobalja was excavated. During that period, 2,183 graves were unearthed. It needs to be mentioned that the skeletons numerated 1 to 162 were not included in the anthropological study (Mikić 1984).

It is known that Viminacium was both a legionary fort and a civilian settlement, actually a city. Since, according to archaeological criteria, it was not possible to separate the military from the civilian Viminacium necropolis (or necropolis parts), we tried to make a division according to the health criteria, in order to understand the differences in some other aspects. – The author considers that the social stratification of the buried Viminacium inhabitants could be determined according to paleopathological elements. The reason lies in the fact that not all of the Viminacium

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

inhabitants suffered from same diseases in the same period. The importance of such a hypothesis must be based primarily on the most common diseases and not on those appearing only in a small number, or sporadically (bone diseases, treponematoses (eg. male skeleton nr. 1651/b from Pećine etc.).

MATERIAL AND METHOD

In spite of the well conducted archaeological research, the preservation degree of the Viminacium skeletons was not high. Because of this, at the Pećine necropolis, due to the very poor and incomplete state of preservation, 1,075 grave contents suitable for anthropological analysis were not lifted from the graves. In addition to this, 27 skeletons were chronologically ascribed to the Middle Ages (marked as G_4), whilst an additional 26 graves were ascribed to the prehistoric Celts (marked as G_3). This, therefore, results in the fact that the anthropological analysis was performed on 4,312 graves from the Roman period.

In 1988, the necropolis at Više Grobalja included 2,183 graves. Graves 1 to 162 were not used for the anthropological study, along with 329 graves whose content was not lifted due to the previously mentioned reasons. Another 120 skeletons from this location were ascribed to the period of the Great Migration (marked as G_2), therefore resulting in the fact that the analysis was performed on 1,574 graves from the Roman period.

The starting point for this attempt of social stratification of the southern Viminacium cemeteries, archaeologically excavated and documented as the cemeteries of Pećine and Više Grobalja, is based on a total of 5,886 graves from the Roman period. As mentioned, these include 4,312 graves from the Pećine cemetery and 1,574 graves from the Više Grobalja cemetery (Korać i Golubović, 2009).

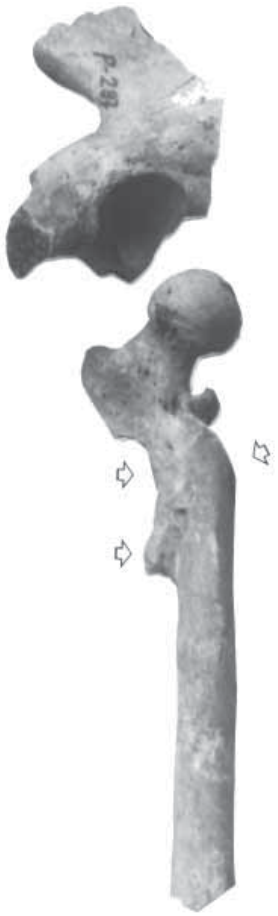
The paleopathological study method of the human osteological material from Viminacium was primarily macroscopic. Only about 1% of the established diagnoses were radiologically documented, including only very rare and specific finds which do not directly fit into the title of this paper. All of the paleopathological diagnoses were categorised according to pathological handbooks, written by G.T. Steinbeck (1976), A.C. Aufderheide and C. Rodrigez-Martin (1998) and D. J. Ortner (2003). Our previous experience was also used. This included the Atlas written by A. Lovrinčević and Ž. Mikić (1989), as well as the paleopathological handbook by E. Hoševski and Ž. Mikić (1995).

All of the radiological recordings were conducted earlier, in the clinical centre of the Radiological Institute in Sarajevo, at the same time that the Atlas by A. Lovrinčević and Ž. Mikić was prepared. Since a certain number of paleopathological finds from Viminacium have been kept and preserved up to the present day, there is a possibility to conduct the latest microscopic and molecular analyses. Such finds are specific and they would surely be indicative, both for the development and application of further methodology, as well as for the Roman city and the legionary fort of Viminacium.

The photographic documentation from Viminacium which is at our disposal will be presented here only in a limited number, mostly in order to avoid unnecessary repetition of the already partially published material. It should, once again, be stressed that this paper should result in a social stratification of the individuals buried at the southern Viminacium cemeteries, all of which is based on the examined paleopathological categories.

RESULTS

After examining the huge amount of anthropological documentation of almost six thousand (5,886) skeletons from the Roman period, the results are presented in Table 1. This shows all the discovered paleopathological diagnoses in the order determined from the number of finds, since



Viminacium, Pećine No. 297

Viminacium, Više grobalja No. 197

we consider this best matches with the title of the paper. As the table shows, apart from the cranial and post-cranial skeleton parts, jaws and teeth were also considered, as a part of each skeletal individual. Trepanning is also listed in the table, since it most directly indicates the state of medical treatment in Viminacium (Mikić 2006).

What needs to be mentioned is that with such a large number of samples, diagnoses that appear on less than ten, again subordinated to the title of the paper, shall not be considered. However, all of them were noted. This refers to periodontitis of a very high degree, specific contagious diseases (treponematoses), osteoporosis senilis and bone tumours (noted on skulls only).

The most numerous paleopathological observations regard the jaws and teeth, with caries, tooth loss *intra vitam* and the accompanying cysts (*peridentisis periapicalis chronica granulomatesa*).

At the Pećine necropolis, with 40 cases, the frequency of caries and loss of teeth caused by it, does not even reach one percent (0.93%), whilst at the Više Grobalja necropolis, with 105 cases, it reaches 6.67%.

Dental cysts on the jaws from the Pećine necropolis (17 cases), compared with previous finds, show an even smaller percentage – 0.39%. At the Više Grobalja cemetery, with 32 cases, this percentage climbs to 2 (2.03%).

In Viminacium, accidental traumas always occur on the post-cranial part. In the greatest number of cases, there are healed fractures (*status post fracturam*) of the long bones. The accuracy of sanation was not always of a high level and many different cases were discovered. The first case of a badly healed femur fracture at the Pećine necropolis was observed on skeleton number 279 (female, up to 40 years). This case was photographed by the author and is depicted in the annex, as Figure 1.

The first fracture noted at the Više Grobalja necropolis was on skeleton number 197 (male, over 40 years of age). The healed fracture of his ulna was also depicted in Figure 1.

Site Number of examined skeletons	Pećine 4,312	Više Grobalja 1,574
JAWS AND TEETH		
Caries – intra vitam tooth loss	40	105
Dental cysts	17	32
Periodontitis (of a developed degree)	6	7
TRAUMAS		
Accidental traumas – status post fracturam	33	14
Deliberate traumas (Causa mortis – amputation)	5	9
RHEUMATIC CHANGES		
Regardless of location	21	24
UNSPECIFIC CONTAGEOUS DISEASES		
Poriostitis – osteomielitis	10	10
SPECIFIC CONTAGEOUS DISEASES		
Treponematoses	2	1/2
METABOLIC DISEASES		
Cribra orbitalia	8	13
Osteoporosis senilis	3	1
TUMORS		
Osteomas on skull	3	1
SKULL TREPANNING	1	2/1
Total of paleopathological diagnoses	149	219
Percentage of the total number of diagnoses	3.46%	13.91%

Table 1: Tabelar display of paleopathological diagnoses of the southern Viminacium cemeteries categorised according to the number of specific cases

In Viminacium, deliberate traumas always relate to the skull (Korać i Mikić, 2012). One exception is an amputation noted on male skeleton number 1226/D from the Više Grobalja necropolis, where the lowest part of the left ulna (towards the wrist) is missing. The biggest part that remained is slightly rounded and therefore healed, with an obvious reduced length (about 2 cm). However, since there were other paleopathological changes noted on this skeleton, it is quite possible that an intervention "due to surgical reasons" was performed. A separate and expert publication of skeleton number 1226/D will follow, exactly because of the paleopathological changes on its bones.

At the Pećine necropolis, accidental traumas were noted on 33 skeletons, representing a total of 0.77% of the number examined. On the other hand, at the Više Grobalja necropolis, there were 14 skeletons with healed fractures of long bones, a total of 0.89% of the number examined.

Site Number of examined skeletons	Više grobalja 1,574	Pećine 4,312
JAWS AND TEETH		
Caries – intra vitam teeth loss	6.67%	0.93%
Dental cysts	2.03%	0.39%
TRAUMAS		
Accidental – status post fracturam	0.89%	0.77%
Deliberate – causa mortis	0.57%	0.12%
RHEUMATIC CHANGES		
Regardless of location	1.52%	0.49%
UNSPECIFIC CONTAGEOUS DISEASES		
Poriostitis – osteomielitis	0.64%	0.23%
METABOLIC DISEASES		
Cribra orbitalia	0.83%	0.19%
Percentage of the total number of diagnoses (according to the number of examined skeletons)	3.46%	13.91%

Table 2: Percentual relation of the most numerous number of paleopathological diagnoses according to the number of specific cases

Deliberate traumas always relate to the skull in all the noted cases. The Pećine necropolis revealed five such cases, while the Više Grobalja necropolis revealed nine cases. This is 0.12% in Pećine and 0.57% in Više Grobalja.

Rheumatic diseases were noted on different skeleton parts - at the Pećine necropolis, they were noted in 21 cases, or 0.49%. On the Više Grobalja necropolis, this number is 24, or 1.52% (compared to the total number of examined skeletons).

As shown in Table 1, at both of the cemeteries, unspecific contagious diseases were noted in ten cases each. Compared to the total number of skeletons, at the Pećine necropolis, this is 0.23%, while at the Više Grobalja necropolis, this is 0.64%.

When it comes to the specific contagious diseases of the inhabitants of Roman Viminacium, only three cases of trepomenathosis were noted. Two of them were discovered on the skeletons from the Pećine necropolis and only one from the Više Grobalja cemetery.

Metabolic diseases, primarily *cribra orbitalia*, were noted on the buried at both of the cemeteries. At the Pećine necropolis, it occurs only on infant skeletons, in eight cases (0.19%). The Više Grobalja necropolis revealed thirteen cases (0.83%), both on infant, as well as female skeletons (see Table 2).

Osteoporosis senilis (*parietalis*), categorised into the same paleopathological group, was noted in only four cases. Three occur on finds from the Pećine necropolis and only one on a skull from the Više Grobalja necropolis.

Tumours, or osteomata, were noted on three skulls from the Pećine necropolis and only on one skull from the Više Grobalja necropolis.

Due to the already mentioned reasons, trepanning was included into Table 1, but does not offer any significant results. There are three cases

from both of the cemeteries. What is typical is the application of an older trepanning technique - scraping. Trepanning using the so-called piercing technique (using a suitable metal piercer – trepanner), which is certainly chronologically younger and would have been easier for the "patient", was not noted on the studied anthropological material from Viminacium.

DISCUSSION

The discussion relevant for the title of this paper and its content refers only to skull number 1651/B. In 1995, it was published (Hošovski and Mikić 1995) and illustrated (p. 151, T. XVI), with the conclusion that it represents syphilis with significant periostal sediments. Some ten years later (Mikić 2006), after comparing similar published finds, the author regarded this as an interrupted trepanning. It is sufficient to compare it to the previous case from the same Viminacium necropolis – Više Grobalja number 1037, in order to conclude that the positioning is practically the same (at the arch of the left parietal and occipital bone), the same technique was applied (scraping the outer bone cover), while the surface included in the "scraping" is slightly bigger and is clearly visible. The "surgeon" did not reach the outer brain membrane (*Dura matris*), while the intervention zone is only slightly bigger compared to the previous case of trepanning (number 1037). The newly formed irregular osteoblast conglomerations certainly reveal bone healing, still leaving the possibility open that there might have been certain infections which influenced the appearance of the new bone surface.

CONCLUSION

According to our results, the disproportion of the archaeologically excavated human osteological material from all of the cemeteries that are included in the southern Viminacium necropolis (4,312 : 1,547 skeletons), gave priority to the percentage ratios of the highlighted paleopathological categories. Our attempt of social stratification will actually be based on these percentage ratios between the Više Grobalja and the Pećine cemeteries (see Table 2).

It should be emphasised that, although the number of examined skeletons from the Više Grobalja necropolis was about 2/3 smaller, there is always a much larger percentage of paleopathological diagnoses compared to the Pećine necropolis. This primarily relates to jaws and teeth (6.67% : 0.93%, actually 2.03% : 0.39%). Rheumatic diseases show a ratio of 1.52% : 0.48%. Both trauma categories reveal the same image (0.89% : 0.77%, actually 0.57% : 0.12%). – The same ratio shows with unspecific and specific contagious diseases, as well as with metabolic diseases (Grupe 1995).

The frequency percentage of paleopathological diagnoses is much higher with the individuals buried at the Više Grobalja necropolis, compared to those buried at the Pećine necropolis. A similar situation is seen with tumours, noted only on skull bones.

When it comes to skull trepanning, as already explained in this paper, each necropolis possesses one case, a total of two cases, among its discoveries. Until now, the site at Pirivoj, basically representing the eastern Viminacium cemetery, possesses five skulls with trepanning, which were recently published (Kirilenko and Mikić 2014).

Generally speaking, we will not discuss paleopathological diagnoses, parallel diagnoses and their ethiologies, since everything is subordinated to the title of the paper: The attempt of social stratification according to paleopathological categories, actually diagnoses frequencies according to the number of the buried at each of the cem-

eteries. Also, according to archaeological criteria (Korać and Golubović 2013), it transpired that the cemeteries at Pećine and Više Grobalja spatially form the southern Viminacium cemetery, separated due to the cadastre division of the areas included, and this is how the graves and skeletons were excavated and numerated.

Geographically, the part of the southern cemetery named Pećine was situated somewhat to the west and closer to the city, which can clearly be seen on the spatial plan of Viminacium. The part of the same necropolis named Više Grobalja, was situated to the east and most likely included the sites of Velika Kapija and Carine (excavated only partially).

The parallel analysis of paleopathological diagnoses performed in this paper show two basic results. The first indicates that the western part (Pećine) revealed a smaller number of diagnoses (149). The eastern part of the southern necropolis (Više Grobalja) possesses a larger number of diagnoses (219), with the number of the examined skeletons about 2/3 smaller (see the tables). – Basically, the population buried in the western part possessed a proportionally better health profile compared to the Viminacium inhabitants buried in the eastern part of the southern necropolis. – Precisely this is the most important indicator regarding the existence of social stratification within the population of Roman Viminacium. It shows not only in the archaeological data (according to the field diary), but also in health status, which differs significantly from one necropolis to the other.

Another conclusion, regarding the total of the results gained, indicates that this was "a very vital population". With this conclusion, one should consider the importance of Viminacium as a city and a legionary fort.

There are certainly elements of criticism regarding the method applied and the conclusions drawn. In the first place, it is the lack of the graves', or the skeletons' stratigraphy, but this will be considered in one of the future archaeological projects. In one of the further phases, this context should also include the eastern, Pirivoj necropolis, at which there was the imperial mausoleum etc. It is considered that to the west and the north of the city, there were no geo-morphological conditions for cemeteries. However, what remains is a successful attempt of social stratification of the inhabitants of a huge urban Roman settlement, based on the ratios of pathological diagnoses that left their destructive mark on solid soil, and the number of anthropologically examined skeletons within a known chronological span.

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REZIME

POKUŠAJ SOCIJALNE STRATIFIKACIJE JUŽNIH NEKROPOLA VIMINACIJUMA NA OSNOVU PALEOPATOLOŠKIH KATEGORIJA

KLJUČNE REČI: VIMINACIUM, SKELETI IZ RIMSKOG PERIODA, PALEOPATILOŠKE KATEGORIJE, PERCENTUAL RELATION OF DIAGNOSES, ZDRAVSTVENI PROFIL, ELEMENTI SOCIJALNE STRATIFIKACIJE.

Prilog predstavlja specifičan pokušaj da se na primeru južnih nekropola Viminacijuma, koje su tokom arheoloških iskopavanja imenovane po katastarskim kriterijumima kao «PEĆINE» i «VIŠE GROBALJA», pomoću uporedne statističke analize dijagnostifikovanih paleopatoloških kategorija sagleda socijalna stratifikacija sahranjenih pretežno u periodu od II do IV veka nove ere. Te paleopatološke kategorije su: promene na aparatu vilica i zuba, zatim traume, reumatske promene, nespecifične i specifične zarazne bolesti, metaboličke bolesti i tumori. U obzir su uzete i trepanacije lobanja, koje su svakako odraz lekarstva, konkretno iz Viminacijuma.

Iz nekropole PEĆINE antropološki je pregledano 4312 skeleta i konstatovano 149 dijagnoza (što iznosi 3,46%). Iz nekropole VIŠE GROBALJA pregledano je 1574 skeleta na kojima je uočeno 219 patoloških promena, što predstavlja 13,91% (videti tabele 1 i 2).

Upoređeni rezultati nekropole PEĆINE (4312 skeleta sa 149 dijagnoza) i nekropole VIŠE GROBALJA (1574 skeleta sa 219 dijagnoza) jasno pokazuju da je u istočnom delu jedinstvene južne nekropole Viminacijuma bilo sahranjivano stanovništvo slabijeg zdravstvenog statusa. Zapadni deo južne nekropole PEĆINE je sadržavao, prema našoj analizi, skelete žitelja ovog antičkog lokaliteta koji su imali znatno bolji zdravstveni profil. Dobijen je egzaktan pokazatelj o postojanju socijalne stratigrafije stanovništva Viminacijuma, a koji se manifestuje i u određenim lokacijama unutar velike i jedinstvene južne nekropole.

ADDENDUM I

Pećine necropolis (M - male, F - female, N - infant, n - unidentified gender)

Caries and intra vitam tooth loss: number and skeleton gender:
385(F), 445(M), 455(F), 457(F), 459(F), 473(M), 479(M), 1002(F), 1048(M), 1055(N), 1068(M), 1106(M), 1123(M), 1305(M), 1352(M), 1359(M), 1566(M), 1570(M), 1584(M), 1603(M), 1677(M), 1684(M), 1688(M), 1690(M), 1691(M), 1876(F), 1986(M), 2004(M), 2050(M), 2113(M), 2201(F), 2317(F), 2372(M), 2428(M), 2432(M), 2503(M), 2507(M), 2568(M), 2569(F) and 2625(M).

Dental cysts:
445(M), 1068(M), 1110(M), 1352(M), 1359(M), 1566(M), 1677(M), 1684(M), 1688(M), 1876(F), 1986(M), 2113(M), 2317(F), 2372(M), 2428(M), 2503(M) and 2625(M).

Parodontitis (of a developed degree):
455(F), 1305(M), 2050(M), 2317(F), 2428(M) and 2432(M).

Accidental traumas:
297(M), 405(F), 458(F), 474(N), 476(M), 486(F), 1399(F), 1471(M), 1524(M), 1560(F), 1562(M), 1584(M), 1590(M), 1710(M), 1869(M), 1957(M), 2056(M), 2079(M), 2096(M), 2357(M), 2412(N), 2697(M), 2759(M), 2764(M), 2786(M), 2980(M), 3010(M), 3251(M), 3304(M), 3328(M), 3428(M) and 3518(M).

Deliberate traumas:
1587(M), 2158/B(M), 3155(M), 3260/A(M) and 3260/B(M).

Rheumatic changes:
432(M), 1071(M), 1380(M), 1381(F), 1569(M), 1471(M), 1723(N), 1994(M), 2286(F), 2295(F), 2361(F), 2373(M), 2467(M), 2666(M), 2716(F), 2786(M), 3052(M), 3183(M), 3347(F) and 3524(M).

Unspecific contagious diseases:
357(M), 386(F), 410(M), 426(N), 1071(M), 1431(F), 1444(M), 1687(M), 3368(F) and 3430(M).

Specific contagious diseases:
1624(M) and 1699(F).

Cribra orbitalia:
1003(N), 1347(N), 1536(N), 1784(N), 1976(N), 2191(N), 2279(N) and 3396(N).

Bone tumours:
2164(M), 2509(M) and 2882(M).

Trepanning:
2570(M).

ADDENDUM II

Više Grobalja necropolis (M - male, F - female, N - infant, n - unidentified gender)

Caries and intra vitam tooth loss: number and skeleton gender:
166(M), 172(M), 187(M), 208(F), 246(M), 301(M), 327(F), 343(M), 347(F), 359(M), 367(F), 367/A(F), 369(M), 369/A(M), 385(M), 455(M), 457(M), 468(M), 477(F), 489(F), 493(M), 527(M), 527/A(M), 543(M), 543/A(M), 575(F), 579(M), 589(M), 594(F), 595(M), 596(F), 617(M), 637(M), 655(M), 683(F), 688(F), 694(M), 698(M), 698/A(M), 707(F), 710(M), 718(F), 736(F), 745(M), 756(M),772(M),773(M), 774(M), 780 (F), 782 (M), 788 (F), 827 (M), 850 (M), 851 (F), 860 (M), 861 (F), 872 (M), 876 (M), 892 (M), 908/A(M), 908/B(F), 915(F), 916(M), 933M), 934(F), 942(M), 948(M), 959(F), 962(M), 981(M), 987(M), 998/A(M), 1006(M), 1007(F), 1009(M), 1017(M), 1026(M), 1035(M), 1039(F), 1048(F), 1050(F), 1052(M), 1053(M),

1057/A(M), 1058(M), 1074(F), 1086(M), 1094(M), 1099(M), 1110(M), 1114(M), 1115(M), 1118(M), 1120(F), 1128(M), 1132(F), 1133(M), 1136(F), 1137(F), 1138(M), 1145(F), 1146(M), 1247(M), 1340(F) and 1442(F).

