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SOMMAIRE – CONTENTS – INHALT

STUDIES

FLORIN GOGÂLTAN
Ritual Aspects of the Bronze Age Tell-Settlements in the Carpathian Basin. A Methodological Approach 7

ALEXANDRA GĂVAN
Metallurgy and Bronze Age Tell-Settlements from Western Romania (I) 57

DÁVID PETRUŢ
Everyday Life in the Research Concerning the Roman Army in the Western European Part of the Empire and the Province of Dacia. 91

CORIOLAN HORAŢIU OPREANU
From *"στρατόπεδον"* to Colonia Dacica Sarmizegetusa. A File of the Problem. 113

CĂLIN COSMA
Ethnische und politische Gegebenheiten im Westen und Nordwesten Rumäniens im 8.–10. Jh. n.Chr. 137

ARCHAEOLOGICAL AND EPIGRAPHICAL NOTES

AUREL RUSTOIU
Commentaria Archaeologica et Historica (I) 159

VITALIE BÂRCĂ
Some Remarks on Metal Cups with Zoomorphic Handles in the Sarmatian Environment. 185

FLORIN FODOREAN
"Spa" Vignettes in *Tabula Peutingeriana*. Travelling *Ad Aquas*: thermal Water Resources in Roman Dacia. 211

DAN AUGUSTIN DEAC
Note on Apis Bull Representations in Roman Dacia 223

SILVIA MUSTAŢĂ, SORIN COCIŞ, VALENTIN VOIŞIAN
Instrumentum Balnei from Roman Napoca. Two Iron Vessels Discovered on the Site from Victor Deleu Street 235

IOAN STANCIU
About the Use of the So-Called Clay "Breadcakes" in the Milieu of the Early Slav Settlements (6th–7th Centuries). 253

DAN BĂCUEŢ-CRIȘAN
Contributions to the Study of Elites and Power Centers in Transylvania during the second Half of the 9th – first Half of the 10th Centuries. Proposal of Identification Criteria Based on archaeological Discoveries 279

ADRIANA ISAC, ERWIN GÁLL, SZILÁRD GÁL
A 12th Century Cemetery Fragment from Gilău (Cluj County) (Germ.: Julmarkt; Hung.: Gyalu) 301

ADRIAN ANDREI RUSU
Stove Tiles with the Royal Coat of Arms of King Matthias I Corvinus 313

REVIEWS

IULIAN MOGA, *Culte solare şi lunare în Asia Mică în timpul Principatului/Solar and Lunar Cults in Asia Minor in the Age of the Principate*, Editura Universităţii "Alexandru Ioan Cuza" Iași (Iași 2011), 752 p. (Szabó Csaba) 327

DAN GH. TEODOR, *Un centru meșteșugăresc din evul mediu timpuriu. Cercetările arheologice de la Lozna-Botoșani/An Artisan centre from the Early Middle Ages. The archaeological research from Lozna-Botoșani*, Bibliotheca Archaeologica Moldaviae XV, Academia Română – Filiala Iași, Institutul de Arheologie, Editura Istros (Brăila 2011), 200 p. (including 118 figures), abstract and list of figures in French (Ioan Stanciu) 331

CĂLIN COSMA, *Funerary Pottery in Transylvania of the 7th–10th Centuries*, Series Ethnic and Cultural Interferences in the 1st Millenium B.C. to the 1st Millenium AD. 18, Romanian Academy – Institute of Archaeology and Art History Cluj-Napoca, Mega Publishing House (Cluj-Napoca 2011), 183 p., 49 plates (Aurel Dragotă) 339

RESEARCH PROJECTS

Crossing the Boundaries. Remodeling Cultural Identities at the End of Antiquity in Central and Eastern Europe. A Case Study (Coriolan H. Oprean, Vlad-Andrei Lăzărescu) 343

Warriors and military retainers in Transylvania of the 7th–9th centuries (Călin Cosma) 349

Seeing the Unseen. Landscape Archaeology on the Northern Frontier of the Roman Empire at Porolissvm (Romania) (Coriolan H. Oprean, Vlad-Andrei Lăzărescu) 352

Abbreviations that can not be found in Bericht der Römisch-Germanische Kommission 363

Guidelines for "Ephemeris Napocensis" 366

METALLURGY AND BRONZE AGE TELL-SETTLEMENTS FROM WESTERN ROMANIA (I)*

Alexandra Găvan[1]

Abstract: *This paper focuses on evidence attesting melting and casting activities at tell settlements from Western Romania, the easternmost area of Bronze Age tells distribution within the Carpathian Basin. The analysis is based on a catalogue of finds generally associated with metalworking uncovered inside these sites. The question of available copper ore deposits in the region is also addressed. By comparing the amount of metalworking-related artefacts unearthed inside and outside the tells, an attempt is made to identify the role that tell settlements played in the metallurgical production of the region during the Early and Middle Bronze Age. Another aim of the inquiry is to trace possible workshops inside the tell settlements, and the type of finished metal objects manufactured in the tells from Western Romania.*

Keywords: *Early and Middle Bronze Age, Carpathian Basin, bronze industry, casting moulds, metal-working sites*

Introduction

The landscape of the Carpathian Basin was marked at the beginning of the Bronze Age by the re-emergence of tell settlements[2]. The tells differ visibly from the rest of contemporary settlements both in terms of architectural building patterns and thickness of the occupation debris resulted from long-term inhabitation of the same area. The central function of tell settlements has been repeatedly highlighted[3], tell sites being conferred the highest position in the settlement system of the Carpathian Basin[4] and the role of centres of production, redistribution and trade, chiefly residences of the Early and Middle Bronze Age elites[5]. Furthermore, various

* This work constitutes a part of my PhD research intitled *Metallurgy in the Bronze Age tell settlements from the Carpathian Basin* and was supported by the European Social Fund in Romania, under the responsibility of the Managing Authority for the Sectoral Operational Programme for Human Resources Development 2007–2013 [grant POSDRU/107/1.5/S/78342]. I would like to thank Dr. Florin Gogâltan, Dr. Nikolaus Boroffka, and Dr. Tudor Soroceanu for their important comments on an earlier draft of this paper.

1 "Alexandru Ioan Cuza University", Bulevardul Carol I 11, 700506, Iaşi, Iaşi county, RO: alexandra.gavan@gmail.com

2 Tells have been known in this area also during Neolitihic, see GOGÂLTAN 2003.

3 VLADÁR 1973, 288–293; JOCKENHÖVEL 1990, 215; HARDING 1996, 254; HÄNSEL 1996, 244–245; KRISTIANSEN 1998, 412; HÄNSEL 2003, 208–209; UHNÉR 2005, 745.

4 GOGÂLTAN 2005b, 38; see also GOGÂLTAN 2010; for a different opinion regarding the existence of a proper settlement hierarchy in the Berettyó river valley during the Middle Bronze Age see DANI/FISCHL 2009, 114.

5 KRISTIANSEN 1998, 371, 374; KRISTIANSEN 2000, 9; DANI 2009, 21; for a different view regarding the organization of craft production, especially metallurgy, during the Early Bronze Age see KIENLIN 2007, 13–18; also for a different interpretation of the Bronze Age tells from the Carpathian Basin see KIENLIN 2012.

papers have been dedicated to the study of the tells' inner architecture[6], the functions they fulfilled[7], their chronology[8] and fortification systems[9].

However, there is no comprehensive research discussing all finds related to the metallurgy of Bronze Age tells from the Carpathian Basin, although matters related to this topic have been touched upon in various studies[10]. A research addressing this subject could lead to a better understanding of aspects related to the social and economic functions of the tell settlements, as well as the role metallurgy played in the economy of these sites. The central role assigned to tells should also be tested by analyzing their metallurgy. A series of moulds, clay tuyères, but also semi-finished objects and metalworking tools were uncovered inside tell-settlements, thus certifying bronze production activities in the settlement area. What is not known is the exact intensity of these activities for each and every site.

This paper is a case study of the metallurgy of tell-settlements from Western Romania, the easternmost area of Bronze Age tells distribution within the Carpathian Basin[11]. The analysis is focused on identifying, based on already published finds, all artefacts related to melting and casting activities (moulds, clay tuyères and casting waste) uncovered inside these sites. In order to facilitate text comprehension, the objects related to the metallurgy of the Western Romanian tells will be presented at the end of this paper in a catalogue of finds[12].

Terminology and chronological framework

There are some terminological issues that have to be pointed out before proceeding to the study of metallurgy inside tell-settlements. In this paper, the term "tell" was used according to the definition set forth by Fl. Gogâltan, who addressed the subject of Bronze Age tells from the Carpathian Basin in various papers[13], dedicating a study to terminological problems[14]. Defining tells as "multi-layered settlements that appeared in a specific geographical area as a consequence of a favourable environment [...] created through the successive accumulation of debris from large surface constructions made of clay and having a wooden structure"[15], Fl. Gogâltan identified 188[16] such Bronze Age settlements in the Carpathian Basin (Fig. 1), 44 of which are located on Romania's current territory. In only 10 cases objects related to metalworking were uncovered (Fig. 2). These constitute the basis for our catalogue of finds regarding the metallurgy of tell-settlements from Western Romania.

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6 CSÁNYI/TÁRNOKI 1992.

7 GOGÂLTAN 2005b.

8 GOGÂLTAN 2005a.

9 GOGÂLTAN 2008.

10 See for example MOZOLICS 1967; HÄNSEL 1968; KALICZ 1968, 162–164; BÓNA 1975, 256, 271–297; BADER 1978, 81–108; MOZSOLICS 1988; BARTÍK 1999; GOGÂLTAN 1999; DAVID 2002; HORVÁTH 2004; ILON 2006; NÉMETI/MOLNÁR 2007; BÁTORA 2009; MOLNÁR 2011. A series of moulds uncovered in tell settlements have been published or discussed in the PBF series – see for example NOVOTNÁ 1970, VULPE 1970, VLADÁR 1974, VULPE 1975, FURMÁNEK 1980, NOVOTNÁ 1980.

11 The paper was conceived as a first step in the analysis of the metallurgy of Bronze Age tell settlements from the Carpathian Basin. The present study is focused on the analysis of finds indicating an indigenous bronze production, therefore aspects related to typology will not be addresed. A typo-chronological examination of the tells' bronze industry will be made in a following contribution.

12 Therefore, references will be made hereinafter to the number the site under discussion was ascribed in the catalogue in order to provide the reader with details about the finds uncovered in the respective tell settlement.

13 GOGÂLTAN 2003; GOGÂLTAN 2005a; GOGÂLTAN 2005b; GOGÂLTAN 2008; GOGÂLTAN 2010.

14 GOGÂLTAN 2002.

15 GOGÂLTAN 2002, 23.

16 GOGÂLTAN 2005a, 161.

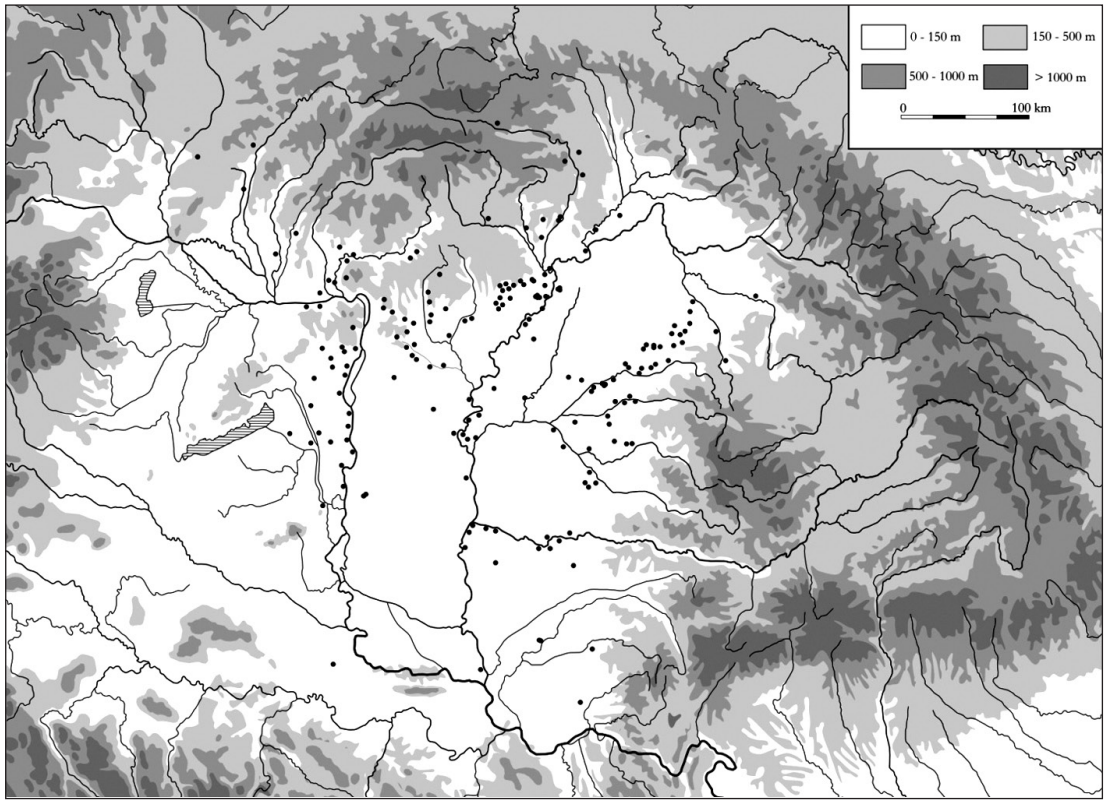

Fig. 1. Bronze Age tell settlements from the Carpathian Basin (after GOGÂLTAN 2005a)