Dental cysts:
209(F), 343(M), 367(F), 369(M), 493(M), 543(M), 579(M), 594(F), 595(M), 617(M), 694(M), 717(F), 736(F), 745(M), 756(M), 774(M), 851(F), 872(M), 876(M), 892(M), 908/B(F), 915(F), 916(M), 942(M), 987(M), 998/A(M), 1026(M), 1039(F), 1053(M), 1114(M), 1132(F) and 1136(F).

Parodontitis (of a developed degree):
213(M), 655(M), 713(M), 718(F), 771(M), 774(M) and 1098(F).

Accidental traumas:
197(M), 301(M), 325(M), 593(M), 651(M), 690(M), 756(M), 916(M), 1031(M), 1184(M), 1213(M), 1479(M), 1783(M) and 1843(M).

Deliberate traumas:
186(F), 257(M), 469(M), 527(M), 565(M), 594(F), 742(M), 1163(M) and 1510/B(M).

Rheumatic changes:
246(M), 266(M), 319(M), 527(M), 588(F), 600(M), 668(M), 707(F), 713(M), 743(M), 746(M), 746/D(M), 780(F), 794(F), 826(M), 935(F), 969(M), 990(M), 996(M), 1052(M), 1134(M), 1136(F), 1156(M) and 1168(F).

Unspecific contagious diseases:
162(N), 190(M), 205(F), 213(M), 319(M), 390(M), 593(M), 1226(M), 2112/B(M) and 2112/C(M).

Specific contagious diseases:
1651/B(M) and 1651/E(M).

Cibra orbitalia:
166/A(N), 199(N), 228(F), 262(N), 264(F), 418(N), 588(F), 669(N), 683(F), 983(N), 1131(N), 1156(N) and 1191(N).

Osteoporosis senilis:
228(F).

Bone tumours:
359(M).

Trepanning:
1033(M) and 1161/B(M), first it was published as a syphilitic changes, and then found that it was initiated and discontinued trepanation (which was not the immediate cause of death of the skeletal individual).

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902.2:572.73(497-15)
904:726.8”653”(497-15)
COBISS.SR-ID 219297292

Original research article
Received: July 10th 2015
Accepted: November 15th 2015

OSSA VORAMINA IN REGIONE BREGMAE PARS SECUNDA-MEDIUM AEVUM

ABSTRACT

As an extension to the Pars Prima-Viminacium, this paper includes another four examples of bones inserted in skull sutures, originating from different sites, just a single example from Serbia and from, what are today, neighbouring states. These include Bisko/Poljanice near Sinj, Arnautovići near Visoko and from the monastery necropolis of Tvrdoš near Trebinje. One of the two medieval skulls from Lepenski Vir is also included. There are no other medieval inserted skull bone finds in Serbia.

With two cases – Bisko/Poljanice and Arnautovići near Visoko, there were no problems in positioning the bregma measuring point (B). According to the methodological rules of biophysical anthropology, on the remaining two skulls - from the Tvrdoš monastery and on one skull from Lepenski Vir, the B point was gained only after using the graphical drawing method.

KEYWORDS: THE GREAT MIGRATION, THE MIDDLE AGES, VIMINACIUM, BISKO/POLJANICE, ARNAUTOVIĆI/VISOKO, LEPENSKI VIR (MEDIEVAL SKULLS), TVRDOŠ/TREBINJE, OS SUTTURAE SAGITALIS, OS SUTTURAE CORONALIS, OS BREGMATICUM.

INTRODUCTION[1]

In the previous paper of the same title, but with the subtitle – *Pars Prima – Viminacium*, typical cases from this site were presented, and this is now in the final stage before publishing. It was established that the typical *Os bregmaticum* was discovered only on one female skull (G2-97), dating from the Great Migration. According to the anthropological finds from *Viminacium*, eight further skulls were presented in the same paper. They possessed inserted bones in the bregma region (B - the meeting point of the coronal suture and the sagital suture). All of them originate from the archaeologically excavated cemeteries at ‘’Pećine’’ and ‘’Više Grobalja’’, both of which form parts of one large southern *Viminacium* cemetery (Korać and Golubović 2009; Mikić I. 2013).

Pars Secunda-Medium Aevum is partially based on the anthropological documentation of Ž. Mikić (retired professor from the Philosophical faculty in Belgrade), who did not manage to fully examine and publish them since they originate

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

from, what are today, independent states.

According to the aforementioned bequested documentation, these are the finds of typical skulls from the sites of Bisko/Poljanice near Sinj and from the monastery necropolis of Tvrdoš near Trebinje. The third find of an inserted skull bone originates from Lepenski Vir (one out of two finds), previously unpublished. The find from Arnautovići near Visoko was published in 1995 (Hošovski 1995).

MATERIAL AND METHOD

In the publication of 1995 (Hošovski 1995) regarding the anthropological finds from the medieval necropolis of Arnautovići/Zidine near Visoko, among the epigenetic elements on skulls, there is only a single find of *sutura metopica* on female skull number 53 (pp. 14). It is remarked that, due to the poor and incomplete skeletal preservation, the author was not able to perform an analysis of epigenetic elements and use the possible results as markers for the examined population group. In accordance with the content paper, skull number 22 is of interest. It should be added that it comes from a necropolis which lay partially under monumental grave-stones, so-called stećci (pp. 11) and that it had a brachicranial medieval population (pp.13). Skull number 22 belongs to a male at the age of *senilis* (see Table II).

Next in order is the late medieval necropolis of Bisko/Poljanice, actually Poljanice near the village of Biska in Cetinska Krajina, in the Dinaride mountains (Milošević 1991). In this paper, only skull number 5/2 will be presented. It belongs to a male at the age of *maturus/senilis* (Table II).

The third skull in our analysis comes from Lepenski Vir, although from the Middle Ages (Nemeskeri 1972). Only two skulls of this kind have been discovered, but only one here is of interest to us. This is skull number 30. It belongs to a male at the age of *maturus* (Table II).

Among the anthropological context of the Tvrdoš monastery near Trebinje, there is skull number 65. It was separated from the osteological material, which has been partially published (Mikić Ž., 2001). It comes from a mass burial with at least seven skeletons. It belongs to a male at the age of *adultus/maturus* (Table II).

The methodology applied to the four medieval skulls from the sites of Arnautovići/Visoko, Bisko/Poljanice, Lepenski Vir and the Tvrdoš monastery near Trebinja, is within the standardised criteria of modern biophysical anthropology. Therefore, gender and individual biological age were determined according to the methodological rules determined by V. Bass (Bass 1971), but also according to the handbook of European anthropologists (Ferembach, Schwidetzky and Stloukal 1980). Osteometric parameters were taken according to the standardised definitions of R. Martin (Martin and Saller 1957) and V. Bass (Bass 1971).

Finally, epigenetic analysis was performed according to the method defined in 1967 by A. C. Berry and R. J. Berry (Berry and Berry 1967), initiated as non-metric elements on skulls in 1959 by D. Brothwell (Brothwell 1959). Certainly, more recent publications were also included, such as that of G. Hauser and G. F. De Stefano (1989).

RESULTS

The goal of our paper was not to report on common *os suturae coronalis* (see Table I), nor on the typical *os bregmaticum*. As far as we know, the deltoid os *bregmaticum* was discovered only among the *Gepidae* population (Kazanski, Ivanišević and Mastikova 2006) in *Viminacium* (see Table I). Our attention was focused on specific joint bones located in the region of the coronal joint, regardless of size.

Among the four cases (illustrated in Table II), due to the very difficult identification caused by concrescence (obliteration) of the *suturae*, we abandoned the alphabetical order used when introducing the material. As a result, the starting

point was skull number 5/2 from the site of Bisko/Poljanice.

The inserted bone in the meeting point of the two large joints on the skull from the medieval necropolis of Poljanice near Bisko, close to Sinj, is 1 x 2 cm in size (see Table II). Due to its irregular shape, it is very difficult to tell whether it moved the sagital joint into the zone of the frontal bone. The same is true of the skull from Arnautovići near Visoko. On skull number 22, the position, shape and size of the inserted bone are very similar to the Bisko/Poljanice case. The old age (*senilis*) of this skeleton, together with the obliteration and poor state of preservation, meant that its inserted bone was somewhat difficult to notice. It should be mentioned that there is a big difference between anatomic samples and human osteological material from archaeological sites. Nevertheless, our comment holds true for the previous case: it is very difficult to say whether any movement of the sagital joint in the *os frontale* region occurred (Table II).

One of the two medieval skulls from Lepenski Vir possesses an inserted bone in the *bregma* region, with a size of 2x4 cm. It is of a square shape and moved the sagital joint about 1 cm into the region of the frontal bone (see Table III). However, we should mention that from Lepenski Vir, there are about one hundred skeletons from the Mesolithic and Proto-Neolithic period, as well as that Lepenski Vir is an eponym for a prehistoric culture, so no literature will be listed here.

Skull number 65 from the necropolis of the Tvrdoš monastery near Trebinje was not previously published. By 2001, the material from 21 graves had been published, as well as from four tombs (Mikić Ž. 2001). Grave number 65 consisted of two graves: 65 and 65A. As can be seen from the preserved anthropological documentation, grave number 65 contained only a single robust male skeleton with no pathological changes. It was noted that on the skull, there was an inserted bone (a bone between two joints).

Grave number 65A belongs to a mass burial in Tvrdoš which contained at least six incompletely preserved skeletons, one of which was an infant. The age of the other skeletons was between 30 and 60 years. In Tvrdoš, a total of 74 graves were examined, containing 103 skeletons: 92 adults and 11 infants. This information is not surprising, since in monasteries, only the "chosen ones" were buried. However, in this entire medieval series, only skull number 65 possessed an inserted bone in the *bregma* region.

As the illustration in Table II shows (bottom right), this inserted bone is of an approximate size of 2.5 x 2.5 cm, shaped more like the posterior *fontanelle* bone (*fontanelle posterior*). It is obvious that this bone penetrated the *os frontale* with its frontal third.

DISCUSSION AND CONCLUSION

As mentioned before, the *os suturae sagitalis* and *os suturae coronalis* were not presented in this paper, with the remark that a large and typical deltoid *os bregmaticum* was discovered only in the *Gepidae* population from *Viminacium* (see Table I). Four skulls were illustrated in Table II, with some doubts regarding the positioning of the inserted bone. They can more easily and precisely be positioned on the skull during anthropological measuring than on the two remaining skulls (the medieval one from Lepenski Vir and from the Tvrdoš monastery near Trebinje).

There is no need to speak about the frontal and the rear *fontanelle* (*fontanelle anterior* and *fontanelle posterior*) during embryonic or later development, since this has been discussed in detail in different medical text-books and in many different languages. We want to avoid repetition and need to directly present our results.

Page 444 of the anthropological hand-book by R. Martin (Martin and Saller 1957), which is not the only one of its kind, clearly states that when there is an *os bregmaticum*, there is also a linear extension of the *suturae sagitalis* and *suturae*

coronalis. This is how, graphically, the *bregma* point (B) is obtained, which is needed in order to determine the height of each skull. In our cases, this represents the skulls from Lepenski Vir and Tvrdoš.

These skulls do not possess a typical deltoid bone on the *bregma*, especially the two aforementioned skulls. With the other two skulls, the *bregma* point was found in the described way. This is why it is necessary to graphically mark the tops of both the skull from Lepenski Vir and from Arnautovići and the direction of both the coronal and the sagital *sutura*. The inserted bones would then show a marker representing the *bregma* point. We will not be doing this graphical reconstruction on the original finds, in order to preserve their authenticity. One reason for this is the lack of their osteometry.

Finally, it should be added that we also decided to include finds that originated outside Serbia, since, as is stated by Hauser and De Stefano (1989: 96), with medieval Serbs, S. Živanović also did not encounter additional bones in the *bregma* region. The goal was to collect all of the samples with this kind of anatomic variation from the Balkan area and to present it together.

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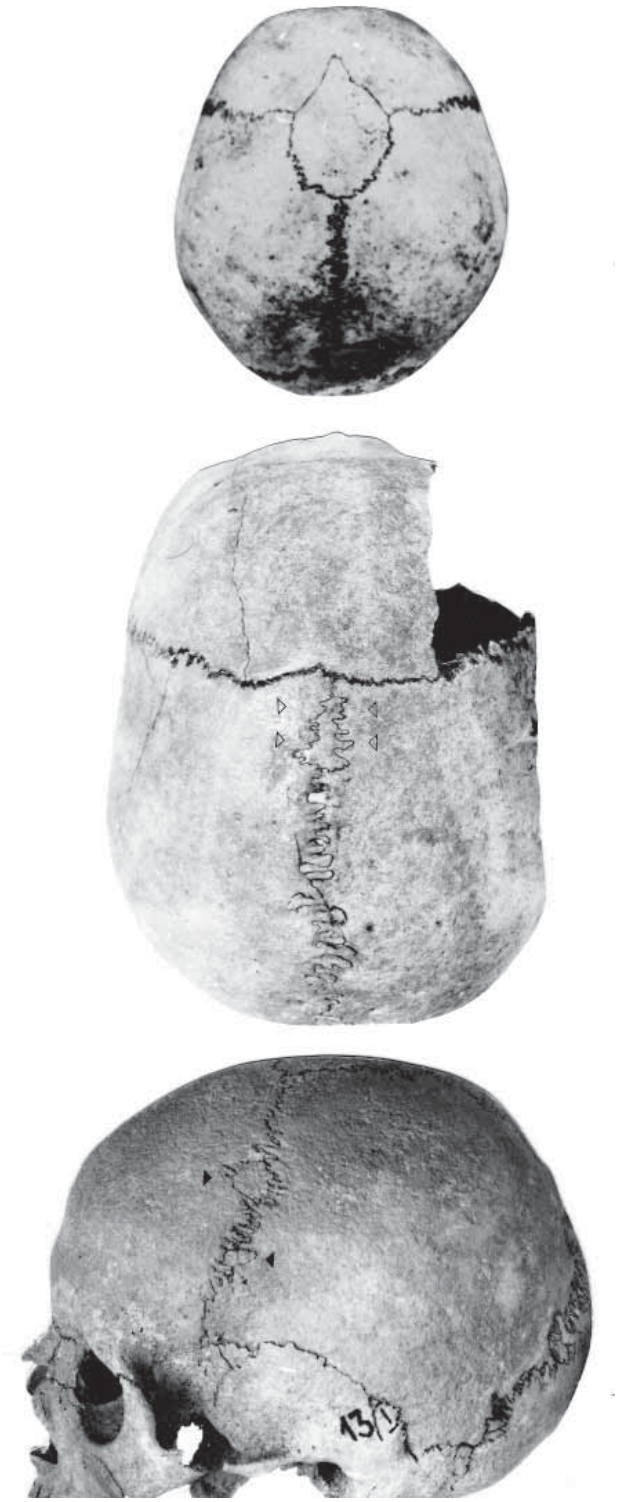
REZIME
OSSA WORMIANA IN REGIONE BREGMAE PARS-SECUNDA-MEDIUM AEVUM

KLJUČNE REČI: SREDNJI VEK, BIOFIZIČKA ANTROPOLOGIJA, BISKO / POLJANICE, ARNAUTOVIĆI / VISOKO, LEPENSKI VIR (SREDNJOVEKOVNE LOBANJE), TVRDOŠ / TREBINJE, OSSA WORMIANA, UMETNUTE ILI PREKOBROJNE KOSTI LOBANJSKIH ŠAVOVA.

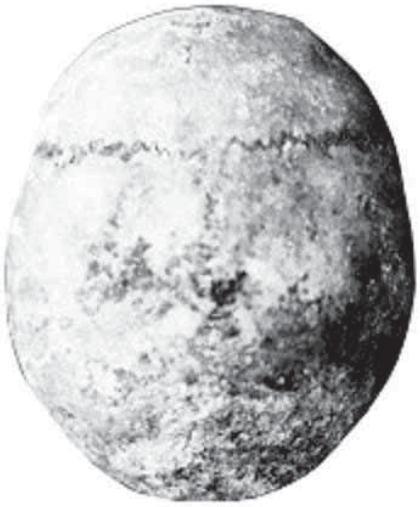
Umetnute kosti ili prekobrojne kosti lobanjskih šavova (*Ossa Wormiana*) od svih epigenetskih elemenata najređe se pojavljuju. Prema raspoloživoj literaturi, u regiji merne tačke *Bregma* (B), kod srednjovekovnih Srba nisu konstatovane. Kada se radi o srednjem veku i širem području Zapadnog Balkana, osim jedne slovenske lobanje sa Lepenskog Vira, tzv. umetnute kosti su uočene na još dve lobanje u Bosni i Hercegovini i na jednoj u Hrvatskoj. To su: manastir Tvrdoš kod Trebinja, Arnautovići kod Visokog i Bisko, odnosno Poljanice u Cetinskoj Krajini. Svi pobrojani nalazi su prikazani na odgovarajućim fotografijama, pošto predstavljaju specifične nalaze u oblasti biofizičke antropologije, a inače se vrlo retko nalaze na lobanjama iz različitih perioda.



Os Bregmaticum Viminacium/necropolis Više Grobalja G2-97
Os suturae sagitalis/Vinča-Beli Breg/br 90
Os suturae coronalis/Viminacium/necropolis Nad Lugom br. 13/1

Table I

Bisko Poljanice br. 5/2



Arnautovići-Visoko br. 22

Lepenski Vir br. 30

Tvrdoš-Trebinje br 65

Table II

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001.92:902(497.11)"2014"
904"652"(497.11)
COBISS.SR-ID 219299596

Original research article
Received: July 27th 2015
Accepted: November 15th 2015

VIMINACIUM AND THE OPENARCH PROJECT

ABSTRACT

With the idea of popularising Archaeological Open-Air Museums, archaeology as well as science, the OpenArch project was created within the EU Culture Programme. This five year project connects Archaeological Open-Air Museums from eight European countries, among which Viminacium is the only Archaeological Park. Many activities have been held in Viminacium since the beginning of the project, including two international symposia, experiments and staff exchanges. All these have brought great benefits to the experience of the management of the Viminacium Archaeological Park and to its promotion among national and international audiences, as well as to the OpenArch partners, better informing them about the challenges of popularising archaeology in the Balkans.

KEYWORDS: OPENARCH, VIMINACIUM, ARCHAEOLOGICAL OPEN-AIR MUSEUM, ARCHAEOLOGICAL PARK, EXPERIMENTAL ARCHAEOLOGY, POPULARISATION.

OPENARCH PROJECT

OpenArch is a project funded by the EU as part of its Culture Programme and is based on the EXARC experience of international cooperation. EXARC is the international ICOM Affiliated Organisation for archaeological open-air museums, experimental archaeology, interpretation of scientific methodology and ancient technology, and has 250 members in 30 countries. The main idea of the project is to present both the tangible and intangible past to the public, through archaeological remains or reconstructions or the story of the people that lived in the past. The work of OpenArch is divided into Work Packages and one or two partners coordinate them. The leading partner on the project is Calafell (CAT),[1] while the other partners are Foteviken (SE),[2] Kierikki (FI),[3] Archeon (NL),[4] Hunebedcentrum (NL),[5] AÖZA (DE),[6] Terramara di Montale (IT),[7] The Nation-

1*The article results from the project: IRS-*Viminacium, Roman city and military camp – research of material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation (no 47018)*, funded by The Ministry of Education, Science and Technological Development of the Republic of Serbia, and the OpenArch project.

Read more at www.ciutadellaiberica.com.