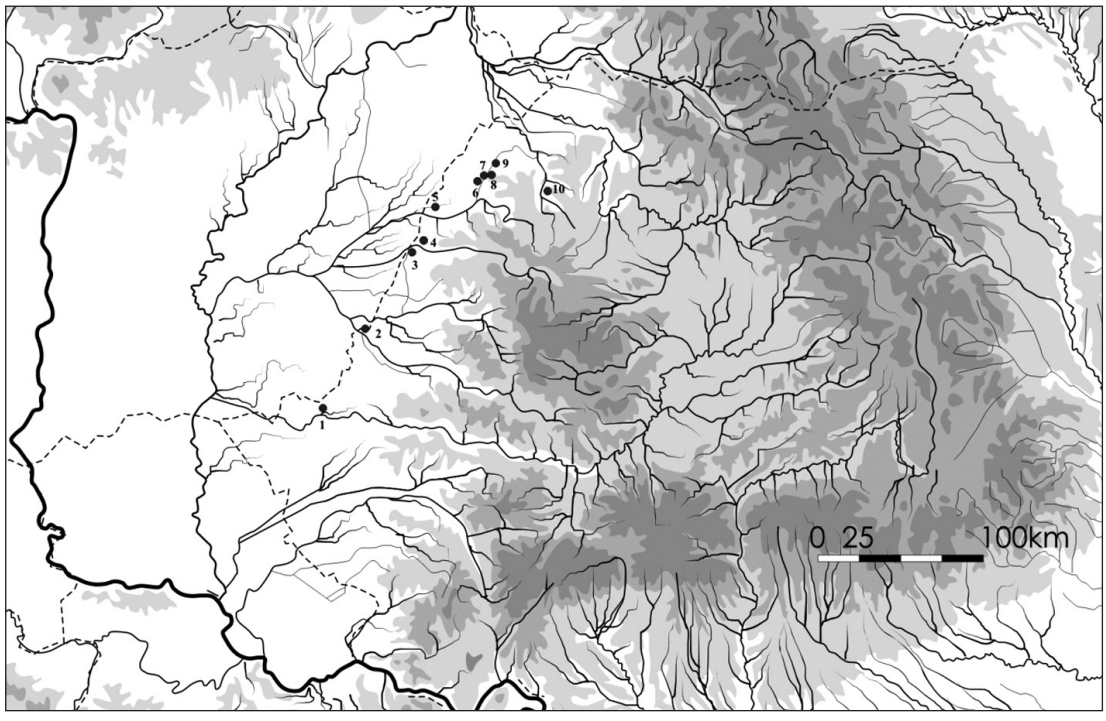

Fig. 2. Map of the Western Romanian tells with artefacts related to metalworking: 1. Pecica–"Şanţul Mare"; 2. Vărşand–"Movila dintre vii"; 3. Girişu de Criş–"Alceu"; 4. Sântion–"Dealul Mănăstirii"; 5. Roşiori–"La sere"; 6. Otomani–"Cetatea de pământ"; 7. Sălacea–"Dealul Vida"; 8. Pir–„Cetate"; 9. Dindeşti–"Cetate"; 10. Derşida–"Dealul lui Balotă".

The development of the Bronze Age tell settlements from the Carpathian Basin spans from the beginning of the Early Bronze Age to the end of Middle Bronze Age, when most of the tells were abandoned. In absolute chronology this period could be dated around 2500–1500 BC[17]. The chronological system used in this paper is the one advanced by Fl. Gogâltan, due to the fact that it accounts for both the evolution of metal artefacts and the stratigraphy of the Bronze Age tells from the Carpathian Basin[18].

Natural occurrence of copper in Western Romania

An essential preliminary to the study of Bronze Age metallurgy in Western Romania is a distribution map of copper-bearing deposits available in the region (Fig. 3). Although there are many references in the Bronze Age literature to Romania's mineral abundance, many of the studies on Bronze Age metallurgy in this region focused more on chronological and typological aspects of the bronze artefacts and less on trying to link the objects with the ore deposits[19]. Nevertheless, it is also important to know the areas rich in copper deposits in order to obtain even a partial picture of the natural resources available to the Bronze Age smiths.

Magmatic origin sources are prevalent in Romania, their regional distribution being tightly bound to mountain ranges. Thus, important copper-bearing deposits can be encountered in the Apuseni Mountains, at the northern border of the Eastern Carpathians[20], in the Banatului and Poiana Ruscă Mountains[21]. According to A. Sherrat, from the point of view of distribution, Romania's ore deposits can be classified in two groups: a South-Western group (ranging from the Iron Gates to the Metaliferi Mountains) where the highest concentrations are to be found, its resources having most likely been used in 4000–3000 B.C., and a North-Eastern group (eastwards of Baia Mare) that is believed to having supported the metallurgical development starting with the onset of the Bronze Age, the researcher connecting the exploitation of these resources with the Otomani communities[22].

A comprehensive research gathering all available data traditionally linked to prehistoric exploitation of mineral resources from Romania was carried out by N. Boroffka. Boroffka pursued both direct (discovery of prehistoric objects at the exploitation site) and indirect evidence (distribution of grooved hammer stones, thought to be used in mining)[23]. The nearest copper and gold-bearing deposits to the here-studied archaeological sites where prehistoric mining tools were found are: Cornea (Caraş-Severin county), Brad, Căraciu (Hunedoara county), Almaşu Mare (Alba county) and Satu Mare (Satu Mare county); however, the uncovered tools cannot

[17] GOGÂLTAN 2005a, 161–173.

[18] GOGÂLTAN 1999, 71–78; GOGÂLTAN 2005a, Fig. 2. Gogâltan divides the Early, as well as the Middle Bronze Age in three stages, setting the onset of the Early Bronze Age around 2500 B.C., while its substage Early Bronze Age IIb would correspond to the recently defined "Reinecke A0" stage from the Central European chronology. Gogâltan's Early Bronze Age III is contemporary with the central European Reinecke A1 stage (except for its end period). As for the Middle Bronze Age, its first phase represents the period prior to the appearance of the Hajdúsámson-Apa horizon (the B III stage in A. Mozsolics' chronology – see MOZSOLICS 1967, 121–123) and it corresponds to the end phase of Reinecke A1. According to Gogâltan, the Middle Bronze Age II is characterized by the bronze industry of the Hajdúsámson-Apa horizon and the gold artefacts belonging to the Ţufalău Type (MOZSOLICS 1968, 38–46) and is contemporary with Reinecke A2 (1900–1650 BC). Characteristic of the Middle Bronze Age III is the bronze industry of the Koszider horizon (dated by I. Bóna at the end of the Hungarian Middle Bronze Age – BÓNA 1958), this stage being contemporary with a part of Reinecke A3 and Reinecke B1 periods of the central European chronology.

[19] For the research history regarding this topic, with a detailed presentation of the state of research regarding mining traces and possible ore exploitation in prehistory see BOROFFKA 2009, 119–124.

[20] See KACSÓ 2009, 348–350, Fig. 1.

[21] LAZAROVICI/POP/BEŞLIU/OLARIU 1995, 214–217, Fig. 2.

[22] SHERRAT 1997, 121.

[23] BOROFFKA 2006, 71–76; see also BOROFFKA 2009, 118–129, Fig. 1, 4.

be dated with certainty[24]. Native copper deposits have been identified in more than 20 areas in the country[25]. Tin is also known from several deposits around the country at Băile Borşa (Maramureş county), Bocşa (Caraş Severin county), Bucuresci, Hondol (Hunedoara county), Ilba (Maramureş county) and Valea lui Stan (Vâlcea county)[26].

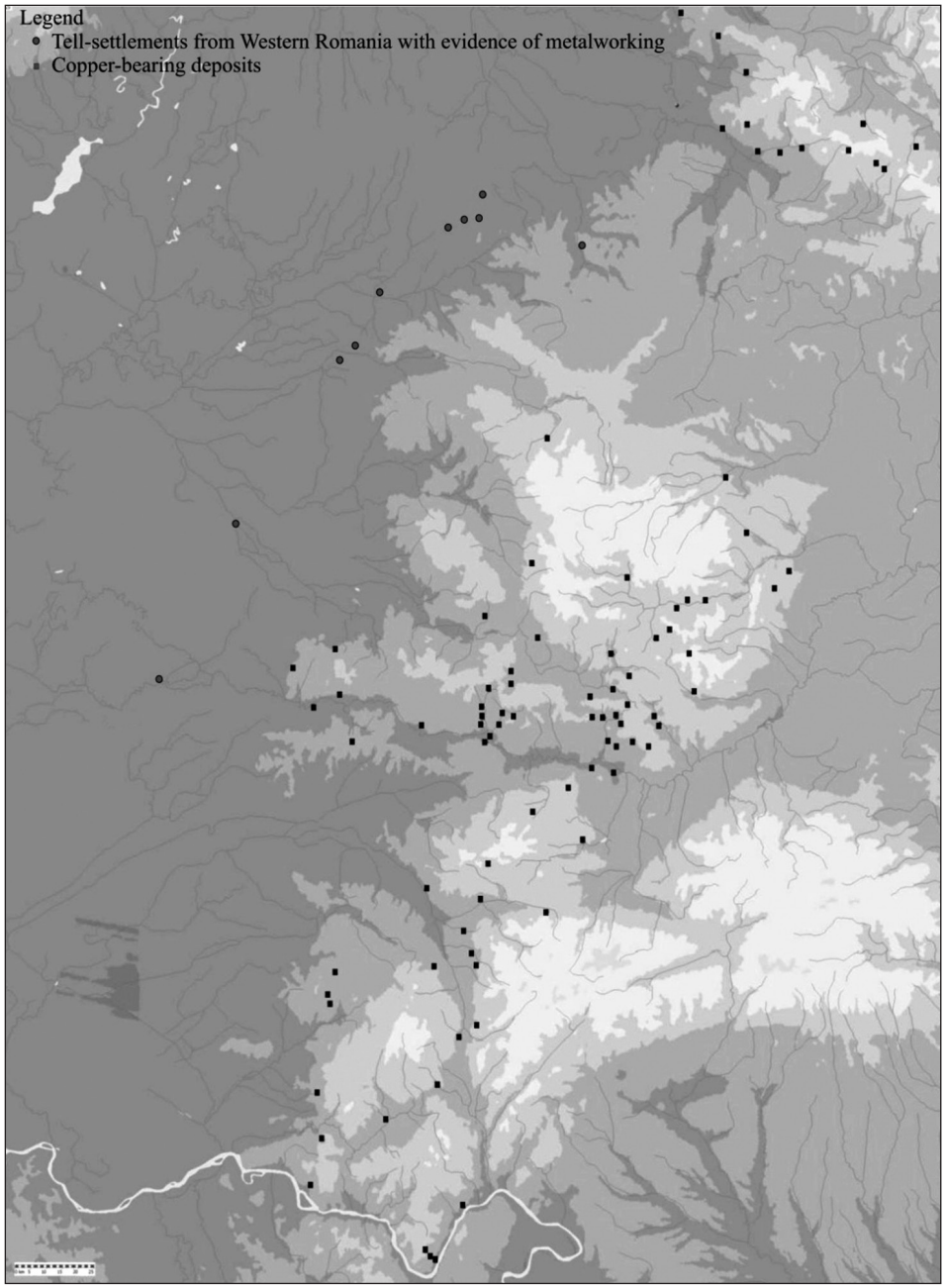

Fig. 3. Copper ore deposits in the vicinity of tell-settlements. Data from RĂDULESCU/DIMITRESCU 1966.

[24] BOROFFKA 2009, 126–128, Fig. 4.

[25] A list of native copper deposits in Romania can be found at RĂDULESCU/DIMITRESCU 1966, 119–120; see also LAZAROVICI/POP/BEŞLIU/OLARIU 1995, Fig 2; a list of copper minerals from Transylvania, compiled from the data published by RĂDULESCU/DIMITRESCU 1966 at KADAR 2007, 222–229.

[26] BOROFFKA 2009, 141–146; see also EMŐDI 2007 for a list of tin sources from Transylvania that were still exploited during the late Middle Ages and also during the XVIIIth–XIXth centuries.

Ch. Papalas, in his dissertation about the Bronze Age metallurgy in the Eastern Carpathian Basin[27], tries connecting slag discoveries to the natural copper deposits in the region by means of metallographic analysis. Relying on this, Papalas highlights the compositional similarity of the studied slag fragments, all coming from Otomani-Gyulavarsánd and Mureş sites, and the copper ore samples from deposits near Veţel (Hunedoara county), Ocna de Fier (Caraş-Severin county), Băiţa (Bihor county) and Zimbru (Arad county), suggesting that the latter represent the most probable known sources that through smelting could have produced a similar pattern to that of the analyzed slag[28]. The analyses conducted on the sample from Băiţa Bihor have also revealed a small tin content[29].

The data presented should be seen as an attempt to outline a general perspective on the copper ores that may have been available to Bronze Age miners operating in this region (Fig. 3). It stands to reason that in prehistory other less rich ores have been mined, ores that today are no longer profitable and that have consequently not been mapped by geologists. It must also be taken into consideration that traces of early exploitations have been very often destroyed by subsequent roman, medieval and modern mining[30].

Evidence of on-site metalworking. Possible workshops in Western Romania

In the 10 tells from Western Romania that yielded objects related to metallurgy, 54 artefacts associated with metalworking (clay tuyères, moulds made of stone or clay and casting debris – Fig. 4)[31] were uncovered. The small conical clay tuyères are generally regarded as important clues for locating workshops where melting and casting activities took place[32]. Nine such objects were identified in the Western Romanian tells. Six artefacts recovered from the Pecica "Şanţul Mare" settlement can be regarded as casting debris. A total number of 36 moulds were discovered in only six tells, containing 44 negative forms.