2 Read more at www.foteviken.se.

3 Read more at www.kierikki.fi.

4 Read more at www.archeon.nl.

5 Read more at www.hunebedcentrum.nl.

6 Read more at www.steinzeitpark-dithmarschen.de.

7 Read more at www.parcomontale.it.

al Museum of Wales (WLS),[8] The University of Exeter (EN),[9] The Institute of Archaeology, Project Viminacium (RS)[10] and EXARC (NL).[11] The Work Packages are Project Management, Improvement of Museum Management, Dialogue with Visitors, Dialogue with Skills, Dialogue with Science, Dialogue with Museum Organisations and, finally, Communication & Dissemination. The coordinators of the Work Package - Dialogue with Visitors - are Archeon (NL) and The Institute of Archaeology-Viminacium (RS). This Work Package focuses on the presentation of archaeology to the public. The partners have great expertise in presenting and working with the living history of sites and their history. The aim of this Work Package is to help children, young people and adults of all ages to discover their own local history, using the OpenArch method. A significant asset of archaeological open-air museums is that they do not attract a limited target group like more traditional museums do.[12]

VIMINACIUM

Viminacium is an ancient Roman site on the right bank of The Danube, in eastern Serbia. With the remains of a military camp, a city and a necropolis, in 2006 Viminacium became the first Archaeological Park in Serbia to open for visitors the whole year round. The history of the site dates back to the 1st century AD, when two Roman legions, IV Flavia and VII Claudia, founded the military camp. Later, the civilian settlement was founded and it grew into a city which became the capital of the Roman province *Moesia Superior*, or Upper Moesia (*Moesia Prima*) in Late Antiquity.[13] Viminacium was destroyed by Hunnic attacks in 441/443. Today, remains of the city and the military camp lay beneath fertile grain and corn fields in an area larger than 450 hectares. The first excavation at Viminacium started at the end of the 19th century[14] and, after a long pause, resumed in the 1970's.[15] Today, protective field excavations of the city, the military camp and the cemeteries are carried out by a multidisciplinary team of The Institute of Archaeology. Objects discovered during these excavations are presented to the public in the Viminacium Archaeological Park. It is of great importance that, besides the protective construction which is made of laminated wood and a so called French tent, the permanent visits prevent the site from being robbed, as had happened in the past.[16] The opening of the archaeological park took place in 2006, when all the necessary facilities were established, such as infrastructure, staff, security, etc.[17] The initial tourist itinerary was defined as *Porta praetoria*,[18] *Thermae*[19] and

8 Read more at www.museumwales. ac.uk/en/stfagans.

9 Read more at www.exeter.ac.uk/archaeology.

10 Read more at www.viminacium.org.rs.

11 Read more at www.exarc.net.

12 Read more in: Paardekooper 2012; More about this Work Package at http://openarch.eu/work-packages/dialogue-visitors

13 More about Viminacium in: Спасић-Ђурић 2002; www.viminacium.org.rs

14 These excavations were conducted by Mihailo Valtrović, Serbian architect and art historian and Miloje Vasić, the founder of Serbian archaeology. *Cf.* Валтровић 1884a: 3-14; Валтровић 1884b: 121-142; Васић 1907: 67-98; Васић 1895: 1-61.

15 Excavation works were conducted by the Institue of Archaeology and the State Institute for the Protection of Cultural Monuments, mostly focused on Viminacium cemeteries. *Cf.* Зотовић 1986: 41-60; Зотовић 2000: 7-17; Зотовић and Јордовић 1990.

16 More about various threats and methods of protection in: Nikolić et al. 2013: 205-214.

17 More about the Viminacium Archaeological Park in: Maksin et al. 2011: 331-339; Anđelković Grašar et al. 2013: 9-14; Golubović and Korać 2013: 65-74; Golubović and Tapavički-Ilić 2012: 67-73; Tapavički-Ilić 2013: 315-326.

18 *Porta Praetoria*, the northern gate of the Viminacium castrum and the remains of its two entrances with stone pavements, the basements of two towers and the sewage system, were shown at the beginning of the Viminacium tour. *Cf.* Golubović and Korać 2013: 68-69.

19 *Termae* – Roman baths are preserved in several levels from different periods between the 1st and the 4th century. There are visible remains of the hypocaust, floor heating, together with four pools for warm or hot water, and a fifth pool for cold water. Baths were luxuriously furnished with

Fig. 1 Domus Scientiarium Viminacium, Scientific, Research and Visitors Center

Mausoleum[20] with underground structures[21] Since the beginning of the building project in 2008, the Domus Scientiarium has also become an important part of visits and events at Viminacium (Fig. 1).[22] Today, the Viminacium Archaeological Park has been enlarged to include the site of the amphitheatre, which has been excavated since 2008, (Nikolić et al. 2014: 58-62; Nikolić and Bogdanović 2012: 42-45; Rogić and Bogdanović 2012, 46-49; Nikolić and Bogdanović 2012: 58-61) while in June 2014, the Mammoth Park was opened, along with a playground for the younger visitors (Mrđić and Jovičić 2014: 54-57).

The Viminacium Archaeological Park is visited by between 50.000 and 75.000 visitors each year, with numerous children's excursions, senior groups and individual visitors, who are the most common visitors at weekends, as well as tourists from cruises (Anđelković Grašar and Tapavički-Ilić 2014: 191-204). Besides the importance of the archaeological remains, at the Viminacium Archaeological Park, special attention is dedicated to additional activities which are of great importance to the experience and emotions of its visitors.[23] Among other things, Viminacium visitors noted that the most important part of the Viminacium tour were the interesting and informative explanations offered by the expert guides, which serve to improve and reinforce the impressions of the ancient ruins and archaeological remains (Anđelković Grašar and Tapavički-Ilić 2014: 191-204). Owing to its extensive of experience man-

mosaics and fresco decoration. *Cf*. Миловановић 2004/5: 51-54; Rogić et al. 2007: 75-82.

20 The mausoleum is located at the Pirivoj necropolis and it is believed that this is the so-called tomb of the Roman emperor Hostilian, who is thought to have died at Viminacium. *Cf*. Рецић 2008: 59-61; Jovanović 2006: 39; Korać et al. 2009: 98-99.

21 Within the Viminacium basement, "Tomb with Cupids" (G-160) is presented with its original frescoes *in situ*, while the frescoes of two other tombs – "Pagan tomb" (G-2624) and "Christian tomb" (G-5517) are now kept at the National Museum in Požarevac and copies are have been installed in the tomb to resemble the original context. *Cf*. Anđelković Grašar et al. 2013: 73-100; Korać 2007: 157-168, 168-185, 186-188; Anđelković 2012: 1-6.

22 The Scientific, Research and Visitors Centre, called the *Domus Scientiarium* is today a completed complex in the design of a Roman villa. *Cf*. Nikolić 2012: 66-68.

23 More about Archaeological park in theory and practice in: Nikolić et al. 2011: 259-268.

Fig. 2 Experimental Archaeology, Experiment of Roman cremation of the Mala Kopašnica – Sase type

aging the archaeological park, Viminacium has become one of the coordinators of the Dialogue with Visitors Work Package.

PROJECT'S ACTIVITIES

Among other activities within the OpenArch project there are meetings and workshops, focused on presentations, lectures and discussion groups regarding 'working together' and staff sessions of the archaeological open-air museums with the aim of exchanging insight into specific methods and of improving each other's skills and abilities. Staff exchanges are considered to be a tool for the exchange of best practices between staff of different museums, targeting of those day to day workers of the museum who are closest to the general public and schools. Experiments and experimental actions are required in order to understand how objects were made, how constructions might have appeared and, not the least, how people in the past behaved.[24] Within the OpenArch project, two experiments were conducted at Viminacium on 19th March, 2013. The first included a Roman cremation of the Mala Kopašnica – Sase type, typical for the area of the Middle Balkans from the 1st to the 3rd century AD (Fig. 2). The cremated remains (of a pig, for the purpose of this experiment) were later transferred to a grave pit. The results gained from this experiment, which was carried out under various conditions, formed the basis for further discussion on the differences between funerary rites. Some of the conclusions obtained from the experiment show that the remains of the deceased were not cremated within the burial pit, and that the amount of ash which was discovered during excavations does not match the amount that remains after a cremation *in situ*. The burial pit was most likely prepared in a separate ritual and after baking its walls, when everything was clear, the remains of the already cremated deceased were deposited

24 More about the project's activities in: Tapavički-Ilić and Anđelković Grašar 2013: 97-100.

Fig. 3 Experimental Archaeology, Experiment of planting grapevine according to Roman customs and practices taken from ancient Roman authors

into it. Thus the funeral of the deceased was carried out in three phases, i.e. three separate rituals.[25]

The second experiment included planting ungrafted (not cross-bred) grapevines according to Roman customs and practices taken from ancient Roman authors (Fig. 3). The planting was made next to elm trees along the parking lot next to the building of the *Domus Scientiarium*, during the week of the waning moon and included some twenty young grapevines. For the purpose of the experimental planting, replicas of agricultural tools were made (Ilić et al. in print).

It is of great importance that two international symposia were held at Viminacium, both for the OpenArch partners and for the employees of museums and scientific institutions from the Balkans. The first international symposium, "Archaeological Heritage – its Role in Education, Presentation and the Popularisation of Science", took place at Viminacium between 5th and 8th October 2012 and hosted researchers from the EU, the Balkans, as well as from, amongst others, Russia, Japan and Africa. The second international symposium "The Impact of the Dialogue with Visitors on the Management of Archaeological Open-Air Museums" also took place at Viminacium, between 29th September and 3rd October 2014. On both occasions, books of abstracts and the conference proceedings were published by the Institute of Archaeology, Belgrade and the Centre for New Technologies, Viminacium.

On 5th July 2014, the Danube Limes Day was organised at the Viminacium Archaeological Park, basically dedicated to children (Fig. 4). Reconstructions of ancient fighting techniques and Roman games were conducted by colleagues in the OpenArch project from Archeon (the Netherlands) and the Institute of Archaeology, Belgrade. At the end of the day, children and their parents, along with other audience members, enjoyed tasting food prepared according to Roman recipes and listened to a concert in the main atrium of the Domus Scientiarium.

25 More about this experiment in: Tapavički-Ilić and Mrđić, in print.

Fig. 4 Roman day at Viminacium, Danube Limes Day

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REZIME

VIMINACIJUM I OPENARCH PROJEKAT

KLJUČNE REČI: OPENARCH, VIMINACIJUM, ARHEOLOŠKI MUZEJI NA OTVORENOM, ARHEOLOŠKI PARK, EKSPERIMENTALNA ARHEOLOGIJA, POPULARIZACIJA.

OpenArch je projekat Evropske Unije iz programa "Kultura", koji okuplja jedanaest partnera, među kojima je projekat Viminacijum Arheološkog instituta u Beogradu, jedini partner iz regiona jugo-istočne Evrope, tj. Balkana. Viminaciujum učestvuje na random paketu "Dijalog sa posetiocima". Osnovni cilj ovog paketa je da se arheologija kao nauka približi posetiocima muzeja na otvorenom, kroz metode projekta *OpenArch*. Kroz učešće u različitim radionicama, sastancima i razmeni zaposlenih u okviru projekta *OpenArch,* Arheološki park Viminacijum dobija značajnu ulogu u širenju informacija i razmeni iskustava u naučnoj i stručnoj javnosti u Srbiji. U okviru radnog paketa posvećenog eksperimentalnoj arheologiji, dva eksperimenta su sprovedena na Viminacijumu, tako otvarajući novo polje istraživanja u viminacijumskom interdisciplinarnom timu.

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902:821.14'02.09 Хомер
COBISS.SR-ID 219300620

Original research article
Received: September 21th 2015
Accepted: November 15th 2015

WARFARE IN MYCENAEAN TIMES: THE ILIAD AS A PARADIGM AND THE APPLICATIONS EMERGING FOR EXPERIMENTAL ARCHEOLOGY

ABSTRACT

If read without prejudice, the Homeric poems present an unequalled wealth of information on the Bronze Age, especially regarding warfare. Much more vivid and elaborate than Egyptian and Hatti bureaucratic or commemorative/propaganda records (and the respective Mycenean/Pylean/Theban tablets) they produce information on geopolitical situation and alliances, armies size, organization and deployment, troop types, tactics, chain of command and weaponeering, meaning weapons proper, intended and possible uses, combinations, manufacture and techniques of use. Such references must be cross-examined with other literary and material evidence and representative arts and skills. But some intrinsic issues, as are the dressing of battle lines, the proper use of weapons, the fabrication of weaponry and support equipment and the implicated metallurgy, an art of the gods, need the assistance of reenactment and experimental archaeology/experimental history to be elucidated in order to obtain a more cohesive and nearer to the truth perspective.

KEYWORDS: MYCENAEAN TIMES, THE ILIAD, EXPERIMENTAL ARCHEOLOGY.

INTRODUCTION

Although the Homeric issue rages, in the Iliad the cohesion of military information makes certain that the author was contemporary, had top-quality information as tactics and injuries cannot be imagined if not experienced/witnessed and was very well acquainted with combat particulars. Although some shadows do loom in some excerpts (i.e. XIII-685);[1] such inconsistencies may be due to the ages-long oral transmission, as, before Peisistratic recording, the epic cycle was transmitted orally. This by no means implies it was compiled in oral form: it was compiled, however, to be orally transmitted in a world of myth, lore and legend. Conventional Archaeology provides material evidence for verification of the claim; to the same end, Experimental Archaeology offers procedures.

1 XIII-685. possible Athenian corruption/forgery, as Iones are mentioned fighting in proximity with the Athenian contingent; Herodotus explains how politically sensitive this issue has been from 510 to 478 BC for the Athenians, and it might have been previously and afterwards as well. There is no mention of their leaders, kings, weapons, warriors at this extract, while there are analytical ones for all others (but the Boetians, who are mentioned elsewhere and in detail) nor any mention in the Catalogue, nor anywhere else.

Fig. 1 Both Trojans and Greeks use from their chariots extremely long and heavy lances, perhaps the "egxeiai" of the tablets, with massive warheads reminding Japanese naginatas of the 16-17th centuries; that is for both thrusting and cutting.

GEOPOLITICS

The Homeric world is focused on two competing powers: the Mycenaean or Achaeans and the Trojans and their allies. The former were set very much from Axios river, in Macedonia, all the way to Cyprus (XI-21), with some exceptions: a part of western Greece (Acarnania-Ampilochia) did not participate due to enmity towards the high king Agamemnon, a part in NW Peloponnese, possibly the homeland of Ionians as betrayed by the name of the adjacent sea (Ionian Sea) is also vividly absent despite its wealth of archeological findings of the era (Museum of Patras), and the Cyclades Isles are not mentioned. To the contrary, the SE Aegean was securely under Mycenaean control and formed part of the campaigning force.

The Trojan confederacy was securely from the Axios River in Macedonia (II-848, XVI-287) to Lycia in SW Asia Minor (II-876), whereas its alliances were extending deep into Asia Minor, at least to the river Sagarius (III-185), from where a relative of the Trojan royal family, Assios,[2] has come for assistance (XV-716). Thrace and almost

2 The name stems from Asia which today is a continent, but at the time it must have been NW Asia Minor, known as Assuwa in the tablets.

half of Macedonia are with the Trojans, and so is the NE Aegean, with the prominent exception of Lemnos, which was turned to the Mycenaean side a generation previously and is governed by the son of Jason the Argonaut (VIII-468/70). For the big island of Chios there is no mention, nor is any for Samos and Ikaria. Contrarily, Lesbos and Tenedos were Trojan allies and stormed by Achilles at the first phases of the war (IX-129/30). Imbros and Samothrace are mentioned as islands but not as theaters of action, and their allegiance is not declared. The relations with the Levant proper are uncertain: a contingent came to help under Memnon, the king of Ethiopians and Priam's nephew, but this ethnic name even in Herodotus is used for the black population south of Egypt (VII, 69), for a similar population in India (VII, 70) and for a fragment of the cypriot contingent pointing to immigrants from the Assyrian coast just opposite of Cyprus (VII,90)- which is the best bet. Homer mentions nothing on the subject, but he does mention that Paris has sacked Sidon, the greatest Phoenician city (VII-290).

ARMIES' ORGANIZATION

There is no question that the Trojan and allied army is a feudal conglomerate under the high command of the Lord of the Hosts of Troy, Prince Hector (who might or might not have been crown prince). After 10 years behind his walls, allied contingents have arrived before his offering battle to the invaders (Othryoneus XIII-364, Asteropaios XXI-156), and continue to arrive by the day and are thrown piecemeal into battle, as they arrive (XXII-434). The basic unit are the 50 men and the size is approximately 50.000; 1.000 campfires, around each 50 men sleeping, sitting or eating (VIII-558/9).

The Greek army had the same unit of 50, as the main ship is the 50-oared galley (pentekonter) of unknown model (II-720, XVI-170). Nevertheless there are some very large ships carrying 120 troops of a certain contingent (II-510); whether all of them were doubling as rowers or not is not stated. There were also 20-oared galleys for other missions (I-309). But the similarities stop there.

The Greek army is NOT a feudal levy, but an integrated organization with distinct functions. There are tactical units (Lochoi, 500-strong in Achilles' own contingent XVI-168/73). The decimal system thus implied fits well with the 10-man Oka of the tablets. During the most part of the Iliad it is indeed operating-and with little success- as a feudal levy, since Achilles, the mind and soul of the army and acting Commander-in-Chief/CiC (as indicated in XXIV-651/8 and directly stated in Odyssey iii-106) is estranged. Before the new series of clashes, described in Iliad, which happen in the 10th year of the war, the elderly tactician Nestor advises the High Commander Agamemnon to deploy the army in feudal manner (II-361/8). This means that for 9 years the army was NOT deployed in such a manner, and this differentiation is due to the absence of Achilles. Once he is back, he clearly issues all the executive directions and orders (XIX-155, XXIV-670) and the army is no feudal assembly, but an efficient war machine. Many scholars detect dramatic effect and projection in this advice of Nestor, but had it been so the poet would have easily projected it into the past, as he did in other cases, as with the pursuit of Aeneas (XX-187/91).

MEDICAL CORPS

The Greeks have a well-organized medical Corps, with two asclepiad brothers (IV-193, XI-833), Machaon (surgeon) and Podaleirios (Internist). They tend both wounded and sick and are much admired and valued, but their humanity is not in question. Nothing divine or miraculous. Moreover, many a warrior, such as Achilles, Patroclus, Sthenelus and others are adequately trained in first aids and wound care, extracting arrowheads and dressing the wound (XI-830) while also

offering analgesic medication. No such thing with the Trojans. There the Gods, within their temples or *ad hoc* offer miraculous treatment (XVI-528, V-447/8), implying that the healthcare is at the hands of the priesthood, mostly of that of Apollo, the patron deity *par excellance*. The best a Trojan noble or follower can do is to bandage a wound with a woolen strip, (Agenor was well-provided with a number for such an emergency and used it on Helenos) to stop the bleeding or any major mechanical deterioration (XIII-599/610).

Both armies are based on the heavy armed and armored noble warrior, owning a chariot and fighting from it. The term is "ιπποτης"/ eqeta of the tablets. The armor of such nobles is plate bronze or copper, but the mention of "copper tunic" (XIII-439) for one -rather elder-Trojan implies also a scaled body panoply. Greeks use greaves (XI-17) and this is an item which characterizes them both in frescoes and within the Iliad. Their greaves are characterized as well-made, white and in some cases special attention is given to their attachment around the ankle, which might imply something elusive, undetected in the frescoes. On the contrary, Trojans are seldom mentioned to using greaves (i.e. Paris against Menelaus III-330/1). The warriors combine heavy armor with mobility; both Achilles and Hector are fleet of foot, excellent charioteers, big of stature and very strong, epitomizing the heroic concept of "tall, strong and brave" adding the "fast".

Other heavily armored warriors in both sides are also notoriously fast: the Greek Antilochos who is an accomplished charioteer, and the wily Odysseus, who has no chariot (not to mention the lightly armed Ajax the Lesser). From the Trojan side, Aeneas, Glaukos and Paris, all of them also possessing chariots, as Troy is known for its horses. The heavily armed and excessively trained warriors dismount from their chariots to fight on foot, and are supported by chariot runners in the Egyptian manner (they are implied twice for the Trojans, one being the prince Polydoros; the other case being better attested in XV-516) and rank and file infantry, while the chariot proper awaits nearby with the driver at the ready to extract them from the fray or to allow a hot pursuit. The Trojans have better chariotry: some of their allies use two-horse teams (V-195), but some of the Trojans have four-horse teams (Hector himself mentioned specifically and by name of the horses VIII-185); whether in two tandem pairs or four abreast it is not known. The Greeks have two horse teams (XXIII-290/305), and Achilles uses a third horse (XVI-149/53) not to drag the chariot, but to make the turns swifter.

Both Trojans and Greeks use from their chariots extremely long and heavy lances, perhaps the "egxeiai" of the tablets (Figure 1), with massive warheads reminding Japanese naginatas of the 16-17th centuries; that is for both thrusting and cutting. Hector is specifically mentioned as holding a 11-cubit such chariotry lance at VIII-494 (Ajax bears a long naval spear, 22 cubits in XV-678) while on chariot; he is also mentioned to pursuit the Greek rank and file[3] on chariot, thrashing heads (XI-309) and wielding his spear. This adds up to the aforementioned weapon. Most obviously, this is also the nature of the great spear donned to Achilles by his father, which could not be wielded by anyone else (XVI-140/3). So heavy a weapon might not be a javelin or anything light enough for casting. It is not accidental, that the Greeks considered lanced chariotry fighting in jousts (as Nestor advocates, IV-306/7) a thing of the past; Nestor, the Elder, is synchronous with the apex of such practice, as had been the father of Achilles. But, for dismounted fighting, the lance may prove impractical. For this reason the warrior is always equipped with a general purpose spear, for casting and thrusting alike, and generally carried in pairs

3 Armed either as medium infantry, with helmet, spear, shield, sword XIII-714/5 or as prescribed in the Odyssey, where "armed for war" means at the very least two items: spear(s) and body shield; helmet might be included in the basic kit, but no sword nor greaves are essentials and might be reserved for better armed troops.

(VI-104, XIII-559). This reminds us of the very later Persian "palta" of the cavalry, much praised by Xenophon. The pair of spears is mentioned many a time Hector jumps out of his chariot, and this might imply that he changes weapons, from lance to spears. It is obvious that both lance and spears are routinely secured within the chariot. An excellent example is Patroclos who sets out with two spears in XVI-139 but after casting one to Sarpedon's mate and never recovering it he is explicitly mentioned as fighting hencewith with one (XVI-733, XVI-801), which he does not cast and for missile he reverts to stones while having the spear at his left hand. In another very enlightening excerpt (XIII-559), Antilochos, son of Nestor (a master charioteer in XXIII-306/8), is mentioned as fast, agile and always eager to fight, either casting from afar, or charging at contact. In both cases the spear is the main weapon, which vividly illustrates the merit of the two-role "dory" which can be thrown or thrust and is carried in pairs. What is of importance, is the fact that Pandaros, one of the very few Trojan allies who came on foot because he doubted the adequacy of fodder for his (two-horse) teams, has taken his bow INSTEAD; his phrasing points to the bow being mutually exclusive with charging chariotry (V-192/210), much unlike the Egyptian practice-but perhaps consenting to the one of Hittites.