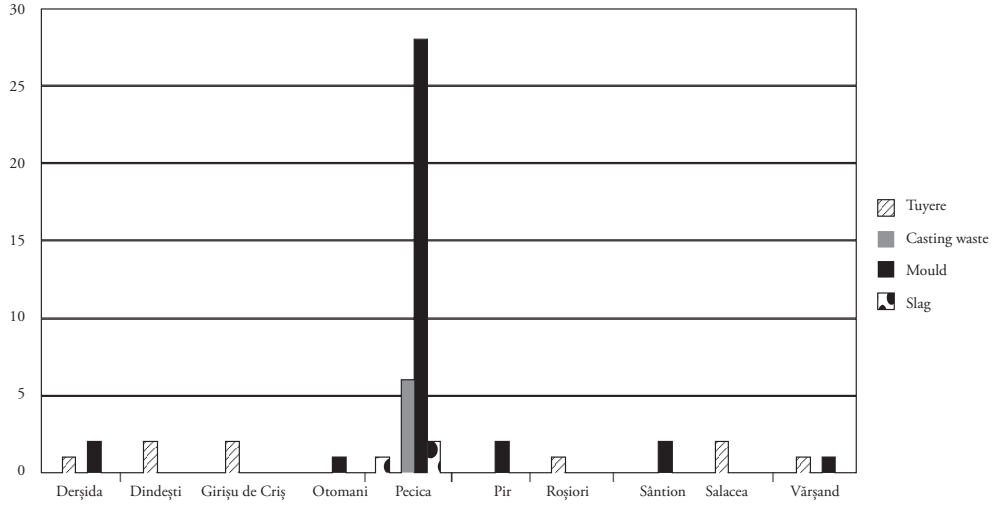

Fig. 4. Distribution of metalworking-related artefacts within the Western Romanian tells.

[27] PAPALAS 2008.

[28] PAPALAS 2008, 168–178.

[29] PAPALAS 2008, 178; tin was still being exploited here during the first part of the XIXth century EMŐDI 2007, 109–110.

[30] GOGÂLTAN 1999, 119–120.

[31] All the artefacts related to the metallurgy of Western Romanian tells are to be found in a catalogue at the end of this paper together with a short description, a typological classification, dating, illustration and bibliographic references for each object.

[32] JOCKENHÖVEL 1985, 196; DUMITRAŞCU 1989, 119–120.

No construction that could clearly be assigned to a proper bronze smiths' workshop has yet been excavated in Western Romania. The same could be said for the neighbouring areas during the Early and Middle Bronze Age[33]. There is however one exception, namely a construction found inside the tell from Mošorin "Feudvár" that contained sufficient evidence allowing its interpretation as the workshop of a Bronze Age smith[34]. However, it has been argued that a smiths' workshop can also be identified by locating tangible metallurgy-related evidence such as clay tuyères, crucibles, moulds, tools used in metalworking, ingots and metalworking debris[35]. Even though no crucibles and ingots that can be certainly dated to the Early and Middle Bronze Age are known from Western Romania[36], the other categories of objects have been identified in this region for the period under discussion.

Sometimes, the discovery of tuyères alone on a site is considered to be enough evidence that melting activities took place in the respective settlement[37]. Such objects are in fact clay nozzles that were set at the end of bellows or blowpipes[38]. Generally, it is considered that the larger versions are associated with smelting furnaces, while the smaller conical tuyères (the type found on the tell settlements from Western Romania) were used for melting furnaces[39]. The discovery of charcoal inside a tuyère indicates that the blowpipes were most likely made of wood[40]. Nine small conical tuyères were identified in Western Romania so far, all uncovered inside tells at Derşida[41] (Pl. I/4), Dindeşti[42] (Pl. I/5–6), Girişu de Criş[43] (Pl. I/1–2), Roşiori[44] (Pl. I/3), Sălacea[45] (Pl. I/7–8) and Vărşand[46] (Pl. I/9). Burnt traces have been noted on all these objects, thus certifying the fact that they have been used. Both tuyères and moulds were found only at Derşida and Vărşand, possibly indicating on-site melting and casting activities.

Moulds, with 48 finds, are the most abundant artefacts related to metalworking found in Western Romania. Most of them were discovered in tells (36), such objects being unearthed at Derşida[47], Otomani "Cetatea de pământ"[48], Pecica[49], Pir[50], Sântion[51] and

[33] Maybe with the exception of the construction uncovered on the hilltop settlement belonging to the Vatya culture at Lovasberény–"Mihályvár" which has been regarded as a casting workshop, although beside 2 hearths, some clay cores and a clay spoon, only one mould has been found (BÁNDI/PETRES 1969; KOVÁCS 1977, 36–38).

[34] HÄNSEL/MEDOVIĆ 1991, 82–83, Pl. 11–12; HÄNSEL/MEDOVIĆ 2004.

[35] BADER 1978, 83–84; WELLS 1984, 65; BÓNA 1992, 49; GOGÂLTAN 1999, 127–128; HARDING 2000, 220–226.

[36] Crucibles were found most probably on these sites, but haven't been identified as such.

[37] BÓNA 1992, 49; KISS/KULCSÁR 2005, 267; KISS 2009, 329.

[38] KUIJPERS 2008, 84.

[39] HUNDT 1988, 99–100; HARDING 2000, 220.

[40] JOCKENHÖVEL 1985, 196.

[41] CHIDIOŞAN 1980, 49, 80, Pl. 23/37; 38/12; DUMITRAŞCU 1989, 122, Pl.: XII/1; XIII/1; BEJINARIU 2005, 49, Pl. VI/4.

[42] BADER 1978, 60, Pl. XXXV/30–31.

[43] DUMITRAŞCU 1989, 119–120., Pl.: I/1–2; II/1–2.

[44] DUMITRAŞCU 1989, 121, 126–127, Pl.: XII/2; XIII/2.

[45] DUMITRAŞCU 1989, 121, Pl. X/1–2; XI/1–2.

[46] BÓNA 1975, 132, Pl. 150/14.

[47] CHIDIOŞAN 1980, 60, Pl. 38/13; DUMITRAŞCU 1989, 130–131, Pl.: XXI/3; XXII/2; XXIV/1–2; BEJINARIU 2005, 49, 59, Pl. VI/2–3.

[48] ORDENTLICH 1963, 137, Fig. 16/12.

[49] DÖMÖTÖR 1902, 271– 273, Ábr. 1–10; ROSKA 1912, Fig.: 25; 55/2–3; 56/1–2; 57; 67/1–6; POPESCU 1944, Fig.: 26/1, 3, 5; 27/1–6; 28/1–10; VULPE 1970, Pl.: 8/108; 13/206–208; 14/224, 225–228; 18/288–290; 35/311–313, 316–318; VULPE 1975, 62, Pl. 35/315; GOGÂLTAN 1999, Fig.: 9/3–5; 10–11; 16–18; 20/4; 22/4; 24; 38/1–3.

[50] SZÉKELY 1955, 857, Fig. 1/3; 10/3; SZÉKELY 1966, 129, Fig. 4/7, 7a.

[51] ALEXANDRESCU 1955, 489, Fig. 2; VULPE 1975, 62, Nr. 319–320, Pl. 35/319–320; DUMITRAŞCU 1989, 129–130, Pl.: XXV/1; XXVI/1; XXVII/1; XXVIII/1.

Vărşand[52]. Moulds were also found in Middle Bronze Age hoards from Western Romania, at Berea[53] and Cehăluţ[54]; one mould comes from the open settlement belonging to the Suciu de Sus culture at Culciu Mic[55]. The moulds found at Ciumeşti[56], Satchinez[57] and Sânnicolau Mare[58] are stray finds. All these objects were considered indications of local bronze production.

A considerable amount of artefacts related to melting and casting activities have been uncovered in the Pecica "Şanţul Mare" tell (Catalogue Number V), wherefrom, besides 28 moulds, six fragments that represent casting waste (Pl. III/3–8) and a clay "runner"[59] (Pl. III/2) used during this process are known, the majority of which were found in layers XIII and XIV[60]. Most of the moulds have use-traces, being burnt or deteriorated[61]. Based on these finds the existence of a casting workshop in the Pecica "Şanţul Mare" settlement can be assumed. A similar assumption was advanced for the tell from Včelince "Lászlófala", where 20 moulds together with two clay tuyères were found[62].

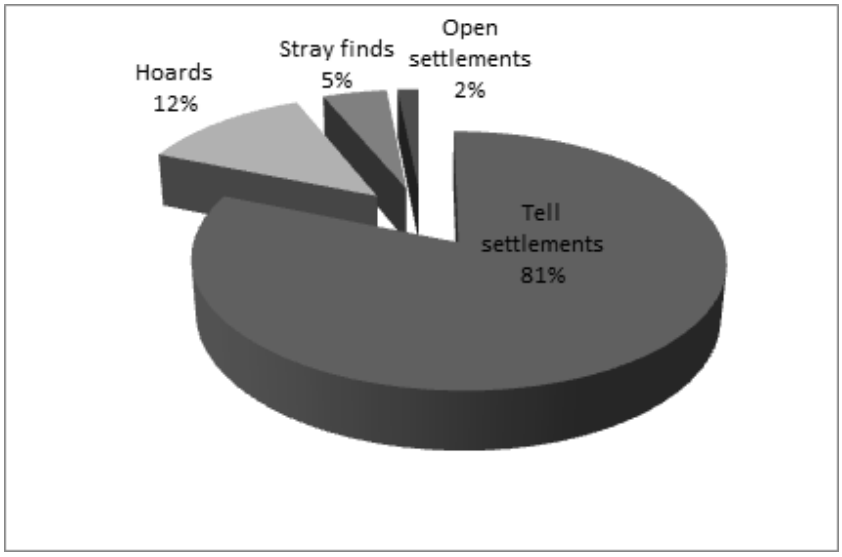

Fig. 5. Diagram illustrating the percentage distribution of metalworking-related artefacts from Western Romania.

As it can be noticed, evidence attesting the local production of copper and bronze objects was uncovered in various sites from Western Romania. A comparison between discoveries made inside tells and those made outside them might help understanding the role that tell-settlements played in the metallurgical production of the surrounding region during the

[52] POPESCU 1956a, 306; POPESCU 1956c, 116–117, Fig. 77/1.
[53] BADER 1978, 120–121, Pl. LXXXV/4–6, 10, 11.
[54] VULPE 1970, 49–50, NR. 209–211, Pl. 13/209–211.
[55] BADER 1978, 87, 107, Pl.: XLV/16; XLVI/1.
[56] BADER 1978, 123, Pl. LXXXV/9.
[57] NESTOR 1933, 129; POPESCU 1944, 129; MOZSOLICS 1967, 42; VULPE 1970, 75, Nr. 3331, Pl. 23/333A; GOGÂLTAN 1999, 146, Fig.: 19/3; 47/3.
[58] GOGÂLTAN 1999, 135, Fig. 12/3.
[59] We only know of one similar find coming from Helemba-sziget (KOVÁCS 1977, 90, Fig. 15/4).
[60] ROSKA 1912, 33–34, 68–69, Fig. 58; GOGÂLTAN 1999, 127, Fig. 39/1–9.
[61] GOGÂLTAN 1999, 127.
[62] FURMÁNEK/ILLÁŠOVÁ/MARKOVÁ 1999, 7–15; in this article, the moulds are counted from 1 to 19; however one of the moulds wasn't ascribed any number. Not all of the moulds come from the same context and there are also later finds from the Piliny period among them.

Early and Middle Bronze Age[63]. Statistically, the distribution of finds related to metalworking discovered in this area is the following: out of the 66 objects that can be associated with melting and casting activities, 54 were found inside tells, 8 come from hoards, 3 objects are stray finds, with only one find coming from a single-layer open settlement[64] (Fig. 5). Of course, this is also due to the current stage of research with most excavations focusing on tell settlements.

Nevertheless, the distribution of metalworking-related artefacts from Western Romania indicates that most of these finds were uncovered inside the tell sites. However, objects associated with melting and casting activities were found in only 10 of the 44 tell settlements known in this region. Furthermore, out of the 54 tell finds related to metallurgical activities, 37 come from Pecica "Şanţul Mare", the only settlement that could be considered a production and distribution centre of copper or bronze artefacts. Raw materials used for the production of metal objects are available in the near vicinity of the tell, copper sources being identified near Zarandului Mountains, at Covăsinţ, Lipova and Milova[65], all in a range of 43–56 km from Pecica.

The moulds found on the site were made of sandstone or clay, both used to manufacture tools and weapons, but also ornaments. The number of negative forms in the moulds from Pecica is 34, mostly weapons and tools (Fig. 6). An interesting aspect is the discovery of multiple moulds[66], which allow several objects to be cast using one mould. They contain the negatives of several forms which are positioned on different sides of the mould. Thus, one side of one of the clay moulds found in Pecica (Pl. VI/3–4) has the negative forms of a flat axe and an awl, while on the reverse side the forms of a socketed chisel and of another awl can be noticed. Another double-sided sandstone mould uncovered here could have been used for the simultaneous casting of a flat axe and of a shaft-hole axe of Hajdúsámson type (Pl. V/2–3). Due to all these finds, the Pecica tell is considered by some scholars to be one of the most important metalworking centres of the Middle Bronze Age in the Carpathian Basin[67].