Moreover, the Greeks have many first-line heroes and kings who do not possess or use a chariot. Some do fight the heroic way, an agile skirmishing fight with javelin and heavy armor (Odysseus), while others (both Ajaxes) fight in a way unsuitable to and incompatible with chariotry, although from close range. Thus, the Greek army has more troop types than the Trojans, who have medium infantry, runners (XV-516), archers and heavy charioteers (knights). The Trojan archers might fire from within the ranks as did Pandaros (IV-114), covered by shields, or individually. It is a fact that they may fire en masse, volleys, especially from their walls; the latter is stated, the former not really but the conjecture is secure.

It is very strange that the Greeks, who despise the weapon, have also competent archery skills. The troops of Philoktetes are good archers and may fire individually (II-720), Teukros exemplifies the pair of heavy shield-bearer-archer (VIII-265/70) with his brother Ajax the Great although he may fight with spear and shield, as medium (armed with helmet, spear, shield, sword XIII-714/5) or heavy infantry, whereas the Locrian contingent fires en masse from a distance (XIII-716/22), shirking contact and shooting some Trojan assaults to pieces from behind the storm troops' lines. Except medium infantry, chariotry and missile troops, that is archers, the Greeks also have heavy shielded infantry for static defense, a commodity never implied for the Trojans. The personification is Ajax the Great, a very tall and strong warrior, the second in valor and merit to Achilles, but never accused as fleet of foot nor seen to mount a chariot. His resolve, steadfastness and endurance are admirable. He is supported by either his brother Teykros, the archer, or another chariotless king, the Locrian chieftain Ajax the Lesser. Although his contingent is archers only, Ajax the Lesser is storm trooper, but definitively light infantryman, as he substitutes metal armor with linen corselet (II-529). He is very fast, an excellent spearman and offers to Ajax the Great's stability a skirmishing support (XVII-719/21) and a destructive power of pursuit (XIV-520/1), more or less exposing the combined tactics of the integrated Greek army.

TACTICS

For army tactics, Achilles favors charge and clash (XX-354/5); this is not always the choice of neither commander, who may stop at a distance and exchange missile fire (XV-710), as did the European armies of the 16-18th centuries, while skirmishers, usually the well-protected nobles, may jump in between opposing armies and strike targets of opportunity as exemplified by Antilochos

(XIII-559). After a prolonged exchange which has softened up the one opponent, the other one charges (XI-85/90). The reason for avoiding the clash from the first encounter is obviously the lying of the advantage with the offensive weapons; thus rushing to contact with a large and expedient in missile warfare enemy body is ill-advised. Shields and armor are more often penetrated than not. Menelaus, an important and powerful and wealthy king is hit by an arrow and wounded after the arrowpoint (which is explicitly mentioned as "iron" IV-123) pierces three successive armor parts (IV-133/5); such a succession of armor is indicative of Dendra-type armor and would not have been found in other body parts, which would have been pierced more easily. But the same corselet staves off Helenos' arrow from point-blank (XIII-585/95). Only Achilles (with armor made by a God) suffers no penetration-his greave even staves off a direct spearcast (XXI-591/4). But he himself is not very confident on the subject (XX-261/5). Despite this fact, he chooses to strike Hector in a spot not covered by his own, captured armor: as the latter charges leaning forward, Achilles thrusts at the joint of neck and shoulder (XXII-322/6). Although panoplies are routinely penetrated, the thing is different with the shields. Archery is not mentioned to pierce shields. Most lethal spearcasts and thrusts are delivered around shield coverage, to the body armor or to unprotected body parts. Few hits on armor are repulsed, in cases resulting in broken spearpoints or even spears-but the latter is considered a god-sent strike of misfortune (VI-306, XIII-564/5) (most probably a failed –and flawed in manufacture-weapon). Shields, on the other hand are just as often pierced as they repel the points (Ajax's and Achilles' shields are never pierced). Helmets are routinely giving way under direct hits and blows, but are also responsible for some spectacular saves: Hector, Paris, Menelaus are saved by spearcast, swordcut and straight-axe blow respectively (XI-350, III-362, XIII-615).

Greeks have very tight phalanx formations (XIII-129/131, XVII-352/65); the Trojans cannot do the same, nor break them. It is an issue whether this is due to the shields used or to any other factor. Tower shields are not mentioned for Trojans, who do use 8-body-shields, as do many Greeks; Hector has a body shield which demands dexterity in moving and handling (VII-238/9) and when thrown back it is felt at heel and neck while running (VI-118); and he is no exception, but the rule. It is described also as symmetric (XI-61, VII-250) (not meaning circular, as interpreted, but 8-figured). Both enemies use round shields. There might also be double-grip shields, as in Pylos frescoes, reminiscent of argive shields. The tower shield mentioned is the one of Ajax the Great. Homeric language is inconsistent, but it is the only one that might be called "sakos", as the greek term implies something rectangular-ish, which is not the figure of 8 or the eclipse or the round shields.

Body – shield-bearers, armed with extra-long lances (egxeiae) were most probably NOT deployed in tight phalanx. First, being able to get INTO the shield is important when NOT in phalanx. In phalanx, enough to go behind the shield, as hoplites would show some centuries later. A close phalanx would have been crushed by the leading teams of chariotry, especially if supported by powerful and accurate missile fire. An open deployment, however, would expose body-shield bearers them to runners and light infantry. The fresco of Thera, showing a dispersion which allows motion so as to avoid being trampled by the chariotry, while the length of the lances permits to support a comrade from light infantry swarms, is perhaps a more viable paradigm. The dispersed troopers do not offer a solid target for massive archery but must be picked one by one, which is tricky if they are not in even spaces and straight lines and files. The spears offer crossfires, and evasion of charging chariots while lancing at the team or the crew is possible. The concept is still viable if lance is substituted for spear, and archers can be dispersed within the formation. The shorter spear might turn the formation a bit denser, but

not too much; this might be the Homeric paradigm for both opponents.

The Greek dense phalanx is clearly depending on three things (XIV-371/82): men (must be heavy and strong, not light and agile), shields and spears. Longer spears are better suited for porcupine formations and it is very probable that explicit reference to spearfighters in both armies implies use long spears- rather lances "egxea"- instead of the more typical "dory" double-use spear which was the current standard and is seen in Thera's fresco arming light infantry. For the Greeks the best case-study is the contingent of Avantes, while a Thracian contingent is the respective from the Trojan side (IV-533). It is explicitly mentioned for Avantes that their spears break through cuirasses (II-543/5) and armor; thus they are special weapons compared to standard "dorata". But the heart of the issue lies with the shields: Homer mentions partial redistribution of weaponry (unevenly issued as a result of conscription practices, a millennia-old problem) to have the heavy shields in front, to shield a phalanx (XIV-376/7). This is not necessarily correct: the lighter shields, termed «laiseia» (V-453) and being either the Warrior Vase reverse crescent copper-faced models, or circular ones, either one-handled (as the Herzsprung example) or two-handled, as in Pylos frescoes, allow denser packaging; and denser packaging of men means a more threatening and repulsive wall of spearheads (as shown by the Macedonian phalanx, which, according to Diodoros, just brought back to life the Homeric phalanx), which clearly intercepted Hector and the Trojan onslaught (XIII-145).

The last issue on greek tactics is the "tower" (IV-334), an effective offensive but not defensive formation. It must have been similar to 19th century columns used by the Napoleonic French infantry for prompt assault minimizing exposure to line fire and giving momentum in the collision. The rationale should have been similar in the bronze age and a kind of drill would allow transformation of infantry units.

The Trojans, with their intimate knowledge of the peculiarities of land, space and weather, seem to follow Sun Tzu and use such conditions proficiently. Their attacks under low visibility due to fog, mist and wind (XV-668/70, XVI-645/50) in the "Windy Ilion" caused much distress to the Greeks, who are better performing in good visibility, due to numbers and perhaps tactical efficiency. Both opponents are more or less considered capable of expedient and massive kindling of fire for offensive use against enemy positions, ships or cities- a near fatal inability of the Athenian army at Marathon (490 BC where they could not burn Persian ships and had to capture them, resulting in just 7 prices-out of some hundreds).

It might have been a Trojan tactic to aim for the legs facing heavy opponents. The proverbial "Achilles' heel" is not an isolated incidence. In XI-379 Paris' arrow nails Diomedes' foot to the ground by hitting the ankle. It might be more of skill and intention and less than luck to hit two prominent heroes at the same spot, heroes with highly regarded armor (and one of them having survived a direct hit of an iron-tipped arrow at the cuirass (Diomedes, when hit by Pandaros in V-99). Last, Agenor shot his spear at Achilles' shin (XXI-591), which is the same concept-or even a slight miss, if he aimed for the ankle and foot and missed his precise mark as Achilles charged forward.

EXPERIMENTAL ARCHAEOLOGY – EXPERIMENTAL HISTORY

There are many issues in the above observations. Some focus on "how was that done" and others on "is this possible?". The ability to do it today in reenactment or simulation proves positively that a procedure is attainable. It does not prove that the ancients did it in this way. And if today we cannot do it, the negative value of the simulation is limited. They knew better....

Some things are just a matter of sweat. Issues can be simply tried by teams in a field. The way

Fig. 2 What is the metal for the greaves? Are they copper/bronze/brass? The Greeks are mentioned as "having white greaves" or as having "nice greaves".

in which standard shield-bearers, armed with extra-long lances (egxeiae) were deployed is one of such problems. A close phalanx would have them crushed by the leading teams of chariotry. An open deployment would expose them to runners and light infantry. The fresco of Thera, showing a dispersion which allows motion so as to avoid being trampled by the chariot, while the length of the lances allows mutual support in cases of from infantry swarms, is a nice subject for experimentation.

The way the heroes chased after their cast spear using the force of the cast to follow, not to recoil as today's athletes, in order to either retrieve the weapon or to continue the attack with the sword (as does Menelaus against Paris and Achilles against Aeneas) before the initiative is seized by the opponent is another interesting issue (in XIII-512 Idomeneus was considered too mature to be capable of executing the drill). This practice is highly reminiscent of current protocols for air combat by fighter pilots, who engage the enemy successively using the longer-range weapons to gain time and advantage as they close in for shots with shorter range ones. In this case the "DD", the "duel dance", which means the almost standardized procedures in homeric duels which, though, had tactical meaning, may be validated mainly by reviving and reenacting such moves with realistic weaponry. The use of secondary weapons is important, after the spear is cast or broken: there is one mention of the straight axe, in Trojan ally's use (XIII-612 *αξίνη* instead of "*πέλεκυς*"/regular axe for tree falling in XXIII-115) and then a direct mention of both straight and conventional axes (XV-710).

The usual choice is the sword. Homeric terminology is inconsistent, but one can discern the very long, thrusting weapon (fasganon in Homer, pakana in the tablets) and the sturdy, double use "aor", which chops limbs and heads (XX-481) and is bulged near the point ("oarlike" XV-713, XX-475). A distinguished such weapon is mentioned as being of Thracian origin, imported to Troy for prince Helenos (XIII-576). Archers are equipped with swords if they are of heroic status. In Homer, though, swords often break. It is experimental archeology which might identify the flimsy ones with the thrusting fasgano instead of the heavy aor. Though, during the middle ages the main kind of straight sword was triangular and long; despite this fact they were excellent cutting weapons, and it might well be the same with fasganon- only robust modeling, simulation and experimentation might prove each side's merits (apart from the obvious, to kill someone through a bodyshield-which might have been the reason for copper-covered bodyshields in Iliad, which are not mentioned in Odyssey).

But other issues need different approaches, and other cases need more elaborate skills, schemes and equipment.

Can there be a bow made of horn as is stated for Pandarus? The issue is not if the Scythians, the English or the Mongols did it otherwise. Is it pos-

sible? In 2014 the American bowmaker Jack Farrell (https://www.facebook.com/jack.farrell.794/posts/10202864416985661) presented one such item. On the other hand, as with the shield of Achilles, a technological secret may be wrongly perceived due to the common name (bow made of horn-implying that it is not just of wood, as usual ones, but horn has been used, too-though not exclusively). Poets are not technicians-although they might be surgeons or warriors or even farmers and herders. Thus technical details are not their strong point. What is much more easy to approach is the technique: Pandaros is mentioned (IV-121/3) to draw to the chest, less and lower than the English/Welsh longbow practice to the ear. He draws both arrow and string, and the arrow has carved edge to provide a better grip, not slipping due to sweat, blood or water.

What is the metal for the greaves? Are they copper/bronze/brass? The Greeks are mentioned as "having white greaves" or as having "nice greaves" (see Figure 2). The latter is never used for Trojans; they may be assumed not to use them. But the white argive greave, is it painted? What is the metal of Achilles' ones, which staved off a direct spear-cast (XXI-558)? Tin (mentioned as the metal of manufacture in XXI-558) does not convince. Is there any other, white metal?

Are we right to suppose the weapons of the era were not of copper but of bronze? Copper is not durable, but this is for pure copper. The mines of Greece do not produce very pure copper and the admixtures of the native copper ore provide readily a rather robust product. Are there any spectral analyses of findings, to see whether tin was such a strategic metal after all? Or was it mostly used for cooking pans, to avoid copper poisoning? Greek helmets from the classical era are green-rusted, and some even show blue rust patches. The helmet of Miltiades is green-rust after 2500 years; a Persian helmet taken from the same battle as a prize, and kept at the same museum, is yellowish as if used last year.

Attacking through the fog and mist or with the wind on the back would be easy for a native host. The prompt kindling of fire to prepared torches for the moment the enemy ships would be reached upon is also rather simple. But what is to make of the pinpoint accuracy with which Diomedes is assaulted by lightning bolts- which defy natural laws and instead of Ozon smell of Sulfur? Patroclus was disarmed by Apollo's strike on his back and the description is reminiscent of a blast (XVI-790/806). As a result his spear is broken, his shield and armor blown away and he emerges stunned and disoriented; much like the victims of 17th century grenadiers. Moreover he emerges through a cloud: was it dust from a windburst or smoke from a blast explosion? With the known ingredients of the period can one be too bold to assume the use of black powder, which is easy to make and smells of sulfur, while producing the noise of the thunder? Does this have something to do with the appeasement of the priests of Athena (the Goddess of Inventions) in Troy by Hector's seer-brother Helenos? It is not very original. The Thebans most probably had used it on Sthenelus's father, Kapaneus, thus claiming victory a generation earlier.

A martial art with weapons is implied in Achilles' rampage (XX-455/89) and in Tudeus killing an impressive 49 out of 50 ambushers (IV-393).

The ultimate experimental goal would be the restoration of the composition of the shield of Achilles. In here there is metallourgy, the disdained art. Homer writes that copper, tin and gold where used in 2/2/1 ratio (XX-270/2) and believes that this means layers or plates. Is this so? In such case, what was the order? Gold was in front, at the back or in the middle? If in the middle, the layers of copper and tin where palindromes or tandem? And what if it is NOT so? Even the best scribe and poet might not understand that these are the necessary ratios for forming an alloy, instead of using the ingredients in successive layers. Do we have anything to learn from this process as far as armoring and protection from kinetic energy threats (not only in war, but also in urban and industrial accidents) are concerned?

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REZIME

RATOVANJE U MIKENSKO DOBA: ILIJADA KAO PARADIGMA ZA PRIMENU U EKSPERIMENTALNOJ ARHEOLOGIJI

KLJUČNE REČI: MIKENSKI PERIOD, ILIJADA, EKSPERIMENTALNA ARHEOLOGIJA.

Za Homerovu poeziju možemo reći da predstavlja najiscrpniji izvor informacija o bronzanom dobu, naročito onom segmentu koji se odnosi na ratovanje. Ona je daleko životnija od egipatskih zvaničnih zapisa ili spomen ploča koje su imale propagandnu funkciju ili mikenskih i tebanskih tabli. Homerova poezija pruža informacije o geopolitičkoj situaciji i savezima, veličini vojske, organizaciji i rasporedu vojske, trupama, lancu komandovanja i naoružanju, oružju i njegovoj nameni, proizvodnji i tehnici korišćenja. Uz to treba dodati da podatke dobijene iz Homerovog speva treba unakrsno ispitivati sa drugim literarnim izvorima i materijalnim dokazima, kao i reprezentativnim umetničkim delima. Međutim, pojedini specifično vojni problemi kao što je postavljanje borbene linije, pravilna upotreba oružja, proizvodnja oružja i opreme i povezanost sa metalurškom proizvodnjom, zahteva pomoć eksperimentalne arheologije, koja treba da rasvetili određeni period u cilju dobijanja što koherentnije i istinitije slike prošlosti.

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930.85:27(497.11)"2013"
338.485:902/904(497.11)
711.52:902
COBISS.SR-ID 219301132

Original research article
Received: May 27th 2015
Accepted: November 15th 2015

ARCHAEOLOGICAL PARK VIMINACIUM: CULTURAL-HISTORICAL HERITAGE IN THE JUBILEE YEAR OF CHRISTIANITY*

ABSTRACT

In the Jubilee year when the Christian world celebrated 17 centuries since the signing of the Edict of Tolerance – the Edict of Milan, through the proclamation of which, in 313 in Milan, Emperor Constantine the Great allowed religious equality and stopped the persecution of Christians, the Archaeological Park Viminacium, was actively involved in a program to mark this important anniversary with two events, actually important national exhibition and famous Verdi's opera Aida. Those events attracted thousands of visitors and again marked the Archaeological Park Viminacium as one of the most important and most successful promoters of cultural and historical heritage in Serbia. In future, we hope that tourism in this area, based on rich cultural and historical heritage will be more developed, using Viminacium as a leader and a model.

KEYWORDS: EDICT OF MILAN, EXHIBITION, OPERA, THE VIMINACIUM ARCHAEOLOGICAL PARK, CULTURAL-HISTORICAL HERITAGE.

EXHIBITION

One of the central events which marked the seventeen centuries since the official recognition of Christianity was the exhibition *Constantine the Great and the Edict of Milan 313. The birth of Christianity in Roman provinces in the territory of Serbia*, organised by the National Museum in Belgrade. It was initially displayed in the exhibition rooms of the building *Domus Scientiarum Viminacium* – Archaeological scientific and research centre, at the Archaeological Park Viminacium[1] (Fig. 1, 2), before moving to the atrium of the National Museum in Belgrade, concluding in Niš, the birthplace of Constantine the Great.[2]

1 About the building Domus Scientiarum Viminacium - Archaeological scientific and research centre, see in: Nikolić, 2012 and Nikolić, 2014a.

2 This exhibition is accompanied by a luxury published catalog in which preparation involved numerous authors, experts in different fields of Roman archeology. Editors of the publication are Bojana Borić Brešković and Ivana Popović, who are also the main organizers of the exhibition.

*The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

Fig. 1 Archaeological park Viminacium, Domus Scientiarum Viminacium.
(Photo-documentation of Institute of Archaeology, Belgrade)

The exhibition was divided into several thematic parts which covered several periods: before the Tetrarchy, the Tetrarchy and the period of the rule of Constantine the Great and his successors. The richness of life in the urban centres of the Roman provinces of the territory of the Central Balkans was represented by items of gold, silver and bronze which are archaeological finds from the residential complexes of *Sirmium*, *Mediana*, *Romulina,* Šarkamen etc. More than 180 artefacts were on display, produced between the 2nd century AD and the time of Constantine's successors in the period of Late Antiquity. They represented archaeological items found in the territory of Serbia which have been preserved in museums. Among the displayed items (sculptures, fragments of architectural decoration, frescoes, mosaics, jewellery, silver dishes, parts of military equipment and Roman imperial coins), there were several artefacts of exceptional value such as a helmet from Berkasovo in Vojvodina, imperial jewellery from Šarkamen in eastern Serbia, a cameo from Kusadak (Fig. 3) etc.

As an introduction to the time that preceded Constantine's epoch, the exhibition included jewellery from the end of the 2nd and the 3rd century AD, parade armour and a pectoral from Ritopek (*Castra Tricornia*), organ pipes from Golubac (*Cuppae*), two sceptres, made of wood and gilded silver, from Dubravica (*Margum*) and Kostolac (*Viminacium*), as well as items of luxury silver ware which were sourced from the major mining centres of the mountains Rudnik and Kosmaj.