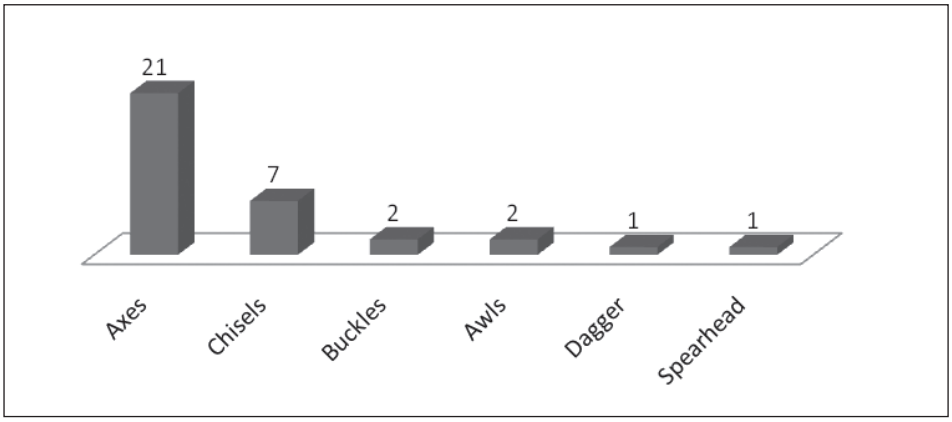

Fig. 6. Distribution of artefact types that could be casted in the moulds from Pecica at one time.

The house of a metalworker excavated in the Bronze Age tell-settlement from Mošorin "Feudvár" can be considered a good example of the way a workshop of a bronze smith operating

[63] Of course, it should be born in mind that the picture of the metallurgical production in Western Romania (area approximately overlapping the nowadays counties of Arad, Bihor and Satu-Mare) thus obtained could be biased by various factors, the current state of research being one of the most important.

[64] We know of no artefacts connected with metalworking from Western Romania that have been found in a grave or funerary context and that can be certainly dated to the Early and Middle Bronze Age.

[65] RĂDULESCU/DIMITRESCU 1966, 327, 332–340.

[66] Using the classification set forth by Barbara Armbruster (ARMBRUSTER 2010, 14).

[67] BÓNA 1975, 272.

in a tell could have looked like. The construction (made of wattle and daub) was well integrated in the regular layout of the surrounding dwellings, having similar orientation and size (its length was however smaller than the other houses which were aligned in parallel rows), but it differed in that it had a working space[68]. It was from inside this working space, on both sides of the collapsed wall, that a series of metalworking related artefacts were uncovered: crucible fragments, moulds, waste products of the lost wax casting technique, metal droplets, clay cores, polishers and grinders[69]. However, no clay tuyères were found in this workshop, which currently represents a unique discovery for the Carpathian Basin.

Such workshops, as the ones that could have functioned on the tells from Western Romania, as indicated by the distribution of artefacts connected with metalworking, suggest a small-scale, household production. In the case of Pecica "Şanţul Mare" (Catalogue Number V), the relatively large number of complete casting moulds (28) could indicate that the products may have also been intended for trade[70]. One has to emphasize the fact that the moulds discovered at Pecica amount to an impressive number only when compared to contemporary sites from the Carpathian Basin. For example, in the workshop from Mošorin "Feudvár", only 23 complete casting moulds were found[71]. No comparable number of moulds was retrieved from a contemporary settlement, not even from the Slovakian tells, where larger-scale excavations were conducted and which are known for the considerable amount of metal artefacts and hoards they have yielded and the fact that they were located in the vicinity of non-ferrous metal deposits[72]. At Včelince "Lászlófala" only 16 moulds belonging to the Early and Middle Bronze Age were uncovered[73]. The investigations conducted at the rich settlement of Košice "Barca" revealed, apart from several bronze and gold hoards[74], a number of 10 moulds[75], while the excavations at the Nitriansky Hrádok "Zámeček" tell, where an impressive number of metal artefacts[76], together with two bronze hoards[77] were found, yielded just 8 moulds[78].

On-site melting and casting activities are generally assumed for every settlement that yielded casting moulds, with local smiths operating on a small-scale base, meeting the demands of the local community[79]. The idea of an itinerant smith, a full-time travelling specialist[80], is no longer accepted by all scholars[81] and is not always supported by the available archaeological data, or by all the ethnographic accounts[82]. Petrographic analysis conducted on the stone moulds from Včelince "Lászlófala" have shown that they were made of local raw material[83]. Similar results have been obtained for the casing moulds found at Veselé "Hradisko", which were made from sandy shale

[68] HÄNSEL/MEDOVIĆ 2004, 88–90, Fig. 2.

[69] HÄNSEL/MEDOVIĆ 1991, 82–83; HÄNSEL/MEDOVIĆ 2004.

[70] GOGÂLTAN 1999, 194.

[71] It has to be mentioned however that this site has yielded over 100 small clay fragments that can be connected to the lost-wax casting technique (HÄNSEL/MEDOVIĆ 2004, 98–100).

[72] SCHALK 1998, Fig. 3; For a recent study on the Bronze Age metallurgy of the fortified settlements from Slovakia see BÁTORA 2009, with Fig. 1–3 showing the copper, gold and tin deposits available in the region.

[73] FURMÁNEK/ILLÁŠOVÁ/MARKOVÁ 1999, 7–15.

[74] Apparently four bronze hoards and one gold hoard were found here according to FURMÁNEK/VLADÁR 2006, 188–189.

[75] NOVOTNÁ 1980, 184, Nr. 1503–1508, Pl. 53/1506–1508; NOVOTNÁ 1983, 120, Pl. 1/1, 3–4.

[76] TOČÍK 1981.

[77] MOZSOLICS 1967, 144; TOČÍK 1981, 105, Pl. CXLIX/13–25.

[78] TOČÍK 1981, 38, 114, 119, 136, 187, Pl.: LX/10; LXXX/12; CXXX/5; CLXXXVI/26; BÁTORA 2009, 206.

[79] WELLS 1984, 66–68 for a later period that comprises the Late Bronze Age and the First Iron Age.

[80] This view on the bronze age smith, promoted by V. G. Childe (CHILDE 1930, 44–45) has long dominated the archaeological literature.

[81] KISS 2009, 329, n. 7.

[82] HARDING 2000, 236 with further references.

[83] FURMÁNEK/ILLÁŠOVÁ/MARKOVÁ 1999, 10.

that can be found in deposits at about 20 km away from the tell settlement[84]. Unfortunately none of the 36 stone moulds uncovered in the tells from Western Romania underwent such analysis.

Analysing the metallurgy of the Vatya culture, T. Horváth underlines the fact that although metalworking debris was uncovered in most of the central settlements of this culture, these finds are not even nearly comparable to the discoveries known from the Late Bronze Age metallurgy workshops. Consequently, this evidence should be associated with the smith her/himself and her/his activity within the settlement area rather than with the existence of a proper workshop[85].

Products of the tells' metallurgy

Out of the 44 negative forms found on the moulds from the Western Romanian tells (Fig. 7), 28 represent different types of axes, pointing to a leading role for axe manufacture in the metallurgy of these settlements. Moulds for axes of various types have been uncovered in 5 of the 6 tells that yielded mould finds at: Otomani "Cetatea de pământ" (Catalogue Number IV), Pecica "Şanţul Mare" (Catalogue Number V), Pir "Cetate" (Catalogue Number VI), Sântion "Dealul Mânăstirii" (Catalogue Number IX) and Vărşand "Movila dintre vii" (Catalogue Number X). There are some types of artefacts known in this area only by means of mould discoveries, such as Hajdúsámson-type axes, identified on ten moulds from the Pecica "Şanţul Mare" tell[86] (Catalogue Number V) (Pl. V/3, VI/5–6, VII/1–3; 5–6, VIII/1–3) and on a mould discovered at Pir "Cetate"[87] (Catalogue Number VI) (Pl. II/1). Even in the Carpathian Basin, there are only few finished objects of this type, coming mostly from hoards or stray finds[88]. Surprisingly, in the same category of shaft-hole axes we find, on the reverse side of the mould from Pir, an object that belongs to the Monteoru Type of axes according to Al. Vulpe[89] (Pl. II/1), the distribution area of these artefacts comprising especially South-Western Moldavia and North-Eastern Muntenia (being related to the area of the Monteoru culture)[90].

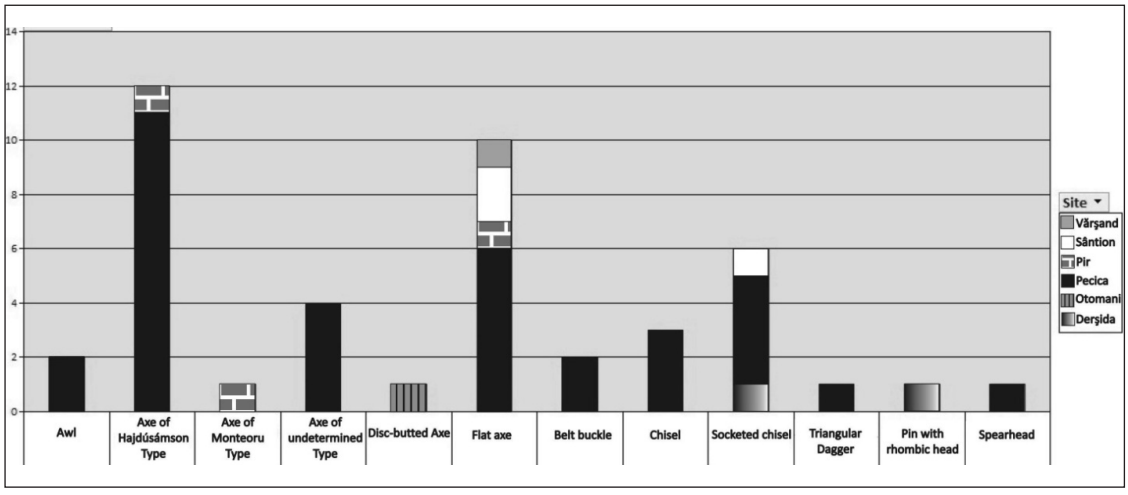

Fig. 7. Distribution of negative forms on the moulds retrieved from tells.

[84] BÁTORA 2009, 207.

[85] HORVÁTH 2004, 63.

[86] DÖMÖTÖR 1902, 272–273, Ábr. 10; ROSKA 1912, 32–37, 68–69, Fig.: 56/1–2; 67/5–6; POPESCU 1944, 66, Fig.: 26/2–3, 5; 27/3; 28/10; VULPE 1970, 40, Pl.: 8/108 "Kozarac Type", 49–50; 13/206–208, 52; 14/224–226 "Balşa Type"; GOGÂLTAN 1999, 144–145, Fig.: 11/3; 16/1, 3–4; 17; 18/1–3.

[87] SZÉKELY 1966, 129, Fig. 4/7, 7a.

[88] MOZSOLICS 1967, 18–19, Pl.: 10/2–5; 11/1; VULPE 1970, 49–50, Pl. 13/201–203, 205.

[89] SZÉKELY 1966, 129, Fig. 4/7, 7A; VULPE 1970, 46, Pl. 12/ 192.

[90] VULPE 1970, 48.

Other prominent types cast were chisels and awls (11 negative forms). Only three moulds for the manufacture of ornaments have been found so far. This should not seem surprising, given the fact that a small-scale bronze production, as the type that seems to have been going on in the tell settlements from Western Romania, is more likely to be oriented towards the manufacture of tools for everyday use. Two moulds for the manufacture of belt buckles[91] were uncovered in the Pecica "Şanţul Mare" tell (Pl. IX/2, 5); these are quite rare finds for this period, with few analogies among the contemporary finished bronze objects known from the Carpathian Basin[92]. An atypical piece for this region, occurring mainly in the Eastern and South-Eastern Carpathians, is to be found on one of the moulds from Derşida "Dealul lui Balotă"[93] (Pl. II/2). It is a fragmented mould used for the manufacture of a pin with rhombic plate head and midrib, characteristic of the Noua-Sabatinovka-Coşlogeni complex, but also encountered in the Wietenberg culture, wherefrom comes the best analogy[94].

Another aspect worth mentioning here is the fact that although a considerable amount of artefacts could have been manufactured in the tells from Western Romania, none of the finished metal objects or their analogies have been recorded inside the same settlement that yielded the parent moulds. The same can be said for the Vatya culture, with the exception of Dunaújváros "Kosziderpadlás" tell where excavations have yielded both a mould for casting a reverted heart-shaped pendant and a finished object of this type[95]. The lack of the types cast in the moulds from Veselé "Hradisko" was explained by J. Bartík through the gradual abandonment of the tell, the inhabitants having enough time to recover the most important artefacts[96]. While this hypothesis seems hardly plausible, the situation could also be explained by the common practice of re-melting/recycling[97] the bronze objects. Although this explanation alone cannot account for all instances, it should be stressed out that recycling did take place, and could have been part of many of the bronze objects' cultural biography. The only artefacts that weren't recycled are the ones found in hoards, which represent only a small part of the wide repertoire of metalwork in use during the Bronze Age[98].

Concluding Remarks

Although the amount of metalworking related objects uncovered in the Western Romanian tells may seem small compared to the Late Bronze Age, taking a glance at similar finds yielded from contemporary open settlements and hoards in the close vicinity of the tells proves the fact that these artefacts were found in a higher proportion inside the tell settlements. Therefore, in the current state of research, it can be assumed that these sites played an important role in the Early and Middle Bronze Age metallurgy from Western Romania.

However, a closer look at the distribution of finds connected with metallurgy rather gives the impression of small numbers of artefacts connected with melting and casting activities loosely scattered among the analyzed sites (Fig. 4). Let alone that only 10 out of the 44 Bronze Age tells located in Western Romania have yielded objects associated with bronze production,

[91] DÖMÖTÖR 1902, 272–273, Ábr. 7–8.