What is specific to the territory of Serbia is the number of items from the period of the Tetrarchy. Galerius and Maximinus Daia and later Constantine the Great left an indelible mark on this region with the construction of the imperial residential complexes in *Romuliana* (Gamzigrad), Šarkamen, and *Mediana* (Brzi Brod). Consequently, this period occupied a significant place in the exhibition with displayed busts of tetrarchs carved out of porphyry from Niš (*Naissus*), Gamzigrad (*Romuliana*) and Tekija (*Transdierna*) and pilasters with the busts of tetrarchs from *Romuliana*, as well as the famous gilded bronze bust of Constantine the Great (Fig. 4). Among some extremely valuable exhibits was a set of women's gold jew-

Fig. 2 Archaeological park Viminacium, Domus Scientiarum Viminacium – the exhibition rooms. (Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 3 Cameo from Kusadak (poster of the exhibition). (Photo-documentation of Institute of Archaeology, Belgrade)

ellery from the mausoleum in Šarkamen, which some authors assumed to belong to the mother of the emperor Maximinus Daia (Popović, Tomović 1998) and a silver jubilee plate (*phialla*) made in the imperial workshops in Niš (*Naissus officina*) to commemorate the tenth anniversary of the reign of the emperor Licinius, in 316 AD. Constantine's *vicennalia* in 326 AD was the occasion to officially reward individuals for their services.

In the part of the exhibition dedicated to religion were items related to the traditional Roman gods, among which should be noted a votive porphyry sculpture of Asclepius and Hygeia, and a marble sculpture of a deity of the Dardanians, identified as *Dea Dardanica*, from the residential complex at *Mediana,* Heracles with Telephus from *Singidunum,* sculptures of genius of spring and winter from *Singidunum* (Fig. 5). In addition to the cult of classic Roman deities, from the 2nd century AD there was growing interest in Oriental deities whose cults spread with the arrival of the army and traders from the East. In the exhibition they were represented by the cult emblem of Jupiter Dolichenus in gilded bronze from the sanctuary at Brza Palanka (*Egeta*), a lead icon of a Danubian Horseman from the vicinity of Šabac and a marble relief of the god Mithras from Smederevo (*Vinceia*).

This part of the exhibition was followed by showcases displaying objects that carry Christian symbolism, suggesting the process of the spread of Christianity and the freedom of religious confession allowed by the Edict of Milan. *Sirmium,* as the administrative, commercial and cultural centre of the province of *Pannonia Secunda,* became one of the official residences of the Roman Emperors in the period of Late Antiquity. It was also the city of Christian martyrs. The importance of the city was confirmed by architectural sculptures, including a significant number with Christian characteristics. *Naissus* was also a significant Christian centre as evidenced by the numerous re-

Fig. 4 Pilasters with the busts of Roman emperors; in the centre the famous gilded bronze bust of Constantine the Great. (Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 5 Sculptures of genius of spring and winter from Singidunum. (Photo-documentation of Institute of Archaeology, Belgrade)

mains of sacred objects that point to the Christian commitment of a substantial part of the residents of the ancient city.

Showcased exhibits that bear a Christian message and symbolically portray Constantine's legacy in religion included a silver reliquary from Gamzigrad (*Romuliana*), a blessing hand made of ivory, from Caričin Grad, an elegant deep silver bowl with an engraved Greek cross from Niš (*Naissus*), silver footed goblets with lids and silver spoons from *Viminacium*, a jug made of bronze from Kostol (*Pontes*) and a gold necklace with medallions and a pendant shaped as a cross from Višnjica (*Ad Octavum*) (Fig. 6, 7).

It should be mentioned that there was a whole section at the exhibition dedicated to the Roman army, which was represented by several exceptional exhibits such as a helmet from Jarak and a parade helmet from Berkasovo which were displayed together with a cruciform fibulae (Fig. 8, 9).

The everyday life of the Roman population in today's Serbia during the Late Antique period was revealed by ceramic and glass vessels, as well as the luxurious silver vessels from *Naissus* and *Viminacium*, reflecting the taste of the Roman aristocracy.

Finally, we should mention the section of the exhibition which contained valuable numismatic finds.

Bearing in mind the representativeness of the displayed museum exhibits, we could say that this exhibition was of great importance not only for experts, but also for the general public, since it was the first time that the entirety of the representative antique archaeological material from the territory of Serbia had been presented. This exhibition was a major undertaking that will be remembered as a great cultural event in Serbia, contributing to the general celebration of this important date in the entire Christian world.

Fig. 6 Silver dishes and spoons with Christian features. (Photo-documentation of Institute of Archaeology, Belgrade)

OPERA

In addition to the exhibition, 1700 years of the Edict of Milan was marked by another exceptional event, Verdi's opera *Aida,* performed by the ensemble of the National Theatre of Belgrade.

The musical and theatrical spectacle, as a part of the state program of marking 17 centuries of the Edict of Milan, was solemnly opened by the Ambassador of Italy in Serbia, Armando Varricchio, who was the host of the evening. The Embassy of Italy donated the performance of *Aida* at Viminacium to the state project of marking the Edit of Milan.

The masterpiece of the famous Italian composer Giuseppe Verdi's *Aida* was performed in the Roman amphitheatre of Viminacium, reconstructed for this occasion,[3] under a starry sky in the attendance of approximately 2000 visitors (Fig. 10, 11).

The newly reconstructed amphitheatre has become the biggest attraction of the archaeological site of Viminacium. It is important to mention that this is the only excavated and presented Roman amphitheatre in Serbia. It is a place with all the necessary facilities for both visitors and actors and performers, having a large auditorium as well as a reception hall and changing rooms.

With the protection and presentation of the amphitheatre, Project Viminacium is following the modern processes of sustainable development, whereby the revitalisation of historic buildings is a key factor (Fig. 12, 13). It is hoped that the Viminacium amphitheatre will become an important space for all kinds of modern performances, concerts and sporting events, as well as a setting for summer theatre or film festivals.

CONCLUSION

These events were some of the numerous activities of the Archaeological Park Viminacium, many of which have enjoyed substantial support from the Kostalac power-plant. Through the joint activities of the Archaeological Park Viminacium and the Kostalac power-plant, it has been possible to create a unique cultural landscape that has resulted in a combination of cultural and natural resources, an area that shows how two seemingly opposing activities – the preservation of cultural heritage and the rapid development of industry – can work together for decades (Fig. 14).[4] With the regular and planned maintenance of such landscapes, they can become the basic accelerators of the social and economic development of the local population and even the region as a whole. In the future, when the mining and energy sectors cease to be the carriers of local development, tourism based on a rich cultural-historical heritage will be able to offer new opportunities to this area (Fig. 15).

Today cultural and archaeological tourism is gaining more importance especially in countries with numerous preserved archaeological mon-

3 About the amphitheatre reconstruction, see in Nikolić 2014b.

4 About this see in: E. Nikolić, O. Ilić and D. Rogić 2013.

Fig. 7 Silver dishes with Christian features.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 8 Pectoral from Ritopek.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 9 Luxuriously decorated helmets encrusted with gold foil from Berkasovo.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 10 Verdi's opera Aida in reconstructed Roman amphitheatre of Viminacium.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 11 Reconstructed Roman amphitheatre of Viminacium.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 12 Reconstructed Roman amphitheatre of Viminacium.
(Photo-documentation of Institute of Archaeology, Belgrade)

Fig. 13 Reconstructed Roman amphitheatre of Viminacium.
(Photo-documentation of Institute of Archaeology, Belgrade)

uments among which is also Serbia. The first results show that the Archaeological Park Viminacium has developed into a tourist destination of great importance in recent years, especially since it lies along the cultural-historical road which became part of a tourist project *Itinerarium Romanum Serbiae*.[5]

As confirmation of these assertions, we can mention the results of a poll among foreign visitors who come to Viminacium on the cruise ships on the Danube.[6] The visitors positively evaluated park, but also noted all the problems in the surrounding area. All of them submitted encouraging and constructive comments. The whole presentation of the park was rated as a complete, educational experience and a perfect way to preserve history.

Most of the visitors stated that pollution in the air is a big problem for Viminacium. Some of the visitors expressed a wish to visit this industrial complex, whilst others were interested in the process of archaeological excavation and wished to observe all its phases. Other recommendations came in the form of suggestions of how to improve the offer of the park. These were linked to the sale of souvenirs, but also to easier access for elderly persons, as well as video presentations showing those areas which people with difficulties are unable see. Many positive comments were made regarding the well informed and pleasant guides.

It is interesting to read the blog of one American tourist who wrote "…but Viminacium didn't disappoint me. As I looked over the corn fields, I was reminded of Saint-Exupery's story, *The Little Prince*, when he landed in the Sahara desert and met the (imaginary) boy prince from another planet. The Little Prince taught him that what is important is often invisible to the eye, such as wa-

5 About this, see in: Korać, Golubović and Mrđić 2009; Korać 2014.

6 About this, see in: Anđelković Grašar, Tapavički-Ilić 2012; Anđelković Grašar, Tapavički-Ilić 2014.

Fig. 14 Natural, civilisational, cultural and historical factors of the landscape.
a. Open pit "Drmno". b. Buildings in the Archaeological park Viminacium and the open pit "Drmno".
c. Archaeological park Viminacium, the power plant "Kostolac B", the rivers Mlava and Danube
and the village of Stari Kostolac (Nikolić, E., Ilić, O. and Rogić, D. 2013: 266, fig. 7.

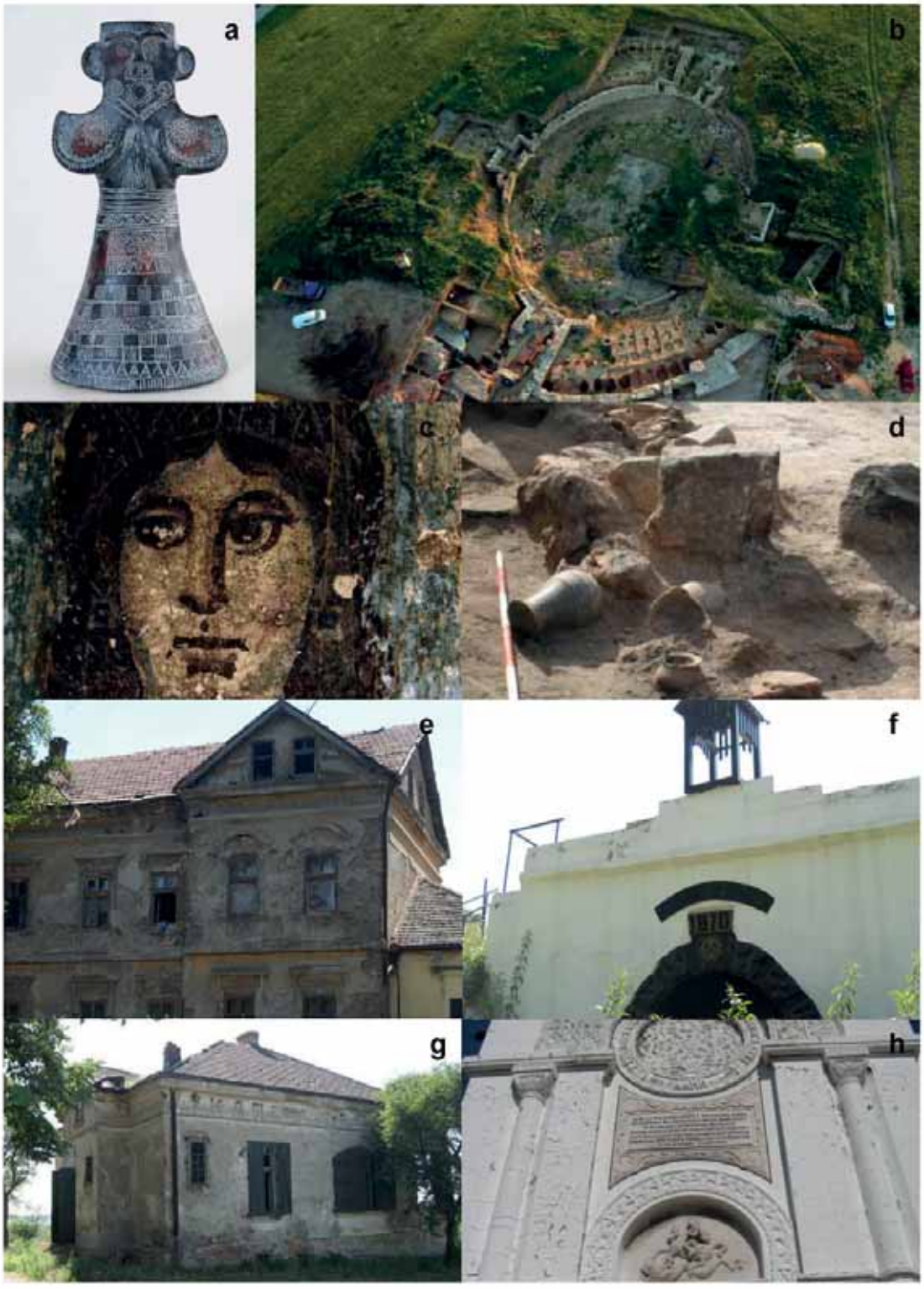

Fig. 15 Cultural and historical factors of the landscape. a. Prehistoric figure named Kličevac idol. b. Viminacium amphitheatre. c. Detail of a fresco from the 4th century found in a tomb in Viminacium. d. Archaeological research of medieval Braničevo. e. Main administrative building of the old mine in the village of Stari Kostolac. f. Entrance to the old mine in the village of Stari Kostolac. g. Family villa of the river captain, on the hill above the village of Stari Kostolac. h. The church from 1924, on the hill above the village of Stari Kostolac.
(Nikolić, E., Ilić, O. and Rogić, D. 2013: 262, fig. 3.

ter hidden somewhere in the desert, and that one must learn to see with one's heart, not just rely on what is seen by the eyes." (The Mystery of Viminacium, Serbia, 2010)

As to the suggestions and comments of domestic and foreign visitors, we can mention entries in the *Viminacium Guest Book* which has been in place since the opening of the archaeological park. There were some comments emphasising the educational role of Viminacium, such as "History is interesting…" and "Roman times have come alive in front of us…" Also, there were comments speaking of the large impact the park has had on the memories, feelings, experiences and thoughts of visitors. "Excitement, satisfaction, enthusiasm are little compared to what I felt and experienced…", "…for a moment it was like I had sat in a time machine and gone into past…", "…a special gift for the soul, eyes, body…", " … real magic, mystery…", "… it sent excitement and shivers to my heart…", "…it is so nice to return to the past, the future looks brighter…" (Viminacium Guest Book).

On the basis of this short review, we can conclude that in modern tourism it is very important that a place has its own distinctive spirit that helps to create the experience of the visitors.[7] With the revitalisation of the Viminacium amphitheatre, started in 2013, one can still feel the spirit of ancient times in an ancient setting, whilst fulfilling modern needs, with the aim to make a building live again, just as it did during the Edict of Milan celebration.

The Domus Scientiarum at Viminacium was designed as a building of ancient composition and themes, with the interweaving of traditional and contemporary building materials whilst, at the same time, a host to modern facilities. (Nikolić 2014a: 185) The motifs and symbols of the mosaic scenes in the exhibition rooms, just like the architectural elements of the massive, heavy, coffered ceiling covered with mosaics and ostensibly carried by the pillars set into the wall, brings mysticity into the space, (Nikolić 2014a:186) a feature that suits a large exhibition, such as the one that, in 2013, celebrated the birth of Christianity.

7 More on the topic connected to Viminacium in: Nikolić, Anđelković and Rogić, 2011.

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REZIME

ARHEOLOŠKI PARK VIMINACIUM – KULTURNO ISTORIJSKO NASLEĐE U JUBILARNOJ GODINI HRIŠĆANSTVA

KLJUČNE REČI: MILANSKI EDIKT, IZLOŽBA, OPERA, ARHEOLOŠKI PARK VIMINACIUM, KULTURNO-ISTORIJSKO NASLEĐE.

U jubilarnoj 2013. godini kada je čitav hrišćanski svet proslavljao sedamnaest vekova od potpisivanja Edikta o toleranciji tzv. Milanskog edikta, Arheološki park Viminacijum se aktivno uključio u obeležavanju ove proslave. Izložba *Konstantin Veliki i Milanski edikt (313), rađanje hrišćanstva u rimskim provincijma na tlu Srbije* u organizaciji Narodnog muzeja u Beogradu imala je posebno mesto u proslavi ovog jubileja. Izložba je otvorena u izložbenim prostorijama *Domus Scientiarum Viminacium* – Arheološkog naučno istraživačkog centra u Arheološkom parku Viminacium, zatim je celokupna postavka izložbe preseljena u atrijum Narodnog muzeja u Beogradu i na kraju je prezentovana u Nišu, rodnom gradu Konstantina Velikog.

Drugi značajan događaj koji je obležio ovaj važan jubilej, bila je opera Aida u izvođenju ansambla Narodnog pozorišta iz Beograda. Čuveno delo italijanskog kompozitora Đuzepe Verdija izvedeno je u rimskom amfiteatru rekonstruisanom za ovu priliku.

Ovi događaji privukli su brojne posetioce pokazujući da je Arheoški park Viminacium jedan od najznačajnijih i najuspešnih promotera kulturnog i istorijskog nasleđa Srbije. U budućnosti, razvoj turizma u ovoj oblasti, baziran na kulturnom i istorijskom nasleđu, svakako će kao uzor i model imati Arheološki park Viminacium.

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001.92:902(497.4)
338.485:904(497.4)
COBISS.SR-ID 219301900

Original research article
Received: May 27th 2015
Accepted: November 15th 2015

ARCHAEOLOGICAL PARK VICUS FORTUNAE – PROJECTS AND PROBLEMS

ABSTRACT

The project Archaeological Park Vicus Fortunae is based on the Roman provincial archaeology and heritage from the Roman era.

The area around the community of Hajdina, where the park is planned, is well known from different archaeological periods (Colonia Ulpia Traiana Poetovio). In the past a few research works were carried out yielding some interesting evidence – in its near vicinity two Mithras' temples were discovered of which the first remains in situ and will be a constituent part of the future archaeological park.

Roman settlement of the contemporary cultural, political and economic site represents nowadays an unexploited advantage for a social and cultural development.

We would like to attract into this project all local people interested in the heritage, as well as tourists. With the help of experts on the Roman provincial archaeology and on communicating heritage (museum experts, archaeologists, pedagogic workers), we shall be able to create thematic workshops and events with the goal to raise awareness about the heritage and its importance. All activities will be meant for all age groups. The programme will contain new ideas and programmes with the aim to promote Roman provincial and classic archaeology, as well as archaeological movable and unmovable heritage and its protection. Conceptually, the programme shall become a new centre of cultural and tourist development of the community of Hajdina.

KEYWORDS: SLOVENIA, HAJDINA, CULTURAL HERITAGE, ARCHAEOLOGICAL PARK VICUS FORTUNAE, ACTIVITIES, WORKSHOPS, PROBLEMS.

Cultural heritage is one of the most important elements of our identity, therefore its protection and restoration are of extreme importance as well as rendering it public in order to foster the establishment of the identity and encourage creativity inspired by the heritage. The project Archaeological Park *Vicus Fortunae* is based on the Roman provincial archaeology and heritage from the Roman era.

The archaeological park is planned on the territory of Hajdina community which boasts rich finds from different archaeological periods (Vomer Gojkovič and Kolar 1993) (Fig. 1).

Poetovio was actively involved in economics and politics already in the prehistoric times. Many merchants reached the town by following the ancient amber road passing through the area. At the arrival of Romans around 15 BC, *Poetovio* was part of the kingdom of Noricum. Thus Celts and Romans developed economic and military rela-

Fig. 1 Aerial photograph of the Hajdina (Photo archive of the Ptuj-Ormož Regional Museum)

tionships very early. Favourable strategic position of *Poetovio* was very much appreciated already at the arrival of Romans in the area (Vomer Gojkovič 2011: 10-13).

The town started to truly develop at the end of the 1st century when the military headquarters were moved to *Vinodobona* on the Danube, and when the emperor Trajan bestowed on Poetovio self-governing rights together with the administrative status of colony – *colonia Ulpia Traiana Poetovio*. The town also got a land register, and veterans who had distinguished themselves during their military career were encouraged to colonise it. All these privileges, economic activities carried out by the citizens, thriving crafts and a growing demand, and ever more dense traffic resulted in prosperity of an important number of citizens and in a high level of civilisation and culture (Horvat et al. 2003: 153-189. Vomer Gojkovič, 2004: 86-89).

In the 2nd century, *Poetovio* had grown into a prosperous provincial town. Most densely populated town quarters were to be found on the last Drava terrace and on the northern part of Spodnja Hajdina were a trade, business and sacral quarter, called *vicus Fortunae* was situated. There, parts of Roman architecture, some decorated with frescoes and mosaics, were discovered. Near residential, business and other public buildings were situated various craft workshops and offices among which the most important was undoubtedly the customs office and warehouses established during the Emperor Hadrian tenure (*publicum portorium Illyrici*).

Amongst numerous unearthed remains of Roman sanctuaries, the most outstanding were the discoveries of Mithras temples dedicated to the god of light Mithras (Fig. 2), one in 1898-1899, the First Mithras temple preserved *in situ* (Vomer Gojkovič et al. 2011) and another found in 1901, the Second Mithras temple (Abramić 1925: 63-73), as well as a sanctuary dedicated to divine wet nurses, *Nutrices Augustae* (Wigand 1915: 189-218), depicted on marble plates from Pohorje, which represent a special feature of Roman *Poetovio*. In the quarter of *vicus Fortunae* in Spodnja

Fig. 2 Inside of the Mithras Shrine I (Photo M. Vomer Gojkovič)

Hajdina, where warehouses and sanctuaries were located, an early-Christian church was discovered where the bishop Victorinus of Poetovio served at the end of 3rd and the beginning of 4th centuries (Bratož 2001: 313-325).

The western cemetery in Hajdina contains some graves dated from the 1st to the first half of the 5th centuries lying along the road in the direction of *Celeia* for some 2.1 km. At certain points graves were relatively far from the road which could imply that the cemetery, in fact, spread along secondary roads leading to south and north. Cremation graves prevail while skeletal ones are less common. The graves contain goods such as ceramics and glassware, weapons and tools, jewellery and also amber goods (Istenič 1999. Istenič 2000).

Roman settlement of the contemporary cultural, political and economic site represents nowadays an unexploited advantage for a social and cultural development. The cooperation of institutions in charge of the presentation of the heritage is at its beginnings.

Tourism in the Lower Podravje region is part of the global and European market known especially for its international events, for its thermal, archaeological, ethnological, cultural, historical, oenological and gastronomic supply, while the entire region offers excellent sports facilities and centres for relaxation and recreation. From the tourist point of view, the region of Lower Podravje is extremely varied and picturesque. The area lying between Slovenske Gorice and Haloze, Drava and Ptuj fields, boasting excellent natural features, rich cultural heritage, unique geographic position, and well-developed and still-growing tourist facilities, as well as the already proverbial hospitality of its people, offers countless possibilities for a sustainable tourism development, as tourism represents an important business and development opportunity.

The site where the archaeological park should be revived is rich in cultural heritage. Research works have been carried out there yielding some interesting results – in its near vicinity two Mithras

Fig. 3: The plan of geophysical research in Spodnja Hajdina (from Mušič 2012: 3)

temples were found of which one is presented *in situ* and will, as such, represent a constituent part of the archaeological park. Due to the fact that the surroundings of the first Mithras temple were taken care of with the help of funds allocated by the European Agricultural Fund for Rural Development through the project Europe invests in rural areas, which ended in 2012, it seems only logical to continue the project by including it in the cultural and tourist offer of the community, and to set up a tourist-information centre at the entrance of the archaeological park in Spodnja Hajdina. Archaeological research carried out by the district institute Regional Museum Ptuj-Ormož shall thus gain additional value through the functioning of the park (Fig. 4).

The project of bringing new content to the mentioned site was submitted to an international call of proposals: Operative Programme IPA Slovenia-Croatia 2007-2013 to get European funds, but unfortunately without success. Even before the outcome was published, some research had been done into archives related to the previous archaeological research followed by some non-destructive research of the soil in order to get the starting point for steps to follow during the implementation of the project.

The establishment of a cultural-information centre Archaeological Park Vicus Fortunae is being under its way with the:

preparation of documents for the establishment of a cultural-information centre with a permanent public presentation of the archaeological heritage and its inclusion in scientific-research, educational and economic-tourist trends;

restoration and modification of the existing farmhouse together with the adjacent outbuildings into a cultural-information centre;

establishment of archaeological parks and preservation of unbuilt plots will consequently become an archaeological reserve;

drawing of a plan of how to use and include the park into the cultural and tourist offer of the region.

In 2012, geophysical research was carried out

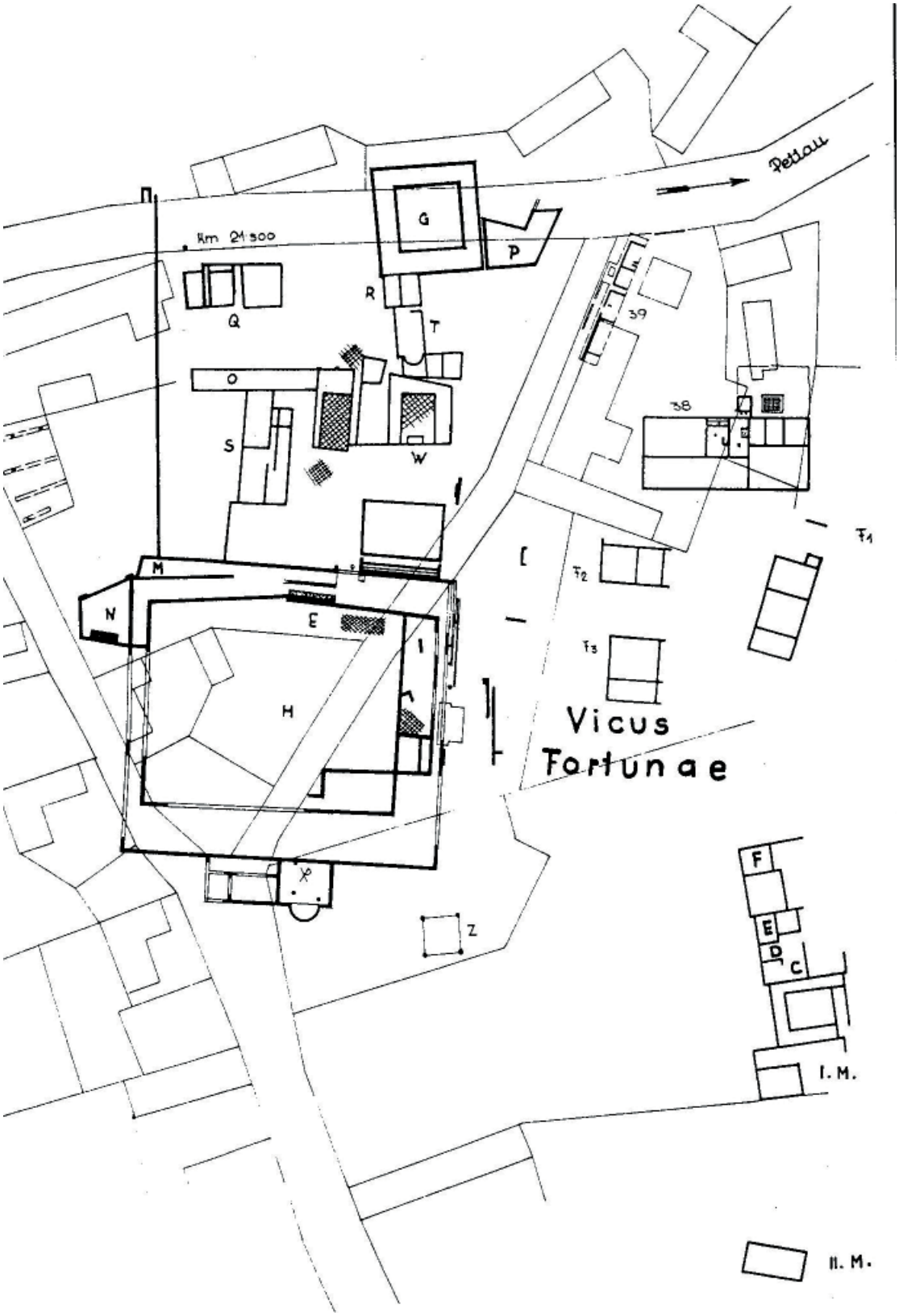

Fig 4: The plan of Schmid's excavations in the Vicus Fortunae (from Vomer Gojkovič and Kolar 1993: 44)

Fig. 5 Roman games in Spodnja Hajdina in the year 2014 (Photo M. Vomer Gojkovič)

by the company Gearh on a part of the territory where the archaeological park *Vicus Fortunae* is being planned (Mušič 2012).

The research was done in accordance with culture-preservation requirements set specifically for the area where the archaeological park is being planned. In compliance with the directives of culture-preservation requirements, more than just two land-plots meant for the park were researched. Due to the extreme importance of this archaeological site and despite insufficient research works in the past, the geophysical research took measurements in a dense net of parallel profiles using a georadar method, geoelectrical resistivity method and magnetic method.

The georadar method yielded very significant results on researched sites. Numerous strong signals were recorded as waves hit different remains from antiquity. Geoelectrical method of map drawing often showed almost identical results as the georadar method; however, at some sites the former significantly completed the latter. Due to the geoelectrical method a ground-plan of a bigger building was found.

Results of the geophysical research serve as a basis for further archaeological research of the area destined to become the archaeological park.

The continuation of the project is based on the research results. Once more the project will be submitted to an international call of proposals to obtain European funds with which the infrastructure would be built and the needed archaeological research could be carried out which represent the base for the functioning of a tourist-information centre in the archaeological park Vicus Fortunae.

PLANNED PARK ACTIVITIES

A disused farmhouse will be adapted to host the main office of the cultural-information centre with all the necessary equipment, a tourist-information office, exhibition grounds, a place for multivision, a classroom, a lavatory, a refreshment room.

Fig. 6 The Society of Women and Girls of the Hajdina Commune as participants of the Roman games 2014 (Photo M. Vomer Gojkovič)

Fig. 8 Participants of the Roman games (Photo M. Vomer Gojkovič)

We would like to attract into this project all local people interested in the heritage, as well as tourists. With the help of experts on the Roman provincial archaeology and on communicating heritage (museum experts, archaeologists, pedagogic workers), we shall be able to create thematic workshops and events with the goal to raise awareness about the heritage and its importance. All activities will be meant for all age groups. The programme will contain new ideas and programmes with the aim to promote Roman provincial and classic archaeology, as well as archaeological movable and unmovable heritage and its protection. Conceptually, the programme shall become a new centre of cultural and tourist development of the community of Hajdina.

The project foresees training workshops during which participants will gather some experience of how to disseminate their knowledge, and they will acquire some new skills. Five workshops are planned:

Roman pottery workshop during which the participants will make various earthenware products with the help of a potter. Finished products will be obtained by burning them in a Roman kiln reconstructed within the boundaries of the archaeological park Vicus Fortunae. At the end of the workshop, the participants will have to present their products in terms of a "museum" approach with the help of a museum-expert. At the same time, they will learn about the national legislation dealing with the preservation, protection and presentation of the archaeological cultural heritage.

Roman make-up and decoration workshop will introduce the creation of jewellery from different materials. During the workshop, a form of experimental archaeology will be used.

Amusement workshop aims to establish an intergeneration contact between children, adolescents, students and adults. Through this workshop, the participants will learn the basics of children's and other games (Fig 5).

Roman cuisine workshop is intended for all age groups. The participants will get to know the use of some herbs, spices and other ingredients needed in the preparation of Roman dishes, and the use of kitchen- and tableware. The Association of Women and Girls from Hajdina will participate in the workshop owing to their expertise in the Roman cuisine which they have been practising for some years now (Fig. 6, 7).

Fig. 7 Roman food (Photo M. Vomer Gojkovič)

Roman daily routine workshop aims to show Roman habits connected with the culture of dressing and everyday work. A form of experimental archaeology will be used during the workshop.

The educational programme planned for the workshops will help disseminate knowledge of the Roman heritage. Once this particular sort of knowledge will have been acquired, it will be possible to include certain activities into the yearly performance of Roman Games (Fig. 8, 9, 10). The Society for Roman History and Culture Ptuj Poetovio LXIX (online resource: http://www.rimskeigre.si/) has taken over the organisation of the Roman Games taking place in August each year. However, in the implementation

Fig. 9 Roman camp in Spodnja Hajdina 2014 (Photo M. Vomer Gojkovič)

of the Games are involved people from the wider area, from the museum to local people, from groups coming from all over Slovenia to more and more numerous international groups. Through active participation in the Roman Games, dozens of groups show their care and concern to revive the rich Roman history. The use of experimental method will help us draw the heritage nearer to the public, and will, at the same time, render the programme of the Games livelier.

Problems at the creation of the archaeological park *Vicus Fortunae*

Roman settlement of the contemporary cultural, political and economic site represents nowadays an unexploited advantage for a social and cultural development. The cooperation between institutions in charge of the presentation and marketing of the heritage is badly coordinated, which is largely detrimental to the promotion of cultural heritage. Because of this, monuments are often considered as an end in itself, are improperly marked and often devoid of any explanatory note; consequently the awareness about the importance of archaeological heritage among citizens and visitors is inadequate. Due to the insufficient education the general public cannot participate in the preservation of cultural heritage, and attempts of creativity inspired by the heritage are scarce.

Despite the existence of a Roman monument *in situ* in the area discussed, its promotion is far from being sufficient. Within the scope of the present project, this cultural site will be revived on the basis of Roman settlement. It is our sincere wish to create better conditions for the due recognition of this outstanding archaeological monument through the establishment of the archaeological park *Vicus Fortunae* and the implementation of the project content.

Fig. 10 Dancers in front of the Mithras Shrine I (Photo M. Vomer Gojkovič)

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REZIME

ARHEOLOŠKI PARK VICUS FORTUNAE – PROJEKTI I PROBLEMI

KLJUČNE REČI: SLOVENIJA, HAJDINA, KULTURNO NASLEĐE, ARHEOLOŠKI PARK VICUS FORTUNAE, AKTIVNOSTI, RADIONICE, PROBLEMI.

Kulturno nasleđe je jedan od najvažnijih elemenata našeg identiteta, dakle njena zaštita i obnova su od izuzetnog značaja, kao i promovisanje u javnosti u cilju podsticanja uspostavljanja identiteta i podsticanja kreativnosti inspirisanih u nasleđu. Projekat Arheološki park *Vicus Fortunae* zasnovan je na rimskoj provincijalnoj arheologiji i nasleđu iz rimskog doba.

Područje oko zajednice Hajdina, gde se planira park je dobro poznato iz različitih arheoloških perioda. Najvažniji je bio od 1. do 5. veka kada je ovo područje bilo sastavni deo rimskog agera sa gradom *Poetovio* (*Colonia Ulpia Traiana Poetovio*), čiji deo se tada zvalo *Vicus Fortunae*. Arheološki park je planiran na lokaciji koja je poznata po svom bogatom arheološkom kulturnom nasleđu. U prošlosti su ovde bili izvođeni istražni radovi koji su doneli zanimljive dokaze – u neposrednoj blizini otkrivena su dva hrama boga Mitre od kojih su ostaci prvog sačuvani na mestu otkrića, *in situ*, i biće sastavni deo budućeg arheološkog parka.

Kulturno nasleđe iz rimskog perioda je posebno bogato u pomenutom području. nekoliko rimskih spomenika predstavljeni su *in situ*, a sitni nalazi s toga područja mogu se videti u muzejima u Štajerskoj.

Rimsko naselje u savremenom kulturnom, političkom i ekonomskom okruženju predstavlja danas neiskorišćenu prednost za društveni i kulturni razvoj. Saradnja između institucija koje su zadužene za prezentaciju baštine su u začetku. Spomenici su nedovoljno obeleženi i često bez ikakvog obrazloženja; pa možemo reći da je svest o važnosti arheološkog nasleđa među građanima i posetiocima još uvek neadekvatna.

Mi bismo želeli da privučemo u ovom projektu sve ljude iz okoline koji su zainteresovani za nasleđe, kao i turiste. Uz pomoć stručnjaka (muzejski stručnjaci, arheolozi, pedagoški radnici), mi ćemo biti u stanju da stvorimo tematske radionice i događaje sa ciljem da se podigne svest o baštini i njenom značaju. Aktivnosti će biti namenjene svim starosnim grupama. Program će sadržati nove ideje i programe s ciljem da promoviše rimsku arheologiju, kao i arheološku baštinu i njenu zaštitu. Konceptualno, program Arheološkog parka *vicus Fortunae* će postati novi centar kulturnog i turističkog razvoja zajednice Hajdina.

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902:37.018.48
902:004
COBISS.SR-ID 219302924

Original research article
Received: May 26th 2015
Accepted: November 15th 2015

ARCHAEOLOGY AND LIFELONG LEARNING

ABSTRACT

We live in a world of technological innovations and it has never been easier to gain knowledge. New information technologies make it possible to always broaden our knowledge and enable us to use our advanced knowledge for an improved way of life. The concept of lifelong learning has a tendency to turn the modern society into an educated society – a society based on knowledge, actually a society that learns. All of the social sectors are included in these new tendencies of everyday learning and archaeology is no exception. Gaining knowledge from the field of archaeology by using new information technologies should especially be designed for children, students, the employed, senior citizens and scientist dealing with archaeological research.

KEYWORDS: ARCHAEOLOGY, LIFELONG LEARNING, EDUCATED SOCIETY, INFORMATION TECHNOLOGIES, LIFELONG EDUCATION.

INTRODUCTION[1]

Once, education was limited to primary and secondary schools, then choosing a profession, studying and gaining a diploma and finally working as an expert of the knowledge gained so far. Not long ago, learning could have been defined according to the institution in which the knowledge was gained (a specific school, faculty, specific town etc.) and according to the length i.e. the number of years spent in education. Today, such a concept is mostly outdated. Gaining knowledge, learning, is now defined as a process which continues throughout life. This is not a new idea, as it has been true since ancient times. Learning is a psychological process which normally appeals to all people of all ages and it does not stop after the completion of obligatory classical school education. On the contrary, after finishing classical education, it is necessary to continue learning in order to develop and upgrade the already existing knowledge.

The existence of personal computers and their wide use during the 1980's and 90's, the development of the web and its global usage during the 1990's changed the lives of people worldwide, therefore changing methods of learning.

1 The article results from the project: *IRS - Viminacium, Roman city and military legion camp – research of the material and non material culture of inhabitants by using the modern technologies of remote detection, geophysics, GIS, digitalisation and 3D visualisation* (*no 47018*), funded by the Ministry of Education, Science and Technological Development of the Republic of Serbia.

The accessibility of knowledge became global. People worldwide have an opportunity to access huge resources of knowledge in a fast, easy and cheap way, 24 hours a day. Archaeology needed to adjust to these changes and make it possible for everyone who wished, regardless of their previous knowledge level and their age, to gain new, or to broaden their already existing, education in archaeology.

LIFELONG LEARNING – THE TERM

In modern times, when success is measured with applied knowledge, one speaks more and more about the concept of lifelong learning and lifelong education. After the Second World War, these terms were applied in English language (Sharma 2002). The most common definitions which apply to lifelong learning are included in the documents of the European Commission[2] (European Commission 2001), UNESCO report[3] (Delors J. et al. 1996), Report of the Australian Department of Education[4] (Watson 2003) and the National Agency for Education, Stockholm[5] (Skolverket, 2000). Through the prism of these definitions it can be noticed that lifelong learning, in its widest sense, can be observed as a *concept of life* in which we always implement accessible, continuous, diverse and flexible *learning regardless of time and place, broadening our knowledge and skills*. This has a double benefit, on one hand it broadens our knowledge and skills necessary for employment and on the other hand, a person achieves personal fulfilment (personal specialisation). Therefore, learning does not stop at the end of school. Much scientific research shows that the human brain is capable of lifelong learning. Through a process called neuro-plasticism (Sprenger 1999), our brain is capable of changes, the restructuring and reorganisation of neural nets with the assistance of new inputs and experiences aimed at better adjusting to a new situation (ZIKZ 2014)[6].

The Japanese have a word describing lifelong improvement – "kaizen" (the word *kai* means change, while *zen* means good). This means that learning never ends (it takes place regardless of time and place), and it defines our development. As professionals, we continue learning only by broadening the process started at birth and continued through our schooling (Krasnic 2012). Lifelong learning is actually a continuous process which starts at birth and ends when we die.

According to Krasnic, lifelong learning has its necessities (Krasnic 2012):

- Keeping the brain stimulated during one's lifetime
- Rejecting old ways which have proven to lack results
- Accepting responsibility for one's success and changing what has proven useless in the sense of increasing success
- Remaining informed and engaged
- Becoming an independent thinker and taking on leadership roles
- Being inspired to produce new thoughts and ideas
- Transforming information into knowledge through learning
- Learning new skills for life

2 European Commission, "Making a European area of lifelong learning a reality", *http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2001:0678:FIN:EN:PDF*, 01.05.2015.

3 Jacques Delors, et al., "Learning: The treasure within Report to UNESCO of the International Commission on Education for the Twenty-first Century", *http://www.unesco.org/education/pdf/15_62.pdf*, 02.05.2015.

4 Louse Watson, *Lifelong learning in Australia*, Department of Education, Science and Training, Canberra, 2003.

5 Skolverket, "Lifelong Learning and Lifewide Learning", *http://www.skolverket.se/om-skolverket/publikationer/visa-enskild-publikation?_xurl_=http%3A%2F%2Fwww5.skolverket.se%2Fwtpub%2Fws%2Fskolbok%2Fwpubext%2Ftrycksak%2FBlob%2Fpdf638.pdf%3Fk%3D638*, 01.05.2015.

6 *http://www.zikz.hr/neuroplasti%C4%8Dnost-mozga-no6*, 01.05.2015.

Other theoreticians attempt to define what lifelong learning includes[7] (Sharma 2002):

- gathering, analyzing and organising information
- the exchange of ideas and information
- planning and organising knowledge resources
- understanding and designing knowledge systems
- solving problems
- using technology
- using mathematical models and technologies
- working with others

Lifelong learning involves continued learning and perfecting, its essence is reflected in upgrading formal methods of education, in the unification of all three ways of learning. Continued education possesses the most important role in educating adults, aimed directly at higher social productivity and faster and easier employment, although it is not only important from the employment point of view. Apart from the fact that we learn in order to work, in order to understand, in order to learn how to live together and in order to exist – lifelong learning is aimed at the complete corporal, spiritual, intellectual, emotional and moral development of each individual.