[92] A belt buckle resembling one of the Pecica moulds (Pl. IX/2) was uncovered in the tell settlement from Mošorin "Feudvár" (see HÄNSEL/MEDOVIĆ 1991, 82, Fig. 6/2); a similar find is also known from grave 55 of the Szőreg cemetery (FOLTINY 1941, 17, Pl. XX/26).

[93] DUMITRAŞCU 1989, 131–132, Pl.: XXI/3; XXIV/2; BEJINARIU 2005, 49–50, Pl. VI/2.

[94] BOROFFKA 1994, 78, Nr. 406, Pl. 117/8; BEJINARIU 2005, 50.

[95] HORVÁTH 2004, 33.

[96] BARTÍK 1995, 45.

[97] For the importance of taking recycling into consideration while trying to outline the metal outflow system during the Bronze Age see NEEDHAM 1998, 286.

[98] NEEDHAM 2007; KUIJPERS 2008, 20–22.

the amount of metalworking-related evidence uncovered in the majority of these tells is rather scarce. In a number of instances this could be explained by limited archaeological excavation of the sites. Still, in extensively excavated settlements like Sălacea "Dealul Vida" (Catalogue Number VIII) and Otomani "Cetatea de pământ" (Catalogue Number IV), only two clay nozzles and a casting mould were found. Therefore, it is obvious that the production of metals did not necessarily play an important role in the economy of Western Romanian tells. In contrast, the tell from Pecica (Catalogue Number V) stands out, due to the amount of metalworking-related objects it has yielded. This settlement is however an exception and its possible role as a local centre will be further investigated[99].

Although metal artefacts associated with bronze production were uncovered in the Western Romania tells, their scarcity in most of the sites indicates that metalworking did not always play an important role in the economy of these settlements. Most likely, the economy of the tells was based on agriculture, the concentration of metal artefacts inside these settlements and the ability to produce bronze objects pointing out to their prosperity, as M. Bartelheim has argued for Early Bronze Age Central Europe[100]. A further argument supporting this hypothesis is the geographical distribution of tell settlements in the Carpathian Basin (Fig. 1), most of them being located along the main two rivers from the region (Danube, Tisza and their tributaries), areas that posses good arable lands[101].

Catalogue of metalworking-related artefacts from the Western Romanian tells[102]

I. Derşida–"Dealul lui Balotă", Sălaj County.

1. *Clay tuyère* (Pl. I/4); found in the fourth layer; conical shaped, perforated longitudinally; height = 6 cm, bottom diameter = 3 cm, diameter towards the insertion of the blowpipe = 1.7 cm, rim diameter = 0.7 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 4961; Middle Bronze Age III (CHIDIOŞAN 1980, 49, 80, Pl.: 23/37; 38/12; DUMITRAŞCU 1989, 122, Pl.: XII/1; XIII/1; BEJINARIU 2005, 49, Pl. VI/4).
2. Sandstone *mould* (Pl. II/3); found inside the third layer; for socketed chisels, with a rib under the opening; length of the chisel = 7.8 cm, width of the blade = 1.4 cm, length of the mould = 11 cm, width of the mould = 5.5 cm, thickness = 1.8 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 5017; Middle Bronze Age (CHIDIOŞAN 1980, 60, Pl. 38/13; DUMITRAŞCU 1989, 130–131, Pl. XXII/2; XXIV/1; BEJINARIU 2005, 49, 59, Pl. VI/3).
3. Sandstone *mould* (Pl. II/2); found in the 1964 campaign; for pins with rhombic head and midrib; length = 8.8 cm, width = 5.1 cm, thickness = 2.3 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 2971; Middle Bronze Age III (DUMITRAŞCU 1989, 131–132, Pl.: XXI/3; XXIV/2; BEJINARIU 2005, 49–50, Pl. VI/2).

[99] GOGÂLTAN/GĂVAN in press.

[100] BARTELHEIM 2009, 34–46.

[101] FISCHL/REMÉNYI in press.

[102] The entries in the catalogue follow the alphabetical order of the sites (Roman numerals), with each subentry (Arabic numerals) presenting individual artefacts related to metalworking uncovered in the respective site; in the description of each artefact the following details were offered: typological class of the object, archaeological find context, short description, measurements, storage place, inventory number and chronology, depending on the amount of information provided in the publications.

II. Dindeşti–"Cetate", Satu Mare County.

1. *Clay tuyère* (Pl. I/5); conical shape and round cross-section, perforated longitudinally; height = 5.4 cm, bottom diameter = 3.8 cm, diameter towards the insertion of the blowpipe = 2.1 cm; Middle Bronze Age (BADER 1978, 60, Pl. XXXV/30; JOCKENHÖVEL 1985, 201, Nr. 54; BEJINARIU 2005, 62).
2. *Clay tuyère* (Pl. I/6); conical shape and round cross-section, perforated longitudinally; height = 5.6 cm, bottom diameter = 3.5 cm, diameter towards the insertion of the blowpipe = 1.9 cm; Middle Bronze Age (BADER 1978, 60, Pl. XXXV/31; JOCKENHÖVEL 1985, 201, Nr. 54; BEJINARIU 2005, 62).

III. Girişu de Criş–"Alceu", Bihor County.

1. *Clay tuyère* (Pl. I/1); found at the depth of 0.80–1.20 m, between the first and the second settlement layer; burn marks are visible; height = 6.5 cm, bottom diameter = 3. 7 cm, diameter towards the insertion of the blowpipe = 1.7 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 8681; Middle Bronze Age (DUMITRAŞCU 1989, 119–120, Pl.: I/1; II/1).
2. *Clay tuyère* (Pl. I/2); found at the depth of 0.80–1.20 m, between the first and the second settlement layer; burn marks are visible as well as small fragments of solidified metal; decorated; diameter towards the insertion of the blowpipe = 2.2 cm, height = 5.7 cm, bottom diameter = 3.7 cm, rim diameter = 0.6 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 8682; Middle Bronze Age (DUMITRAŞCU 1989, 119−121, Pl.: I/2; II/2).

IV. Otomani–"Cetatea de pământ", Bihor County.

1. Sandstone *mould* (Pl. IV/3); for discs belonging to a disc-butted axe, B1 Type; Middle Bronze Age III (ORDENTLICH 1963, 137, Fig. 16/12; HÄNSEL 1968, 190, List 49/26, Pl. 29/10; VULPE 1970, 75, Nr. 332, Pl. 23/332; ORDENTLICH 1973, 73, Pl. XX/15; BADER 1978, 91; MOLNÁR 2011, 291−293, Fig. 4/12).

V. Pecica–"Şanţul Mare", Arad County.

1. Fragmentary *mould* (Pl. VIII/8); from layer X; for triangular daggers with midrib; length of the mould = 14.7 cm, width of the mould = 5.1 cm, width of the dagger = 4.2 cm; Arad County Museum, Inventory No.: 72604; Middle Bronze Age II (ROSKA 1912, 17, Fig. 25; CHILDE 1929, 260; POPESCU 1944, 65; MILOJČIĆ 1953, 267, Fig. 23/26; SOROCEANU 1991, 89; BÓNA 1992, 50; GOGÂLTAN 1999, 148−149, Fig. 20/4).
2. Fragmentary sandstone *mould*; from layer XII; for chisels?; Middle Bronze Age II (ROSKA 1912, 26, 67; GOGÂLTAN 1999, 155−156).
3. Fragmentary *mould*; from layer XII; for chisels?; Middle Bronze Age II (ROSKA 1912, 26, 67; GOGÂLTAN 1999, 155−156).
4. Fragmentary sandstone *mould* (Pl. VIII/7); from layer XIII; for spearheads; length of the mould = 13.5 cm, maximum width = 7.5 cm, minimum width = 5 cm, length of the spearhead = 13.5 cm, tube diameter = 2.9 cm; Arad County Museum, Inventory No.: 871–872; Middle Bronze Age II (ROSKA 1912, 32, 68, Fig, 57; CHILDE 1929, 260; POPESCU 1944, 66, Fig. 27/6; MILOJČIĆ 1953, 267, 270, Fig. 24/6; HÄNSEL 1968, 75, 197, List 65/1, Pl. 9/7; KOVÁCS 1975, 26, Fig. 4/2; SOROCEANU 1991, 90; SCHALK 1992, 144−145, Fig. 56/3; GOGÂLTAN 1999, 152−153, Fig. 22/4).

5. Fragmentary *mould* (Pl. IX/3); from layer XIII; for narrow, possibly socketed chisels; length of the mould = 4.1 cm, width of the blade = 1.4 cm; Middle Bronze Age (ROSKA 1912, 31, 68, Fig. 55/1; POPESCU 1944, 66, Fig. 26/6; SOROCEANU 1991, 89; GOGÂLTAN 1999, 155, Fig. 24/2).
6. Fragmentary sandstone *mould* (Pl. VII/3); from layer XIII; for Hajdúsámson Type axes; length of the mould = 14.4 cm, width of the mould = 4.7–5.5 cm, length of the axe = 13.6 cm, width of the blade = 3.6 cm; Arad County Museum, Inventory No.: 861; Middle Bronze Age II (ROSKA 1912, 32, 68, Fig. 56/2; POPESCU 1944, 66, Fig. 26/5; MILOJČIĆ 1953, 267, Fig. 24/15; HÄNSEL 1968, 28, 57, 59, 186, List 41/7, Pl. 9/9; VULPE 1970, 52, Pl. 14/224; GOGÂLTAN 1999, 144–145, Fig. 16/1).
7. *Mould* fragment (Pl. VI/5); from layer XIII; for Hajdúsámson Type axes; length of the mould =18.6 cm, maximum width of the mould = 7.9 cm, length of the axe = 16.2 cm, blade width = 4.5 cm; Arad County Museum, Inventory No: 870; Middle Bronze Age II (ROSKA 1912, 32, 68, Fig. 56/1; POPESCU 1944, 66, Fig. 26/3; MILOJČIĆ 1953, 267, Fig. 24/5; HÄNSEL 1968, 28, 57, 59, 186, List 41/7, Pl. 9/8; VULPE 1970, 40, Pl. 8/108 "Kozarac Type"; GOGÂLTAN 1999, 144–145, Fig. 17/1).
8. Fragmentary clay *mould* (Pl. IX/1); from layer XIII; for socketed chisels; length of the mould = 18.7 cm, blade width = 1.1 cm; Middle Bronze Age (ROSKA 1912, 31–32, 68, Fig. 55/2–3; POPESCU 1944, 66, Fig. 26/1, 4 "Axe"; HÄNSEL 1968, Pl. 9/10; GOGÂLTAN 1999, 155, Fig. 24/1).
9. Clay *mould* (Pl. V/4–5; Pl. VI/1); from layer XIV; for flat axes; length of the mould = 14.5 cm, length of the axe = 13.8 cm, blade width = 4.3 cm; half of the mould can still be found in the Arad County Museum, Inventory No: 865, but it has been restored, keeping little resemblance with the original photograph published by M. Roska; Middle Bronze Age (ROSKA 1912, 36, 69, Fig. 67/1–2 "chisel"; POPESCU 1944, 66, Fig. 27/1, 4; MILOJČIĆ 1953, 267, Fig. 24/16; HÄNSEL 1968, 65, Pl. 9/16; VULPE 1975, 62, Pl. 35/313, 317; SOROCEANU 1991, 90; GOGÂLTAN 1999, 133, Fig. 9/3–4; 10/3).
10. Fragmentary clay *mould* (Pl. V/6); from layer XIV; for flat axes; length of the mould = 16.2 cm, width of the mould = 8.1 cm, blade width = 4.2 cm; Middle Bronze Age (ROSKA 1912, 36, 69, Fig. 67/4 "chisel"; POPESCU 1944, 66, Fig. 27/5; HÄNSEL 1968, 65, Pl. 9/14; VULPE 1975, 62, Pl. 35/316; SOROCEANU 1991, 90; GOGÂLTAN 1999, 133, Fig. 9/5).
11. Fragmentary stone *mould* (Pl. VII/1–2); from layer XIV; for Hajdúsámson Type axes, on the other side having the shape of a similar axe; length of the mould = 16.6 cm, width of the mould = 7.3–8.3 cm; Romanian National Museum, Inventory No.: 72605; Middle Bronze Age II (ROSKA 1912, 36–37, 69, Fig. 67/5–6; POPESCU 1944, 66, Fig. 27/2–3; MILOJČIĆ 1953, 267, Fig. 24/4; HÄNSEL 1968, 28, 57, 59, 186, List 41/7, Pl. 9/15; VULPE 1970, 52, Pl. 14/226; GOGÂLTAN 1999, 144–145, Fig. 17/3–4).
12. Fragmentary *mould* (Pl. IX/4); from layer XIV; for chisels; Middle Bronze Age (ROSKA 1912, 36, 39, Fig. 67/3; POPESCU 1944, 66, Fig. 27/2; GOGÂLTAN 1999, 155, Fig. 24/3).
13. Fragmentary clay *mould* (Pl. V/1); uncovered during the excavations of L. Dömötör; for flat axes; maximum length of the mould = 12.4 cm, maximum width of the mould = 8.2 cm, maximum length of the blade = 11.1 cm, maximum blade width = 4 cm; Arad County Museum, Inventory No.: 1684–1685; Middle Bronze Age (DÖMÖTÖR 1902, 271–272, 273/1–3; POPESCU 1944, 66, Fig. 28/1–3; VULPE 1975, 62, Pl.35/311–312; SOROCEANU 1991, 91; GOGÂLTAN 1999, 133, Fig. 11/1).
14. Fragmentary clay *mould* (Pl. VI/3–4); uncovered during the excavations of L. Dömötör; for flat axes and awls (chisels?), on the other side the shape of a socketed chisel and of

another awl can be observed; length of the mould = 12.5 cm, width of the mould = 6.5 cm, length of the axe = 12.1 cm, blade width = 4.7 cm; length of the socketed chisel = 12.4 cm; Arad County Museum, Inventory No.: 880; Middle Bronze Age (DÖMÖTÖR 1902, 272, 273/4–5; POPESCU 1944, 66, Fig. 28/5–6; VULPE 1975, 62, Pl. 25/318; SOROCEANU 1991, 90–91; GOGÂLTAN 1999, 133, 155–157, Fig. 10/1–2).

15. Fragmentary sandstone *mould* (Pl. V/2–3); uncovered during the excavations of L. Dömötör; for flat axes, on the other side for Hajdúsámson Type axes; length of the mould = 14.5 cm, width of the mould = 8 cm; Arad County Museum, Inventory No.: 879; Middle Bronze Age II (DÖMÖTÖR 1902, 273/9–10; POPESCU 1944, 66, Fig. 28/8, 10; MILOJČIĆ 1953, 267, Fig. 23/36; VULPE 1970, 49–50, Pl. 13/206; SOROCEANU 1991, 91; GOGÂLTAN 1999, 133, 144–150, Fig. 11/2–3).
16. Fragmentary sandstone *mould* (Pl. IX/5–6); uncovered during the excavations of L. Dömötör; for belt buckles, on the other side for socketed chisels; length of the mould = 9.1 cm, width of the mould = 7 cm, length of the belt buckle = 8.1 cm; length of the chisel = 7.8 cm; Arad County Museum, Inventory No.: 1682; Middle Bronze Age II (DÖMÖTÖR 1902, 272, 273/6–7; POPESCU 1944, 66, Fig. 28/4, 7; BÓNA 1959, 51, Fig. 4/B; HÄNSEL 1968, 109, 196, 218, List 61/10, 113/4, Pl. 9/11, 13; BÓNA 1975, 99, 101, Fig. 15; SOROCEANU 1991, 91; GOGÂLTAN 1999, 155, 177, Fig. 38/2–3).
17. Fragmentary sandstone *mould* (Pl. IX/2); uncovered during the excavations of L. Dömötör; for belt buckles; length = 9 cm, maximum width = 5 cm; Middle Bronze Age II (DÖMÖTÖR 1902, 272, 273/8; POPESCU 1944, 66, Fig. 28/9; BÓNA 1959, 51, Fig. 4/A; HÄNSEL 1968, 109, 218, List 113/4, Pl. 9/12; BÓNA 1975, 99, 101, Fig, 15; SOROCEANU 1991, 91; GOGÂLTAN 1999, 177, Fig. 38/1).
18. Fragmentary stone *mould* (Pl. VI/2); for flat axes; Middle Bronze Age (VULPE 1975, 62, Pl. 35/315; GOGÂLTAN 1999, 133, Fig. 10/4).
19. *Mould* fragment (Pl. VII/6); for Hajdúsámson Type axes; Middle Bronze Age II; first published by D. Popescu (POPESCU 1944, Fig. 26/2; VULPE 1970, 52, Pl. 14/225 "Balşa Type"; GOGÂLTAN 1999, 144–145, Fig. 16/4).
20. *Mould* fragment (Pl. VII/5); for Hajdúsámson Type axes; length of the mould = 20.5 cm, maximum width = 8.4 cm, length of the axe = 17,.8 cm, blade width = 5.1 cm; Arad County Museum, Inventory No.: 855; Middle Bronze Age II (GOGÂLTAN 1999, 144–145, Fig. 16/3).
21. *Mould* fragment (Pl. VIII/3); for Hajdúsámson Type axes; first published by Al. Vulpe; Middle Bronze Age II (VULPE 1970, 49–50, Pl. 13/208; GOGÂLTAN 1999, 144–145, Fig. 18/3).
22. Fragmentary *mould* (Pl. VI/6); for Hajdúsámson Type axes; first published by Al. Vulpe; Middle Bronze Age II (VULPE 1970, 49–50, Pl. 13/207; GOGÂLTAN 1999, 144–145, Fig. 17/2).
23. Fragmentary *mould* (Pl. VIII/1); for Hajdúsámson Type axes; first published by Al. Vulpe; Middle Bronze Age II (VULPE 1970, 52, Pl. 14/227 "Balşa Type"; GOGÂLTAN 1999, 145, Fig. 18/1).
24. Fragmentary *mould* (Pl. VIII/2); for Hajdúsámson Type axes; first published by Al. Vulpe; Middle Bronze Age II (VULPE 1970, 52, Pl. 14/228 "Balşa Type"; GOGÂLTAN 1999, 145, Fig. 18/2).
25. Fragmentary *mould* (Pl. VII/4); for axes of undetermined type; Middle Bronze Age (VULPE 1970, 65; SOROCEANU 1991, 90; GOGÂLTAN 1999, 148, Fig. 16/2).
26. Fragmentary *mould* (Pl. VIII/4); for axes of undetermined type; Middle Bronze Age (VULPE 1970, 65, Pl. 18/290; SOROCEANU 1991, 90; GOGÂLTAN 1999, 148, Fig. 18/4).

27. Fragmentary *mould* (Pl. VIII/5); for axes of undetermined type; Middle Bronze Age (VULPE 1970, 65, Pl. 18/288; SOROCEANU 1991, 90; GOGÂLTAN 1999, 148, Fig. 18/5).
28. Fragmentary *mould* (Pl. VIII/6); for axes of undetermined type; Middle Bronze Age (VULPE 1970, 65, Pl. 18/289; SOROCEANU 1991, 90; GOGÂLTAN 1999, 148, Fig. 18/6).
29. *Slag* fragments (Pl. III/9–10); Middle Bronze Age; Arad County Museum, Inventory No.: 1817–1818; Middle Bronze Age (GOGÂLTAN 1999, 127, Fig. 39/7–8).
30. *Casting debris* (Pl. III/3–8); Middle Bronze Age; Arad County Museum, Inventory No.: 1812, 1814–1816 1822–1823; Middle Bronze Age (GOGÂLTAN 1999, 127, Fig. 39/1–6).
31. *Clay "runner"* (Pl. III/2); Middle Bronze Age (GOGÂLTAN 1999, 127, Fig. 39/9).

VI. Pir–"Cetate", Satu Mare County.

1. Fragmentary *mould* (Pl. II/1); for Hajdúsámson Type axes on one side, on the other for Monteoru Type axes; Middle Bronze Age II (SZÉKELY 1966, 129, Fig. 4/7, 7A; VULPE 1970, 46, NR. 192, 58, Nr. 260, Pl. 12/192, 17/260; BÓNA 1975, 133; BADER 1978, 90; BÓNA 1975, 133; SZÉKELY 2000, 106, Pl. VII/5, 5A; KACSÓ 2003, 273, Pl. IX; MOLNÁR 2011, 286–287, Fig. 5/5).
2. Stone *mould* (Pl. III/1); stray find; for flat axes; length = 12.6 cm, width = 6.5 cm, thickness = 2.8 cm; Székely National Museum, Sfântu Gheorghe, Inventory No.: 14977; Middle Bronze Age (SZÉKELY 1955, 857, Fig. 1/3, 10/3; BÓNA 1975, 133; SZÉKELY 2000, 112, Pl. XXV/3).
3. *Slag*; Middle Bronze Age; (SZÉKELY 1955, 857).

VII. Roşiori–"La sere", Bihor County.

1. *Clay tuyère* (Pl. I/3); found at the depth of 0.7 m; conical shape, burn marks are visible; height = 4.7 cm, diameter towards the insertion of the blowpipe = 0.7 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 4553; Middle Bronze Age (DUMITRAŞCU 1989, 121, 126–127, Pl.: XII/2; XIII/2).

VIII. Sălacea–"Dealul Vida", Bihor County.

1. *Clay tuyère* (Pl. I/8); diameter towards the insertion of the blowpipe = 1.5 cm, height = 4.8 cm, bottom diameter = 3.5 cm; rim diameter = 0.5 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 7658; Middle Bronze Age (DUMITRAŞCU 1989, 121, Pl.: X/1; XI/1).
2. *Clay tuyère* (Pl. I/7); broken; diameter towards the insertion of the blowpipe = 2.4 cm; height = 4.7 cm, bottom diameter = 3.1 cm, rim diameter = 0.7 cm; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 1196; Middle Bronze Age (DUMITRAŞCU 1989, 122, Pl.: X/2; XI/2).

IX. Sântion–"Dealul Mănăstirii", Bihor County.

1. Sandstone *mould* (Pl. IV/2); from the second settlement layer ascribed to the second phase of the Otomani culture; for flat axes; "Ţara Crişurilor" Museum, Oradea, Inventory No.: 4988; Middle Bronze Age (ALEXANDRESCU 1955, 489, Fig. 2; VULPE 1975, 62, Nr. 319, Pl. 35/319; DUMITRAŞCU 1989, 129–130, Pl.: XXV/1; XXVI/1).
2. Sandstone *mould* (Pl. IV/1); from the second settlement layer; for flat axes, on the reverse side the shape of a socketed chisel can be observed; "Ţara Crişurilor" Museum Oradea, Inventory No.: 4987; Middle Bronze Age (ALEXANDRESCU 1955, 489, Fig. 2; VULPE 1975, 62, Nr. 320, Pl. 35/320; DUMITRAŞCU 1989, 129–130, Pl.: XXII/1; XXIII; XXVII/1; XXVIII/1).

X. Vărşand–"Movila dintre vii", Arad County.

1. Fragmentary *mould*; for flat axes; Middle Bronze Age (POPESCU 1956a, 306; POPESCU 1956c, 116–117, Fig. 77/1; MOZSOLICS 1967, 139; BONÁ 1975, 135 "for chisels"; GOGÂLTAN 1999, 134).
2. *Clay tuyère* (Pl. 1/9); Middle Bronze Age (BÓNA 1975, 132, Pl. 150/14).