Today, each individual is expected to speak foreign languages, know how to use a computer, possess team-working skills, communication skills etc. The majority of adults, possessing only the knowledge, skills and competencies gained during their schooling, would not be able to gain employment at all**.**

The life of modern young people is characterised by changes of work locations, job changes in order to achieve better financial conditions, changeable working times, a huge number of meetings and business trips and working in the field. Within our schooling system, there is almost no possibility for students, during their time of study, to attend their lectures and simultaneously perform other tasks, either after the lectures or during weekends, therefore forcing them to choose between two opposing things: studying or working. In the future, this dilemma, either to study or to work, should not exist**.** Young people should be given an opportunity to both work and learn at the same time.

Due to challenges imposed by a modern, dynamic society, lifelong learning shows a tendency to transform such a society into a knowledgeable society.

ARCHAEOLOGY AND LIFELONG LEARNING

Technology plays a key role in lifelong learning. Owing to the development of the internet over the past twenty years and the influence it has had on transferring knowledge and education to people, it can be said that it represents a key component of lifelong learning. The internet has completely transformed the field of learning in all fields, including archaeology. Search engines such as Google[8] and Yahoo[9], online encyclopaedias like Wikipedia[10], content sharing sites like YouTube[11], the social networks of Facebook[12], Twitter[13], LinkedIn, etc[14] and a series of other technological achievements have had a huge influence on the methods of learning, communicating, co-operating and creating. The following table (Table 1) shows the most important knowledge sources.

Computer orientated education in the field of archaeology, with the help of multimedia, simulations, question bases, web sites, on-line courses, learning how to learn, educating educators, long-distance learning, learning at home, the re-

7 Shaloo Sharma, *Modern Methods of Liflong Learning and Distance Education*, New Delhi 2002, 45.

8 *https://www.google.rs*, 01.05.2015.

9 *https://www.yahoo.com*, 01.05.2015.

10 *https://www.wikipedia.org*, 01.05.2015.

11 *https://www.youtube.com*, 01.05.2015.

12 *https://www.facebook.com*, 01.05.2015.

13 *https://twitter.com*, 01.05.2015.

14 *https://www.linkedin.com*, 01.05.2015.

Information resources	
Books	e-books, traditional books, the Gutenberg1 project, Open Library2, Google books3
Traditional sources of information	radio, television, the press, magazines
People	teachers, professors, lecturers, experts in different fields, leaders in different fields, family, friends
Surrounding	environment
Accessibility of multimedia content	iTunes4, YouTube5, TED6, Learnoutloud7, Podcast directory8,
Social nets	Facebook9, Twitter10, LinkedIn11, MySpace12, Instagram13, Pinterest14, Google+15, Tumblr16…
Blogs	A huge number of different authors and themes, indexed blog content, comments and discussion groups
Mobile devices	lap-tops, tablets, mobile phones, smart watches
Schooling and courses	Primary, secondary and high education, traditional and online courses and certification
Search engines	Google, Yahoo, MSN, Lycos, Bing, Krstarica
Online encyclopedias	Wikipedia, Digitaluniverse17, Britannica18and others…
Open source initiatives	Open education consortium19, programs Xseries (EdX20, MitX21), Khanacademy22, Academicearth23, OpenYale24
Other sources of information	Internet forums, e-mail, mailing lists, RSS feeds, bulletin boards, newsgroups

Table 1:Knowledge sources

moval of barriers of physical distance and time-zones and the connection of education and work in the workplace, opens completely new dimensions of the understanding of lifelong learning and lifelong education. Gaining new knowledge in the field of archaeology must be studied separately with regard to children, students, working people, senior citizens and scientists - archaeologists.

Children and gaining knowledge in the field of archaeology

When it comes to educating the youngest, in "*Viminaciumu"* there is the "*Children's scientific camp",* aimed at children between the ages of 8 and 14 years, which has taken place every summer since 2013. A team of experts includes a psychologist in charge of a variety of games, a biologist who introduces the micro-world to the children, a physicist to introduce them to the macro-world and an archaeologist who reveals the secrets of archaeology. This team, co-operating with the "Centre for the promotion of Science", educates the children and teaches them how to become scientists.[15]

Students and gaining knowledge in the field of archaeology

We live in a world in which mobile communication devices have become dominant in the field of information exchange, while educational insti-

15 *http://viminacium.org.rs/arheoloski-park/programi-za-decu*, 01.05.2015.

tutions (schools and faculties) have slowly started to position themselves on mobile device platforms (tablets, smart phones). Gaining knowledge and learning with the help of mobile devices has become really simple. With the use of tablets or smart phones, teaching material is almost instantly accessible via the internet. This means that accessing educational material and other multimedia content necessary for learning is independent from the location of pupils and students.

This saves time and enables access to the necessary information at the same time.[16] In our country, applications like *ITAcademy*[17] contribute to this new way of learning and transfer of knowledge with the help of mobile communication devices. Consequently, an awareness has grown regarding the idea that, in the near future, schooling could be attended and even completed with the use of mobile communication devices.

Despite this, it is of importance to note that the transfer of knowledge in the form of the live words of a professor can not be excluded or completely replaced by anything. This remains an irreplaceable tool in a complex process of building and transferring knowledge since, only through direct interaction and discussion is it possible to critically gain knowledge, and which represents a bilateral process which includes both the professor and the student.

Working people and gaining knowledge in the field of archaeology

An example of the importance of continuous education for the employed is best illustrated with the fact that the state actively encourages the employed to engage in it. A good example can be found in the fields of public health and pharmacy, in which, though *Pravilnik o kontinuiranoj edukaciji zdravstvenih radnika (The rule book about the continued education of health workers)*, defines the renewing of their licences according to the number of collected points, either as lecturers or attendees. The idea is to demand continuous practical work and the improvement of the knowledge of the employed. It is extremely important, since certain therapeutic indications change or modify over time and some new, unwanted therapeutic effects may also appear in practice. A similar situation exists in archaeology – one should continuously follow which new methods are applied and in which way, while employed archaeologists need to be trained in these areas, in order to secure ongoing continuity in the education of archaeologists and to raise the quality of their work.

Concerning the protection of computer systems on archaeological sites, gaining knowledge regarding new malicious attack types is very important, in order to apply the appropriate initial responses to forensically relevant events (Korać 2013). In such a way, the acquired knowledge can offer additional help in the detection of cybercriminals. This can help to prevent potential damage and can offer useful information for preventive protection from future attacks on the information systems of archaeological sites of extreme importance (Korać 2014). Also, by learning from practical examples, and based on data collected by digital forensics, one can analyse the advantages and disadvantages of the applied protection and check the vulnerability of the adjusted configuration (Davidovac and Korać 2011).

Senior citizens and gaining knowledge in the field of archaeology

At the end of a professional career, life with its specificities goes on, while the search for new knowledge is made easier with information – communicational technologies which broaden the accessibility to new educational possibilities. A person's desire to broaden their knowledge is voluntary and directly proportional to their previous educational level. When it comes to lifelong learning, the focus of retired people cannot easily be systematised, but some of the most important fields are: archaeology, creative writing, history, astronomy, sport and its development, the history of art, philosophy, politics, film, psychology, first

16*http://www.b92.net/obrazovanje/vesti.php?yyyy=2014&nav_id=919756*, 01.05.2015.

17 *http://www.it-akademija.com/ITApp*, 01.05.2015.

aid and health and safety at work.

When it comes to the education of senior citizens, one of the examples of good practice is the archaeological site "*Viminacium*", which, with its science and research centre, is designed to offer and transfer multidisciplinary knowledge. People from both Serbia and abroad visit with the wish to become acquainted with the archaeology of this area and with modern research methods. Very often, Danube River cruises land in Kostolac, with visitors aged between 65 and 75, wishing to gain new knowledge. (Anđelković Grašar and Tapavički-Ilić 2013: 192, chart 3). In 2008, for the first time, in the science and research centre, the program "*Science for all"* (Ita. "*Scienza per tutti*") was organised, in co-operation with the Universities of Ancona and Bologna.

Scientists and gaining knowledge in the field of archaeology

Archaeologists performing research need to use new informational technologies more and more. Software platforms for performing active on-line presentations or seminars (*Yugma*[18]*, WebEx*[19]*, Skype*[20]*, Adobe Connect*[21]and others) have introduced many changes in the way in which scientific achievements are exchanged and transferred.[22] Technology has contributed to the fact that lectures, or the so-called web-conferences such as webinars[23], taking place in scientific-research centres, can be followed live or even actively participated in. Thus, technology has made a double benefit possible. First of all, professors from different countries (thousands of kilometres apart) can hold their seminars and engage in active discussions regarding scientific achievements without physical access which, additionally, affords large financial savings. In modern times, the presentation of archaeological results would be unimaginable without the use of the internet and web presentations. Introducing results of archaeological research to a domestic and foreign public represents an important part in the acquisition of new knowledge in this field. Expert publications, scientific and educational institutions and scientific conferences in the field of archaeology are all accessible to scientists from all over the world on a daily bases, allowing them to advance and broaden their knowledge.

CONCLUSION

Since we live in a world of technological innovations, learning has never been more accessible. Success comes to those who either fully accept and participate in lifelong learning or apply concepts of integration of knowledge and critical thinking in their lives. This is achieved through adjusting the way of thinking so that it becomes part of one's lifestyle. Archaeological knowledge represents an important segment of knowledge, helping people of all ages to become more complete, satisfied and happier individuals.

The famous Churchill sentence "*The empires of the future are the empires of the mind"* is dedicated to the ownership of ideas, whereby knowledge represents power. We can learn to be more educated. Many centuries ago, famous philosophers, such as Socrates and Confucius, considered the question of educational methods and their ideas continue to develop, given the ever growing role of informational technologies in education and learning and their accessibility. Lifelong learning is therefore of the utmost importance for career progression and professional and even personal improvement. By applying informational technologies, the possibilities for learning and applying knowledge have become limitlessly accessible.

18 *https://www.yugma.com*, 01.05.2015.

19 *http://www.webex.com*, 01.05.2015.

20 *http://www.skype.com/en*, 01.05.2015.

21 *http://www.adobe.com/products/adobeconnect.html*, 01.05.2015.

22 Spisak programskih platformi i njihova međusobna poređenja prikazana su tabelarno na sledećoj Internet adresi *http://en.wikipedia.org/wiki/Comparison_of_web_conferencing_software*, 02.05.2015.

23 *http://www.webinar.co.rs*, 01.05.2015.

This means that learning possibilities are accessible regardless of location, influencing all aspects of our lives – emotional, social, mental, physical and spiritual. Broadening and continuously gaining new knowledge in the field of archaeology is equally important at all ages and it is, therefore, necessary to offer adequate educational content to children, students, the employed, senior citizens and all those engaged in archaeological research.

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REZIME
ARHEOLOGIJA I DOŽIVOTNO UČENJE

KLJUČNE REČI: ARHEOLOGIJA, DOŽIVOTNO UČENJE, DRUŠTVO ZNANJA, INFORMACIONE TEHNOLOGIJE, DOŽIVOTNO OBRAZOVANJE.

Živimo u svetu tehnoloških inovacija, a sticanje znanja nikada nije bilo dostupnije. Nove informacione tehnologije nam omogućavaju da stalno unapređujemo naša znanja i omogućava-

ju nam da to unapređivanje znanja postane način našeg života. Koncept doživotnog obrazovanje ima tendenciju da savremeno društvo pretvori u društvo znanja – društvo zasnovano na znanju, odnosno, društvo koje uči. Sve društvene oblasti zahvaćene su novim tendencijama svakodnevnog proširivanja znanja, pa tako ni arheologija nije izuzetak. Sticanje znanja iz oblasti arheologije uz pomoć novih informacionih tehnologija trebalo bi da bude posebno prilagođeno deci, studentima, zaposlenima, osobama u starijoj životnoj dobi i naučnicima koji se bave arheološkim istraživanjima.

(Footnotes)

1 *https://www.gutenberg.org*, 01.05.2015.
2 *https://openlibrary.org*, 01.05.2015.
3 *http://books.google.com*, 01.05.2015.
4 *https://www.apple.com/itunes/podcasts*, 01.05.2015.
5 *https://www.youtube.com*, 01.05.2015.
6 *https://www.ted.com*, 01.05.2015.
7 *http://www.learnoutloud.com*, 01.05.2015.
8 *http://www.podcastdirectory.com*, 01.05.2015.
9 *https://www.facebook.com,* 01.05.2015.
10 *https://twitter.com,* 01.05.2015.
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13 *https://instagram.com,* 01.05.2015.
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15 *https://plus.google.com,* 01.05.2015.
16 *https://www.tumblr.com,* 01.05.2015.
17 *http://www.digitaluniverse.net*, 01.05.2015.
18 *http://www.britannica.com*, 01.05.2015.
19 *http://www.oeconsortium.org*, 01.05.2015.
20 *https://www.edx.org*, 01.05.2015.
21 *https://www.mitx.org*, 01.05.2015.
22 *https://www.khanacademy.org*, 01.05.2015.
23 *http://academicearth.org*, 01.05.2015.
24 *http://oyc.yale.edu*, 01.05.2015.

PRIKAZI - REVIEWS

AQUAE IASAE, NAJNOVEJŠE RIMSKE NAJDBE NA OBMOČJU VARAŽDINSKIH TOPLIC, Katalog izložbe, Cankarjev dom, Ljubljana, 21. maj – 26. oktobar 2014, urednica Nina Pirnat Spahič, tekstovi Dora Kušan Špalj i suradnici. Izdavač: Cankarjev dom Ljubljana i Arheološki muzej u Zagrebu. Knjiga sadrži 195 teksta (slovenski i engleski).

Emoni u čast Arheološki muzej u Zagrebu i Cankarjev dom u Ljubljani organizirali su izložbu *Aquae Iasae*. Povodom 2000 godina Emone u Ljubljani su predstavljena dugogodišnja istraživanja u Varaždinskim Toplicama, te predstavljeni najatraktivniji nalazi iz najnovijih istraživanja. Izložbu je popratio katalog koji će sad nakon završetka izložbe privlači pažnju arheološke javnosti, jer su u njemu po prvi puta objavljeni mnogi izuzetni do sad nepoznati nalazi iz najnovijih istraživanja ovog lokaliteta.

Uvodnu riječ ovog kataloga napisala je Nina Pirnat Spahič voditeljica izložbenog programa i pomoćnica dikretora kulturnog-umjetničkog programa Cankarjevog doma u Ljubljani, a predgovor Jacqueline Balen, ravnateljica arheološkog muzeja u Zagrebu. Kroz te tekstove saznajemo kako je došlo do organizacije ove izložbe u godini obilježavanja 2000 obljetnice Emone. Izložbom u Cankarjevom domu prikazali su se rezultati istraživanja Varaždinskih toplica koje je Arheološki muzej u Zagrebu započeo 1953. godine. Svojim značajem i bogatsvom nalaza Varaždinske Toplice privlače brojne znanstvenike kojima je otvoren put učenju o organizaciji arhitetkure rimskog kupališta, religiji i rimskoj i kršćanskoj, umjetnosti, kamenoklesarstvu, epigrafiji te svim drugim aspektima rimskog života.

U katalogu se nalazi devet poglavlja različitih autora te opširne kataloške jedinice. Napisan je dvojezično: na slovenskom i engleskom. U uvodu koji je napisala Dora Kušan Špalj, autorica izložbe, polako saznajemo o šesdeset godina istraživanja na tom lokalitetu. Prvu etapu istraživanja su vodili prof. Moarcel Gorenc, dr Branka Vikić-Belančić i Valerija Damevski u periodu 1953. do 1981. godine kada je otkriven forum i termalni kompleks, kip božice Minerve i druge slavne nalaze. Istraživanja su naglo prekinuta 1982. godine, te se nastavljaju pod vođstvom Dorice Nemeth-Ehrlich i Dore Kušan Špalj 1997. godine. Nakon toga do danas Varaždinske toplice se sustavno istražuju. Podigla se i svijest lokalne uprave o važnosti očuvanja lokaliteta, no i izvora koji i danas stanovnicima „život znači" zbog svojeg ljekovitog svojsta i uporabi u medicinsko-rehabilitacijskom centru. Primjena interdisciplinarnog pristupa koji je uz arheologe uključio hidrogeologe, geostatičare, konzervatore, restauratore, arhitekte i druge stručnjake pomogla je rješavanju nebrojenih poteškoća pri istraživanju izvora, uređenju i konzervaciji arheološkog parka i brojnim drugim koje izaziva ovaj izuzetno zahtjevni lokalitet. Izložbom i katalogom predstavljen je rezultati najnovijih istraživanja, provedenih od 2011. do 2013. godine, kada su pronađeni brojni natpisi, skulpture i reljefi te velika količina rimskog novca koji je od 1. do 4. st. ubacivan u „sveti izvor". Osim kamenih spomenika predstavljen je i ostali arheološki materijal (keramika, staklo, metal), ali i 3D rekonstrukcije kompleksa u raznim fazama izgradnje kao i samo arheološko istraživanje i konzervatorsko-restauratorski radovi provedeni na nalazima i na samom lokalitetu.

Autorice poglavlja Rimska naseobina *Aquae Iasae* – arheološki nalazi u mjesnom parku u Varaždinskim toplicama su Dorica Nemeth Ehrlich i Dora Kušan Špalj. Poglavlje je podijeljeno na četiri teme: Rimska naseobina *Aquae Iasae*, Kompleks rimske arhitekture u gradskom parku, Kupalište i bazilika, Svetište. Kroz te teme se upoznajemo s porijeklom imena *Aquae Iasae* koje nalazimo u panonskom plemenu Jasi, te o prvim nalazima 18. i 19. st. od kojih se ističe Konstantinov natpis o obnovi kupališta, reljef s tri Nimfe i drugi. Kupalište je istraživano dugi niz godina,

istraženo je oko 6000 m^2, no stvarni izgled i najstarije faze ustanovljene su tek u istraživanjima koja su započeta krajem devedestih godina. Najbolje je sačuvana faza iz vremena Konstantinove obnove termalnog kompleksa, zidovi su ponegdje sačuvani i do tri metra, a na mnogim dijelovima su sačuvane freske. Ovaj fenomen je nastao izijevanjem izvora s termalnom vodom, te su nastale debele naslage travertina pod kojim su se sačuvala povijest ovog lokaliteta.

Autorica slijedećih poglavlja je Dora Kušan Špalj kroz koje se predstavila povijest naseobine *Aquae Iasae*. Zatim, *Aquae Iasae* kao centar zdravlja, kulta i proročište sagledane su kroz tri teme: Kultovi u svetištu od 1. do 4. st., Nimfe, Klesarska proizvodnja obrtnička i umjetnička obrada kamena. Zadnje poglavlje koje potpisuje Dora Kušan Špalj bavi se rekonstrukcijom prostora oko prirodnog izvora termalne vode, rituali i upotreba.

Numizmatičke nalaze obradio je Tomislav Bilić, a Dunja Aljinović je obradila geološke izmjere oko termalnog izvora, kao i porijeklo građevinskog materijala.

Opsežan katalog predmeta izradile su Dora Kušan Špalj, Nikoleta Perok, Jacqueline Balen, Sunčica Habus, Miroslav Nađ i Tomislav Bilić.

Ovaj je katalog je svojim obujmom svakako zadovoljio znatiželju publike koja prati istraživanja Varažadinskih Toplica iz godine u godinu i koja donose iznimne rezultate bilo da je riječ o poznavanju rimske arhitekture, skulpture i drugih vrijednih nalaza. Katalog se ponajviše oslanja na interdisciplinaran pristup interpretaciji nalaza u suradnji s arheolozima, numizmatičarima i geolozima. Trodimenzionalne kompjuterske rekonstrukcije, danas već tradiocionalan arheološki pristup dokumentaciji, sastavni su dio istraživanja i prezentacije lokaliteta. Ovakvim sveobuhvatnim pristupom novopronađeni nalazi su predati znanosti na daljnje analize, nova razmišljanja te reviziju starih saznanja. Isto tako mogu biti podložni i znastvenoj kritici i recenziji koja će se u budućnosti svakako desiti, no kvaliteta objave je nesumljiva i omogućit će razvoj daljnjih proučavanja arhitekture, umjetnosti, epigrafije, sitnih nalaza i numizmatike rimske provincije Panonije.

Dojam koji se stiče čitanjem kataloga *Aquae Iasae* je da osim znanstvene, ima i kulturološku misiju jer svojim konceptom omogućava i široj publici pristup informacijama. Ovakvim pristupom dobili smo na uvid jedan važan lokalitet, ali i njegov smještaj u rimskoj provinciji. Isto tako saznajemo kako je lokalitet danas jednako živ i integriran u svakodnevnicu današnjih Varaždinskih Toplica.

I na kraju ćemo ponoviti riječi iz predgovora ravnateljice Arheološkog muzeja u Zagrebu „*Turbulentni povijesni događaji imali su različite utjecaje na stanovništvo, vojnike, državne službenike, trgovce i sve ostale koji su dolazili u lječilište u nadi da će im Izvor, Nimfe ili neko drugo božanstvo pomoći. Isjceliteljska moć termalnog izvora u koju stanovnici Varaždinskih Toplica vjeruju i danas i od koje žive privukla je osnivanje lječilišta i rimskog kupališta. Sasvim sigurno je poneki stanovnik Emone stigao u Aquae Issae poradi izlječenja te izložba u Cankarjevom domu u čast 2000 godina Emone na neki način čini zatvoreni krug.”* Izložbom i katalogom *Aquae Iasae* u sklopu velike obljetnice *Emone* dobili smo i novi doprinos u povijesti ovog iznimno važnog lokaliteta.