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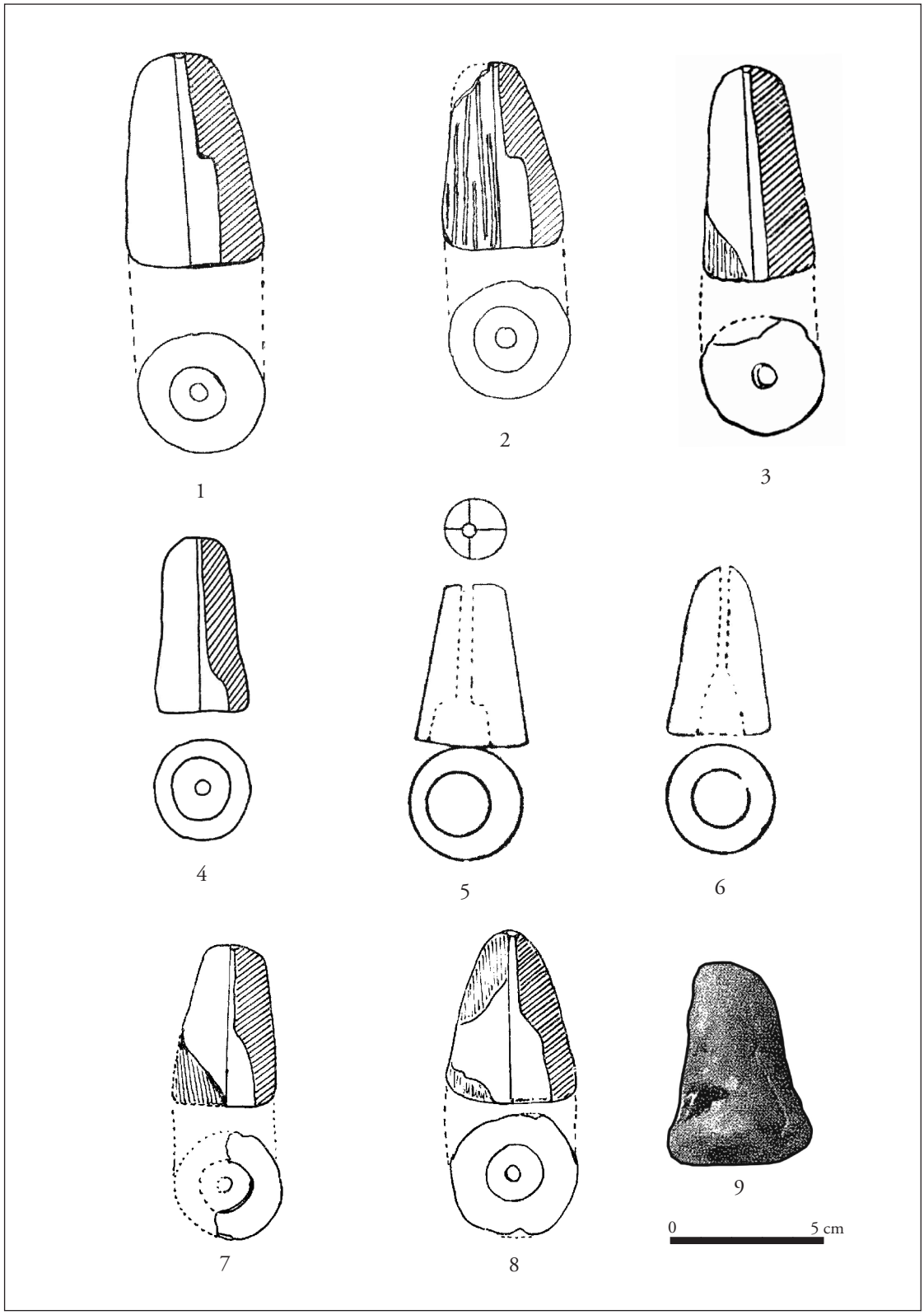
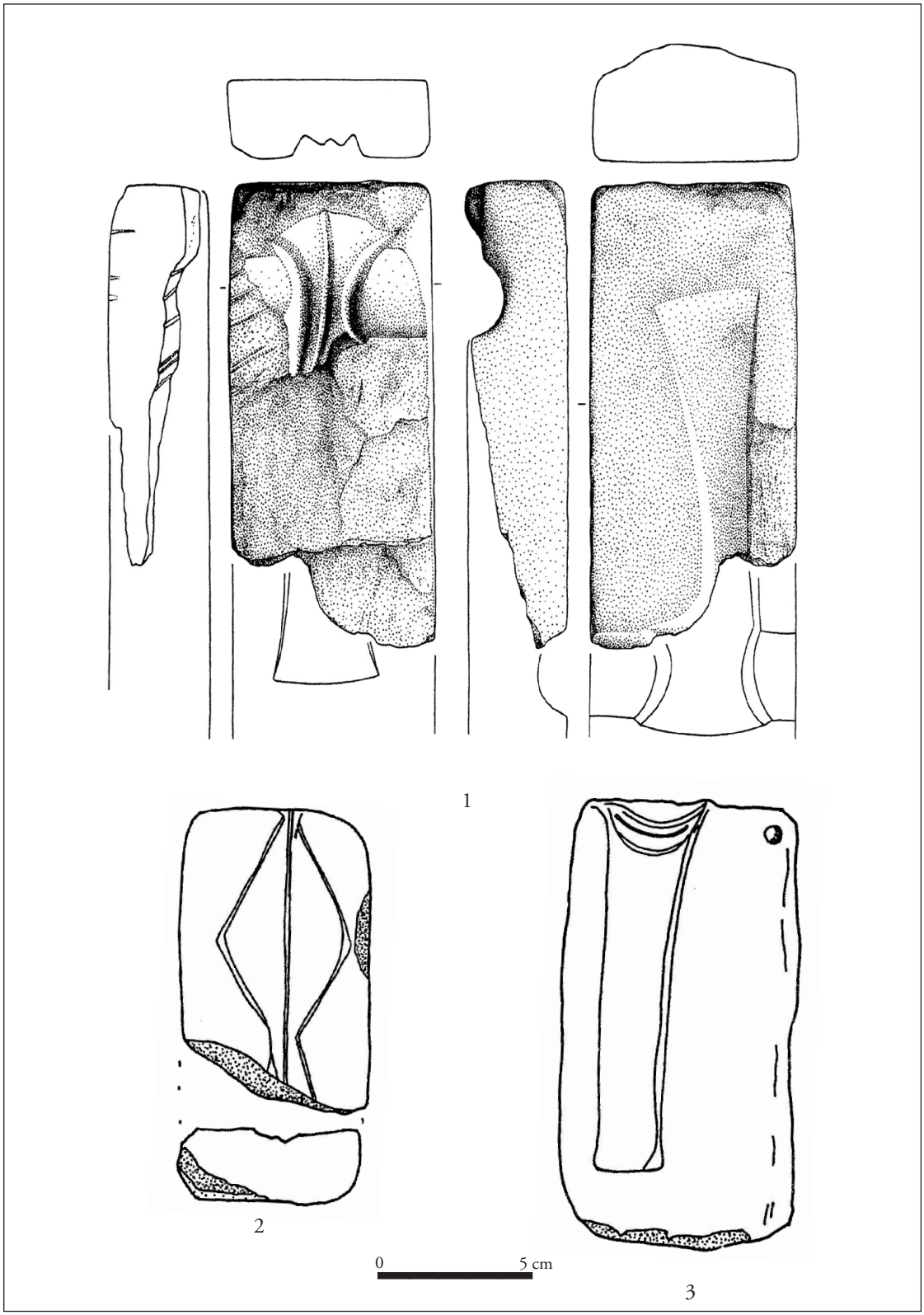


Pl. I. 1, 2 – Girişu de Criş–"Alceu". 3 – Roşiori–"La sere". 4 – Derşida–"Dealul lui Balotă". 5, 6 – Dindeşti–"Cetate". 7, 8 – Sălacea–"Dealul Vida". 9 – Vărşand–"Movila dintre vii". (1–3, 7–8 after DUMITRAŞCU 1989; 4 after BEJINARIU 2005; 9 after BÓNA 1975). 9 – no scale.



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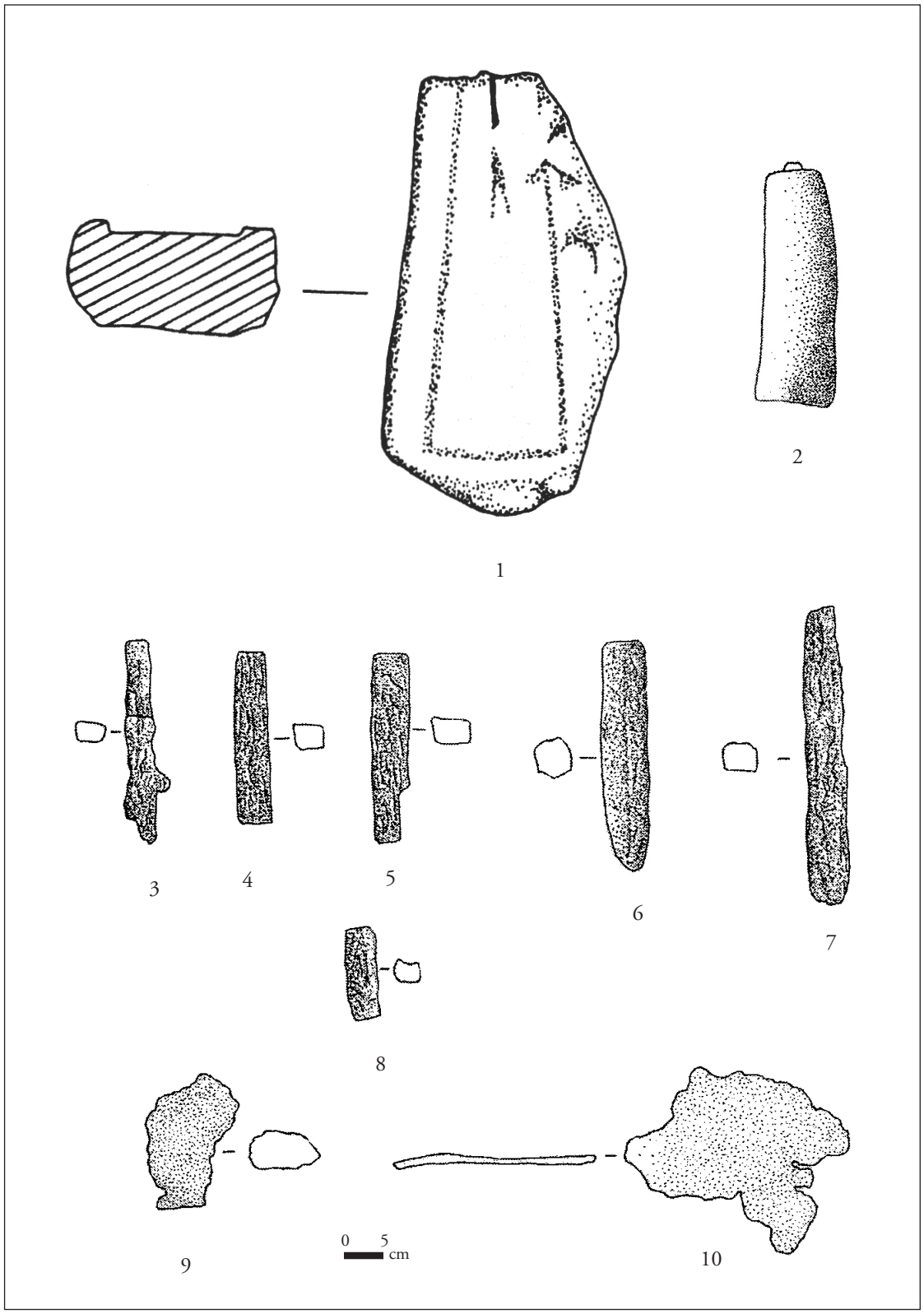
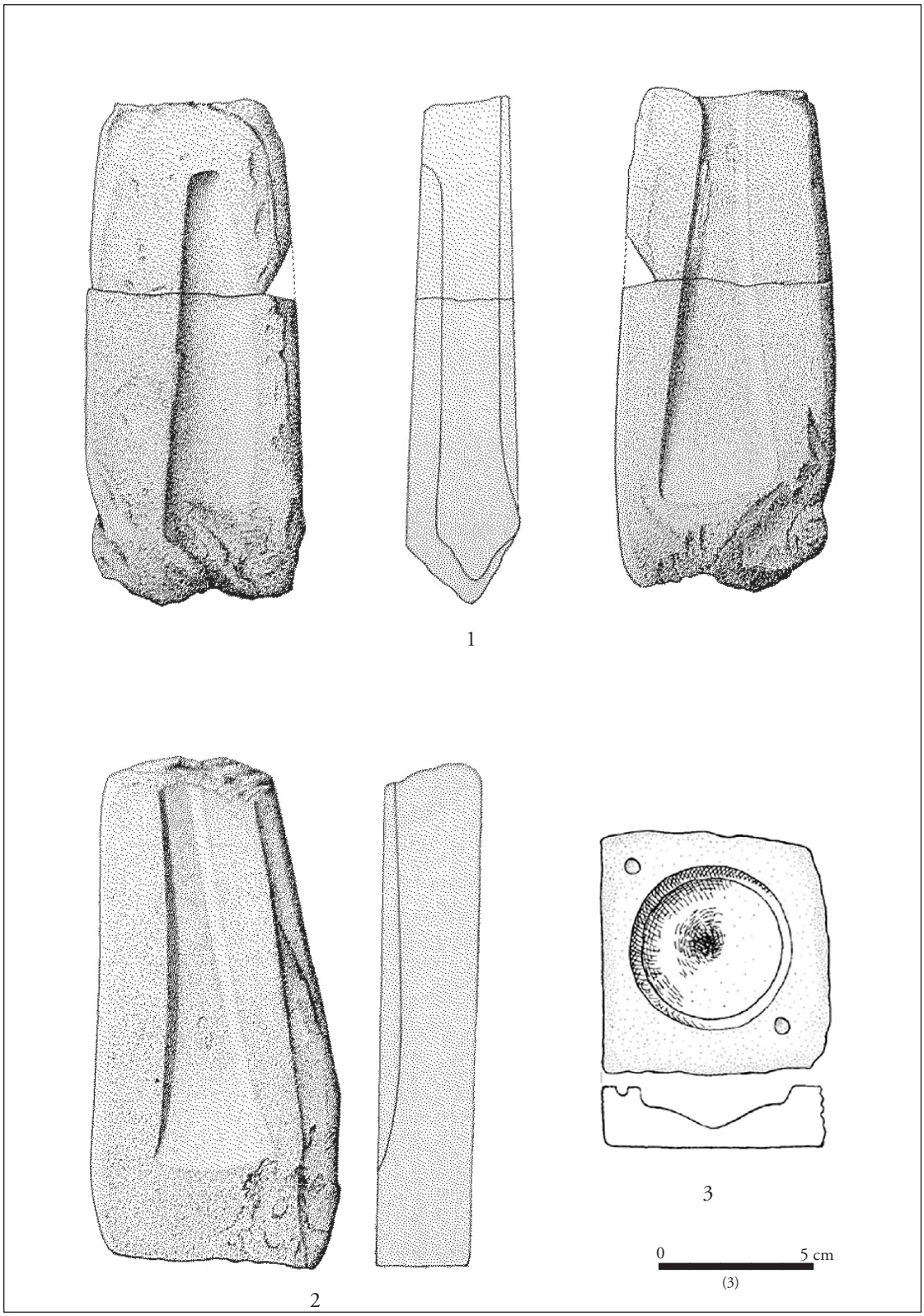
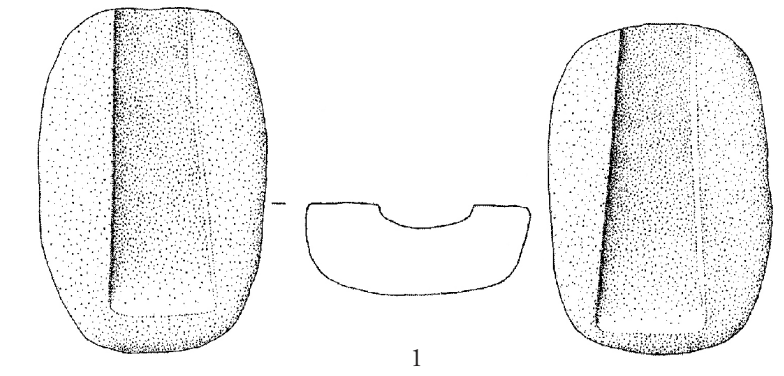


Pl. III. 1 – Pir–"Cetate". 2 – Pecica–"Şanţul Mare" (1 after SZÉKELY 2000; 2–10 after GOGÂLTAN 1999). 1 – no scale.



Pl. IV. 1, 2 – Sântion–"Dealul Mânăstirii". 3 – Otomani–"Cetatea de pământ" (1–2 after VULPE 1975; 3 after MOLNÁR 2011). 1–2 no scale.