Ivana OŽANIĆ ROGULJIĆ

Gordana Gavrić, Mirko Kovačević, MANASTIR DRENČA OD RUŠEVINE DO HRAMA, Kraljevo 2015, Zavod za zaštitu spomenika kulture Kraljevo, 2015. Knjiga sadrži 227 strana teksta sa ilustrativnim materijalom, fotografije i crteži.

U izdanju Zavoda za zaštitu spomenika kulture Kraljevo u okviru edicije Kapitel, 2015. godine objavljena je knjiga *Manastir Drenča od ruševine do hrama.*

Autori ove monografije Gordana Gavrić i Mirko Kovačević veliki su poznavaoci srednjovekovne arheologije i arhitekture. Gordana Gavrić, arheolog Zavoda za zaštitu spomenika kulture u Kraljevu, rukovodilac je brojnih ranohrišćanskih i srednjovekovnih arheoloških iskopavanja i autor većeg broja članaka i monografskih izdanja posvećenih srednjovekovnoj arheologiji, arhitekturi i umetnosti.

Mirko Kovačević, arhitekta, profesor na Beogradskom univerzitetu, čiju oblast interesovanja predstavlja srednjovekovna sakralna i profana arhitektura, rukovodilac je brojnih konzervatorsko-restauratorskih projekata koji imaju za cilj očuvanje srednjovekovne baštine. Autor je brojnih radova u naučnim i stručnim časopisima i koautor nekoliko monografskih izdanja posvećenih arhitekturi srednjeg veka. Dobitnik je nekoliko nagrada za izuzetan doprinos u zaštiti graditeljskog nasleđa.

Monografija *Manastir Drenča od ruševine do hrama*, proistekla je iz višegodišnjih zaštitinih arheoloških iskopavnja i konzervatorsko-restauratorskih radova. Knjiga je dobro osmišljena sa jasnim i pregledno koncipiranim sadržajem, podeljenim u tri poglavlja. Pored uvodnog dela, u drugom poglavlju detaljno su obrađena arheološka iskopavanja, dok je treća celina posvećena arhitekturi i konzervatorsko restauratorskim radovima u okviru manastirskog kompleksa. Svako od ovih poglavlja sadrži više odeljaka koji odgovaraju pojedinačnim problemima o kojima se u knjizi raspravlja. Posebnu celinu čini katalog nalaza, koji je obradio Vojkan Milutinović. Završni deo monografije sadrži prilog Momira Vukadinovića u kojem su izneti rezultati istraživanja metodom geoelektričnog skeniranja. Pored zaključka na srpskom jeziku, knjiga sadrži i rezime na engleskom jeziku.

U uvodnom delu, autori nas upoznaju sa geografsko-istorijskim okvirom manastira Drenča uz prikaz spomeničkog nasleđa u okruženju. Detaljnim pregledom prošlosti oblasti u kojem je sagrađen manastir i otkrićima do kojih se došlo u okviru drugih istraživanja, dobili smo jasniju sliku na osnovu koje možemo naslućivati moguće razloge podizanja manastira u ovakvom geografskom i kulturnom prostoru. Poseban odeljak odnosi se na pomen manastira u istorijskim izvorima i istoriografskim radovima.

Poglavlje posvećeno arheološkim istraživanjima manastira Drenča, sadrži posebne odeljake posvećene istraživanjima crkve Vavedenja Presvete Bogorodice, nekropole i manastirskog konaka i porte. Arheološka građa dobijena višegodišnjim arheološkim iskopavanjima prikazana je sistematično i dokumentovano uz mnoštvo ilustrativnog materijala, crteža i fotografija, tehnički vrlo kvalitetno obrađenim. U okviru arheološkog materijala, kao posebna celina izdvaja se katalog arholoških nalaza koji je obradio Vojkan Milutinović.

Naredno poglavlje posvećeno arhitekturi manastira, autor Mirko Kovačević podelio je na nekoliko odeljaka koji su u skladu sa namerom autora da se očuvanjem autentičnih ostataka arhitekture crkve i pratećih objekata, stvore uslovi za obnovom manastirskog kompleksa. Nakon istorijata arhitektonskih istraživanja, sledi detaljan opis arhitekture i arhitektonske skulpture uz prezentovanje dokumentacionog materijala, crteža i fotografija zatečenog stanja. U trećem odeljku poglavlja posvećnom arhitekturi, autor nas upoznaje sa projetkom obnove manastirske crkve, da bi u završnom delu ovog poglavlja bili prikazani rezutlati konzervatorsko-restauratorskih radova celine manastira Drenče. Sledeći važan princip u zaštiti kulturnog nasleđa, vraćanje kultunog dobra u prvobitnu funkciju, nakon konzervatorsko-restauratorskih radova na arhitekturi hrama, urađen je projekat enterijera kako bi se obezbedili preduslovi za obnavljanje bogoslužbenog života.

Ovakvim sveobuhvatnim pristupom i temeljnom analizom arhitektonskih ostataka, uz prezentovanje rezultata višegodišnjih arheoloških istraživanja i konzervatorsko-restauratorskih radova kroz naučnu i stručnu literaturu, zaokružena je

celina i stvoreni su uslovi za oživljavanje manastirskog kompleksa i obnovu monaškog života. Danas je manastir Drenča, zahvaljujući izuztnom zalaganju autora ove knjige, revitalizovan kompleks u kome je formirano manastirsko sestrinstvo koje je nasledilo vrednosti stvorene nekoliko vekova ranije.

Na kraju treba istaći da je knjiga za naše prilike izuzetno tehnički opremljena sa velikim brojem arhitektonskih skica i kvalitetnim fotografijama u koloru, tako da može biti privlačna ne samo za stručnjake već i za širu čitalačku publiku.

Pominjući sva poglavlja u ovoj knjizi želeli smo da istaknemo širinu i značaj publikacije koja se pojavila i koja će po kvalitetu sadržaja nesumnjivo poslužiti kao pravi i nezaobilazni uzor za svaki budući rad u proučavanju arhitekture i pokušajima restauracije i revitalizacije srpskih srednjovekovnih manastira.

Olivera R. ILIĆ

GUIDELINES FOR SUBMITTING MANUSCRIPTS FOR THE PERIODICAL ARHEOLOGIJA I PRIRODNE NAUKE (ARCHAEOLOGY AND SCIENCE)

Editorial staff of the periodical *ARHEOLOGIJA I PRIRODNE NAUKE* decided to apply *Akta o uređivanju naučnih časopisa*[1] (Acta about editing scientific periodicals) proposed by the Ministry of Science and technological development of the Republic of Serbia. By applying these acta, complete editing of scientific periodicals is determined, quality of periodicals is promoted and their integration into the international system of exchanging academic information shall become more complete.

Papers submitted to the editorial staff of the periodical *ARHEOLOGIJA I PRIRODNE NAUKE* must be formed in a standard way. Each paper submitted has to contain: title; author's name; name of the institution (affiliation); abstract; key words; main text; resume; illustrations with captions; bibliography; contact address.

1. Titles need to be short and clear, describing content in the best possible way. Words used in titles should be apropriate for indexing and web-searching. If there are no such words withing titles, it is advised to add a subtitle. Titles are to be written in the fifth or sixth line, under the top margin, bold and with font size 14 (pts).

2. Author(s) should give their full name(s), including first name, surname and middle initial.

3. Autor(s) need to state official names and addresses of their employees, including names and addresses of employees which conducted research that lead to the results published. With complex institutions, complete title is to be named (ex.: Belgrade University, Faculty of Philisophy, Archaeological Department, Belgrade).

4. Abstract, consisting of 100-250 words, describes shortly content of the paper. Within abstracts, it is advised to use terms convenient for indexing and web-searching. Abstracts should offer data about aims, methods, results and conclusions of the research. Abstracts should be bilingual (in Serbian, English or some other foreign language). Abstracts in foreign languages need to be adequatly lectured, i.e. posses correct grammar and spelling.

5. Key words need to be terms which describe paper's content in a best way, suitable for indexing and web-searching. They should be named according to a widely accepted international source (lists, indexes, dictionary, thesaurus), like list of key-words Web of Science. The number of keywords should not exceed ten words.

6. The lenght of papers should not exceed 32 pages, DIN A4, including footnotes and illustrations. The main text should be written in Times New Roman or Arial (12 pts), MS Office Word 97 or later, line-spacing 1,5 and with margins 2,54 cm. Main text should not contain illustrations. They are to be submitted as separate files.

7. Apart from Serbian, manuscripts can be submitted in one of worldwide languages (English, German, French). Names of translators, if any, should be stated. Papers submitted should have an abstract and a resume written in some other language. If a paper is submitted in a language other than Serbian, there should be an abstract and a resume written in Serbian language. Words, quotations and titles written in some other language should be written in their original form.

Footnotes can be incorporated within the main text. They should contain less important data or apropriate explanations. They are not to be replaced with quoted literature. (An appendix to

1 Acta about editing scientific periodicals, proposed by the Ministry of Science and technological development of the Republic of Serbia, can be found at the following web-site: http://www.nauka.gov.rs/cir/images/stories/vesti/09-07-17/akt_o_uredjivanju-casopisa.pdf

these Instructions explains the way of quoting to be applied).

8. Abstracts should have the same content as resumes, only in an extended form, whose length is not exceeding 10% of the main text. It is very much desired to submit a resume in a structural form.

9. Illustrations (photographs, tables, drawings, graphs etc.) should be submitted in a proposed manner. Scanned illustrations should be submitted in a 600 dpi resolution, while photographs are to be submitted in a resolution of at least 300 dpi, in formats TIFF, PSD or JPG. Illustrations are to be submitted as separate files and should not be incorporated into the main text. Captions should be submitted bilingually (using the language in which the manuscript was written and in English or some other of the proposed languages).

10. Quoted literature should include bibliographic sources (articles, books etc.) and it should be submitted as a separate part of the manuscript, as a list of references. It is a part of every scientific article, with precisely named bibliographic references which were quoted. Bibliography should be written in a proposed manner, depending on standards precisely described in this instruction. Bibliography should be written using the language and alphabet in which it was originally published.

11. Bibliography's structural elements (author's name, title of work, source etc.) should be written according to standard forms of quoting. Editorial staff of the periodical *ARHEOLOGIJA I PRIRODNE NAUKE* accepted the reccomendation of the Ministry of science and technological development and decided that authors should precisely follow quotation rules named below.

The following examples describe the most frequently quoted kinds of references:

I BOOKS (MONOGRAPHS)

1. Author's books

a. single author

within main text: (Popović 2006)

in bibliography:

Surname, name's initial. Year of publishing *Title of book* (*italic*), Place: Editor.

Popović, I. 2006

Roma aeterna inter Savum et Danubium, Works of Roman Art from the Petrović-Vasić Collection, Belgrade: Archaeological Institute.

- Series' name and number is also needed:

Mirković, M. 1968

Rimski gradovi na Dunavu u Gornjoj Meziji, Dissertationes 6, Beograd: Arheološko društvo Jugoslavije.

Papazoglu, F.1969

Srednjobalkanska plemena u predrimsko doba (Tribali, Autarijati, Dardanci, Skordisci i Mezi), Djela 30, Centar za balkanološka ispitivanja 1, Sarajevo: Akademija nauka i umjetnosti Bosne i Hercegovine.

b. two or three authors

Between the names of the first and the second author, or the second and the third author,

"and" should be written, no matter what the main language of the publication.

within main text: (Popović i Borić-Brešković 1994)

in bibliography:

Popović, I. i Borić-Brešković B. 1994

Ostava iz Bele Reke, Arheološke monografije 7, Beograd: Narodni muzej.

Ivanišević, V., Kazanski, M. and Mastykova, A. 2006
Les necropoles de Viminacium a l'Epoque des Grandes Migrations, Monographies 22, Paris: Association des Amis du Centre d'Histoire et Civilisation de Byzance.

c. four or more authors

Books written by four or more authors, within the main text and in Serbian cyrillic, only the first name is written and **i dr.** is added. Books printed in Lati alphabet, the abbrevation ***et al.*** is applied. The abbrevation ***etc.*** is used in cases when there are more than three editors or places of editing.

2. Author's books with added name of the editor

within main text: (Jeremić 2009: 40)
in bibliography:
Jeremić, G. 2009
Saldum, Roman and Early Byzantine Fortification, S. Perić (ed.), Cahiers des Portes de Fer, Monographies 6, Belgrade: Institute of Archaeology.

3. Edited books (instead of the author – editor, translator) - (ed., eds.), (trans.).

within main text: (Поповић 1994)
in bibliography:
Поповић, И. (ур.) 1994
Античко сребро у Србији, Београд: Народни музеј.
within main text: (Morris 2002)
in bibliography:
Morris, I. (ed.) 2002
C*lassical Greece-Ancient Histories and Modern Archaeologies*, Cambridge: Cambridge University Press.
within main text: (Hurst and Owen 2005)
in bibliography:
Hurst, H. and Owen. S.(eds) 2005
Ancient Colonizations-Analogy, Similarity and Difference, London: Duckworth.
within main text: (Радојчић 1960)
in bibliography:
Радојчић, Н. (prev.) 1960
Законик цара Стефана Душана 1349. и 1354., Београд: Српска академија наука и уметности.

4.Way of quoting books without author's name

within main text: (Anon. 1985)
in bibliography:
Anon. 1985
Anonymi Peri strategias, The Anonymous Byzantine Treatise on Strategy, *Three Byzantine Military Treatise* (trans. G.T. Dennis), Washington DC.

5. Simultaneous quoting of several books of the same author

a. written in different alphabets

within main text: (Поповић 2002, Popović 2006)
in bibliography:
Поповић, И. 2002
Накит са Јухора, остава или сакрални тезаурус, Археолошке монографије 14, Посебна издања 36, Београд: Народни музеј и Археолошки институт.
Popović, I. 2006
Roma Aeterna inter Savum et Danubium, Works of Roman Art from the Petrović-Vasić Collection, Belgrade: Archaeological Institute.

b. written in the same year

within main text: (Dawkins 1996a, Dawkins 1996b)
in bibliography:
Dawkins, R. 1996a
Climbing Mount Improbale, London: Viking.
Dawkins, R. 1996b
River out of Eden, London: Pfoenix.

6. Quoting chapters in books (acta)

within main text: (Петровић 1997: 87-90)
in bibliography:
Петровић, Б. 1997
Накит, у: *Античка бронза Сингидунума,* С. Крунић (ур.), Београд: Музеј града, 85-117.

within main text: (Samson 1970: 44-68)

in bibliography:
Samson, C. 1970
Problems of information studies in history, in: *Humanities information research*, S. Stone, (ed.), Sheffield: CRUS, 44-68.

7. Translated books
in bibliography:
Bajron, DŽ. G. 2005 (1812)
Čajld Harold, Z. Paunović (predgovor), N. Tučev (prevod), Beograd: Zavod za udžbenike i nastavna sredstva.

8. Books and articles published in electronic form
within main text: (Fishman 2005: 11)
in bibliography:
Fishman, R. 2005
The rise and fall of suburbia, [e-book], Chester: Casle Press. Available through Anglia Ruskin University Library. http://libweb.anglia.ac.uk>[pristupljeno 5 juna 2005].

II PAPERS PUBLISHED IN PERIODICALS, CONGRESS ACTA AND SIMILAR

within main text: (Vasić 2008: 69, fig.3)
in bibliography:
Surname, name's initial. Year
Title, *Title of the acta (italic)*, Name's initial. Surname, (ed.), Place of editing: Editor, page numbers.

Vasić, M. 2006. Stibadium in Romuliana and Mediana. *Felix Romvliana 50 years of archaeological excavations.* M**.** Vasić (ed.). October, 27-29 2003, Zaječar, Serbia. Belgrade: Institut of Arhcaeology, Committee on Archaeology of Serbian Academy of Sciences and Arts, and Zaječar: National Museum, 69-75.

Series' data are also needed:

Петровић, П. 1997
Римљани на Тимоку, у: *Археологија источне Србије* (Научни скуп Археологија источне Србије, Београд-Доњи Милановац, децембар 1995*)*, М. Лазић (ур.), Центар за археолошка истраживања 18, Београд: Филозофски факултет, 115-131.

III PERIODICALS

within main text: (Бајаловић-Хаџи-Пешић, 2001: 108)

Surname, Name's initial. Year
Title, *Name of the periodical (italic*) number of the periodical: page number.

Бајаловић-Хаџи-Пешић, М. 2001, Налази хабанске и постхабанске керамике у Србији, *Годишњак града Београда* 47-48 (2000-2001): 107–121.
- For periodicals with similar titles, behind the name of the periodical, place of publishing should be stated in brackets:
Анђелковић, Б. 1988
Праисторијски налази са локалитета Јелица-Градина, *Зборник радова Народног музеја* (Чачак) 18: 81–85.
Анђелковић, Б. 1994
Први резултати анализе мумије из Народног музеја у Београду, *Зборник Народног музеја* (Београд) 15-1: 153–159.

- Depending on the year of publishing *Старинар* is named in its full title:
years 1884-1895 *Старинар Српског археолошког друштва*
years 1906-1914 [novog reda] *Старинар* (н.р.)
years 1922-1942 [treća serija] *Старинар* (т.с.)
years 1950-2010 [nova serija] *Старинар* (н.с.)

- If there is a difference between the year of actual printing and the year of publishing, the second is stated in brackets:
Жеравица, З., и Жеравица, Л. 1979, Средњовековно насеље у Поповици код Неготина, *Старинар* (н.с.) XXVIII-XXIX, (1977-1978): 201–211.

IV PAPER IN PRINT / FORTHCOMING

- (in print), within papers written in English (in print)
- (forthcoming), within papers written in English (forthcoming).

within main text: (Јовановић, in print)
in bibliography:
Јовановић, А. (in print)
Бор и околина у античком периоду, у: *Бор и околина у праисторији, антици и средњем веку*, ур. М. Лазић, Бор и Београд: Музеј рударства и металургије и Филозофски факултет.

Papers overtaken from the internet, from electronic periodicals, are quoted in the same way as printed papers, only there is a full web-address written at the end with http://...

V DOCTORAL AND MASTER THESES

Instead of place of editing and editor, the full name of faculty/university is given, where the thesis was conducted.
within main text: (Ilić, 2005)
in bibliography:
Ilić, O. 2005
Ranohrišćanski pokretni nalazi na području dijeceze Dakije od IV do početka VII veka, Magistarska teza, Filozofski fakultet, Univerzitet u Beogradu.

within main text: (Patch, 1991)
in bibliography:
Patch, D. C. 1991
The Origin and Early Development of Urbanism in Ancient Egypt: A regional Study, Ph.D thesis, University of Pennsylvania.

VI ARTICLES FROM NEWSPAPERS

within main text: (Кашанин, 1929)
in bibliography:
Кашанин, М. 1929, Музеј савремене уметности, *Политика, 23. јул, 7-8.*

MAIN TEXT

Quoting bibliography in the main text according to the pattern (author's surname and year: page number, footnote, figure, table):
(Papazoglu 1969: 52, sl. 4/1, T. 18-4-6)
(Babović 1984: 68; Moritz 1978: 68, figs. 40-41; Tasić 1997: 84, sl. 21)
- Additional data within brackets can be written after a dash:
(Swoboda-Milanović 1958: 55, Taf. 18/24 – olovne pločice).
- The same work of the same author in the next quotation can be quoted abbrevated *ibidem* (*ibid.*: page number).
- The second work of the same author in the next quoting, if there are no quotations in between, is quoted as (*idem* year: page number): (Faltings 1998a: 367; *idem* 1998b: 31–32).
- In papers written in Serbian language, the transcribed exact pronounciation of a foreign author's name is written within the main text, without brackets, but the original name is written in quotation: ...Vencel (Wenzel 1965: T. HS/4).
- If the author, work and page number are the same as in the previous quotation, they are quoted as *loc. cit.* (lat. *loco citato)* – quoted place.
- Abbrevation *cf.* (lat. *confer*) - compare
- Abbrevation *e.g.* (lat. *exempli gratia*) - for ex-

ample
- Abbrevation *i.e.* (lat. *id est*) - actually.

12. All of the quoted referrences are listed after alphabetic order, if written in English or some other foreign language, initial's order withing author's surname or the initial letter within the quoted title (if the author or editor are not stated).

SUBMITTING PAPERS

13. While submitting, the author should write his/her full contact address in a separate file: address of the institution and e-mail address. If there are several authors, only the contact address of the first author should be written. Author is also obligated to name title and code of the project, i.e. name of the programme under which the artice came to being, as well as the name of the institution which financed the project.

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Editorial staff of
ARCHAEOLOGY AND SCIENCE
ARHEOLOGIJA I PRIRODNE NAUKE

CIP - Katalogizacija u publikaciji
Narodna biblioteka Srbije, Beograd

902/904

ARHEOLOGIJA i prirodne nauke =
Archaeology and Science / glavni i odgovorni
urednik Miomir Korać. - 2014, No. 10-
Beograd : Centar za nove tehnologije :
Arheološki institut, 2015- (Beograd :
DigitalArt). - 28 cm

ISSN 1452-7448 = Arheologija i prirodne
nauke
COBISS.SR-ID 136747788