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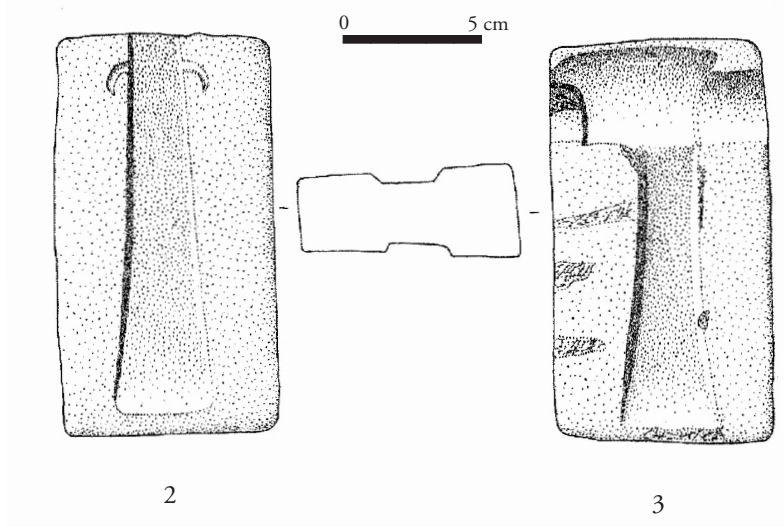

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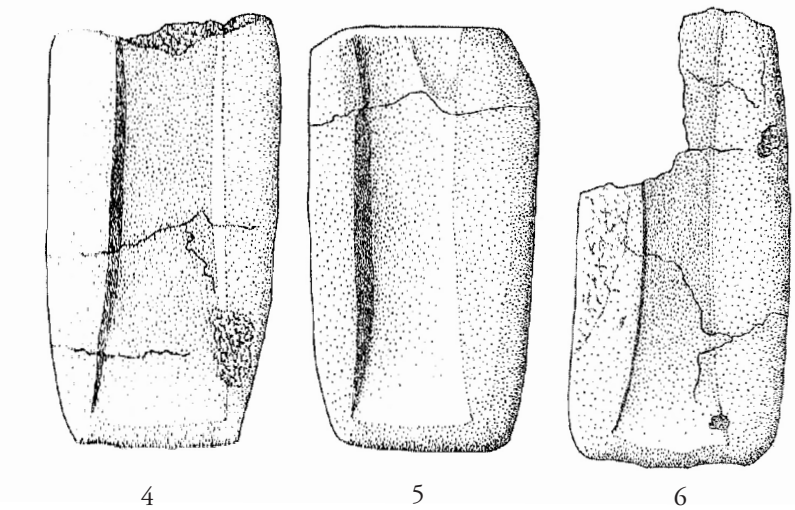

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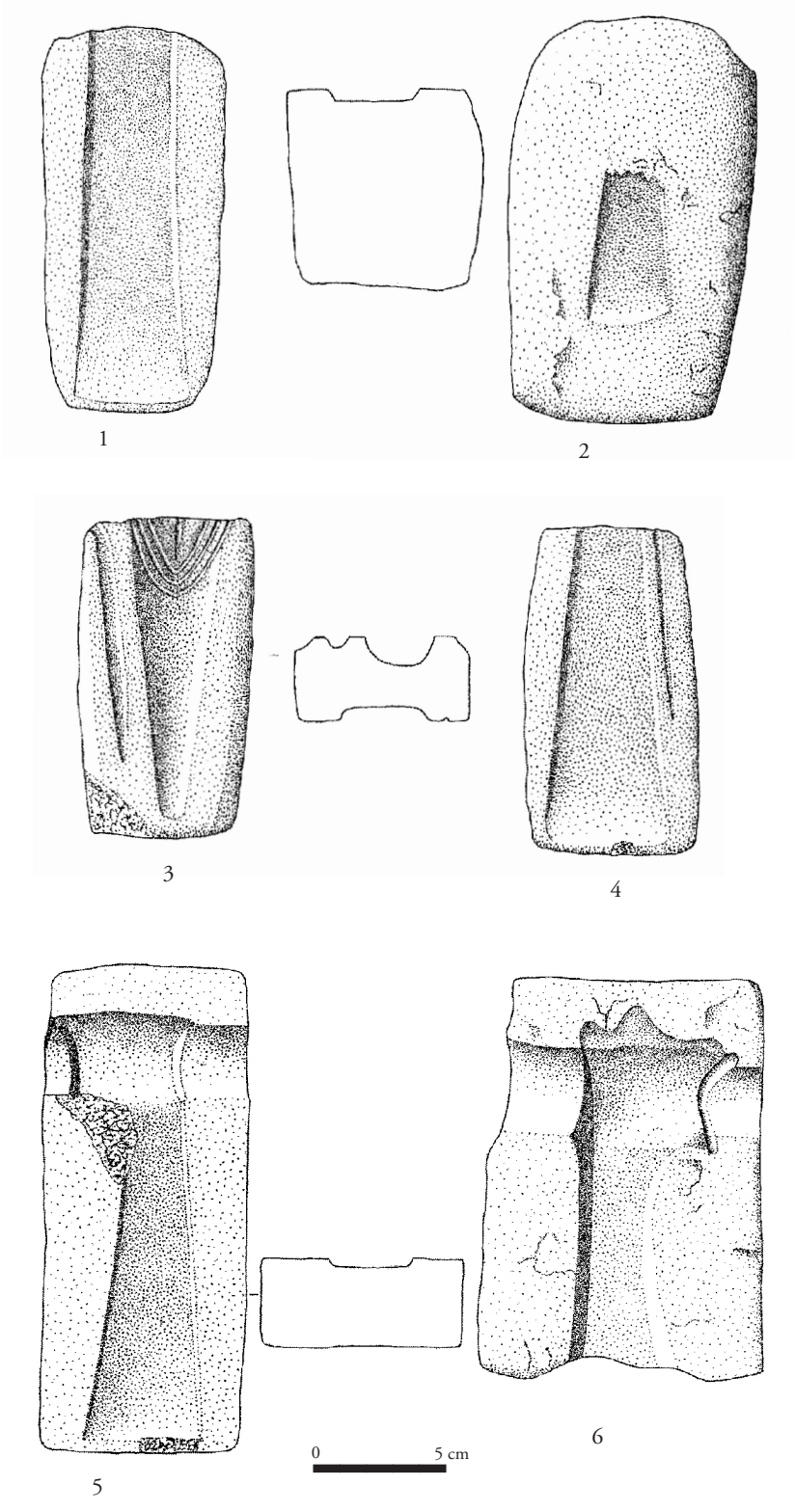
Pl. V. 1–6 – Pecica–"Şanţul Mare" (after GOGÂLTAN 1999).



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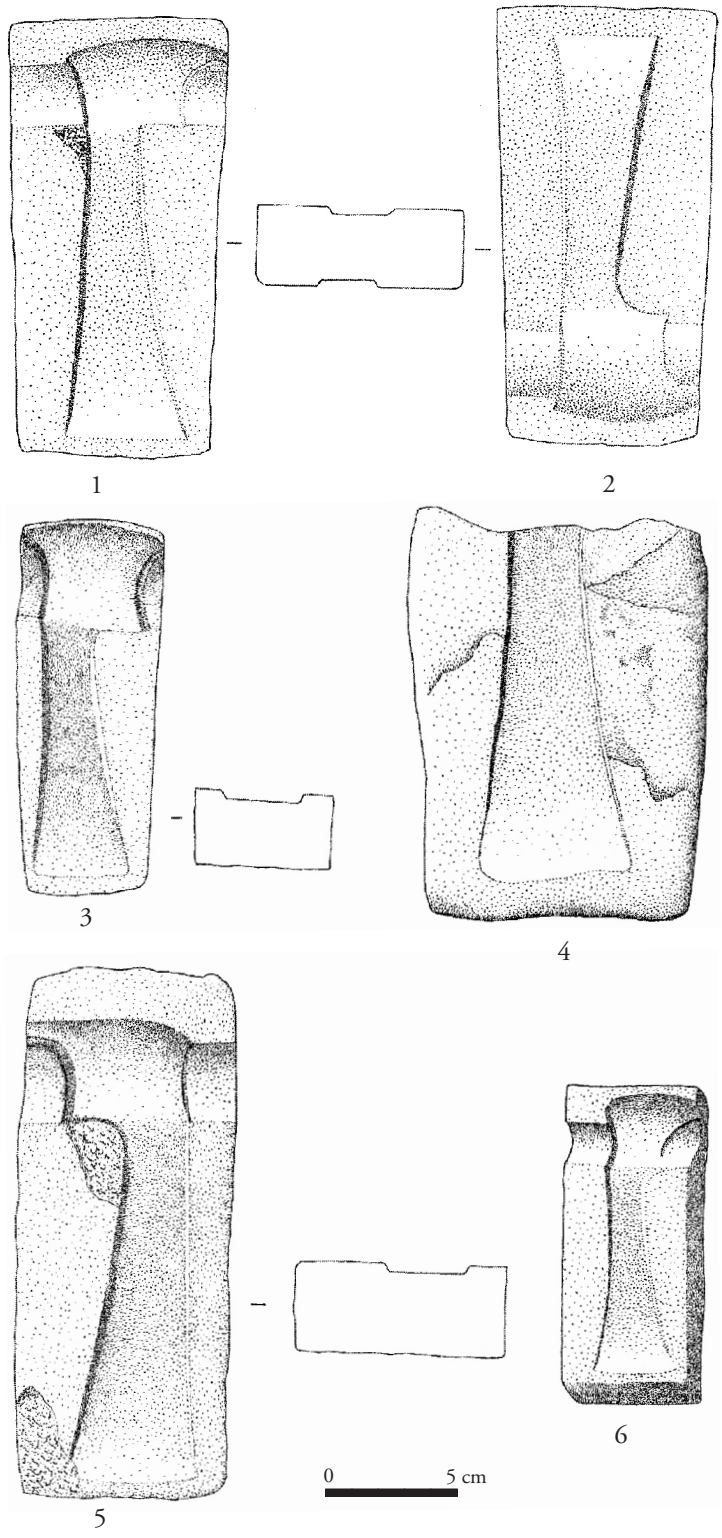

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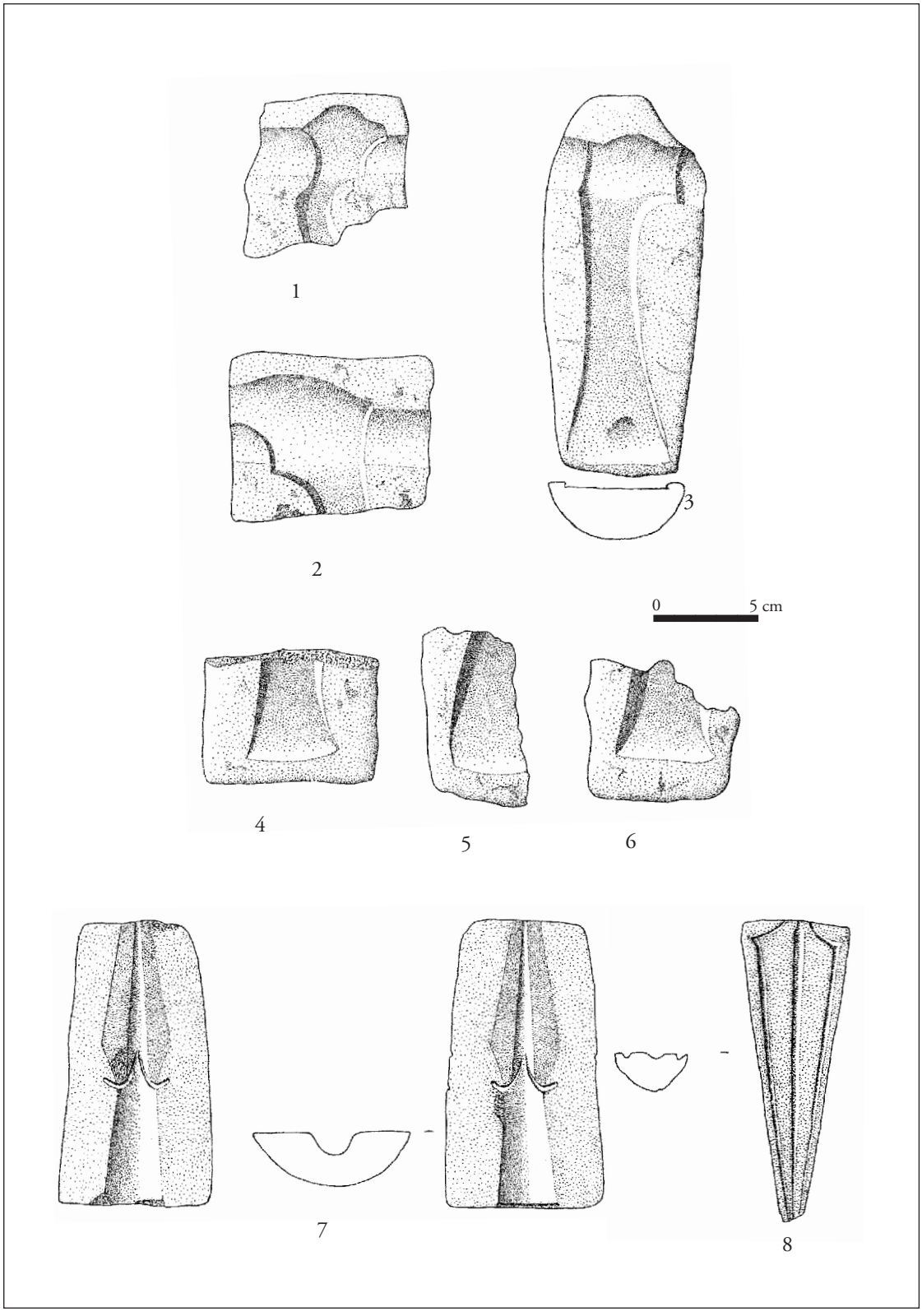
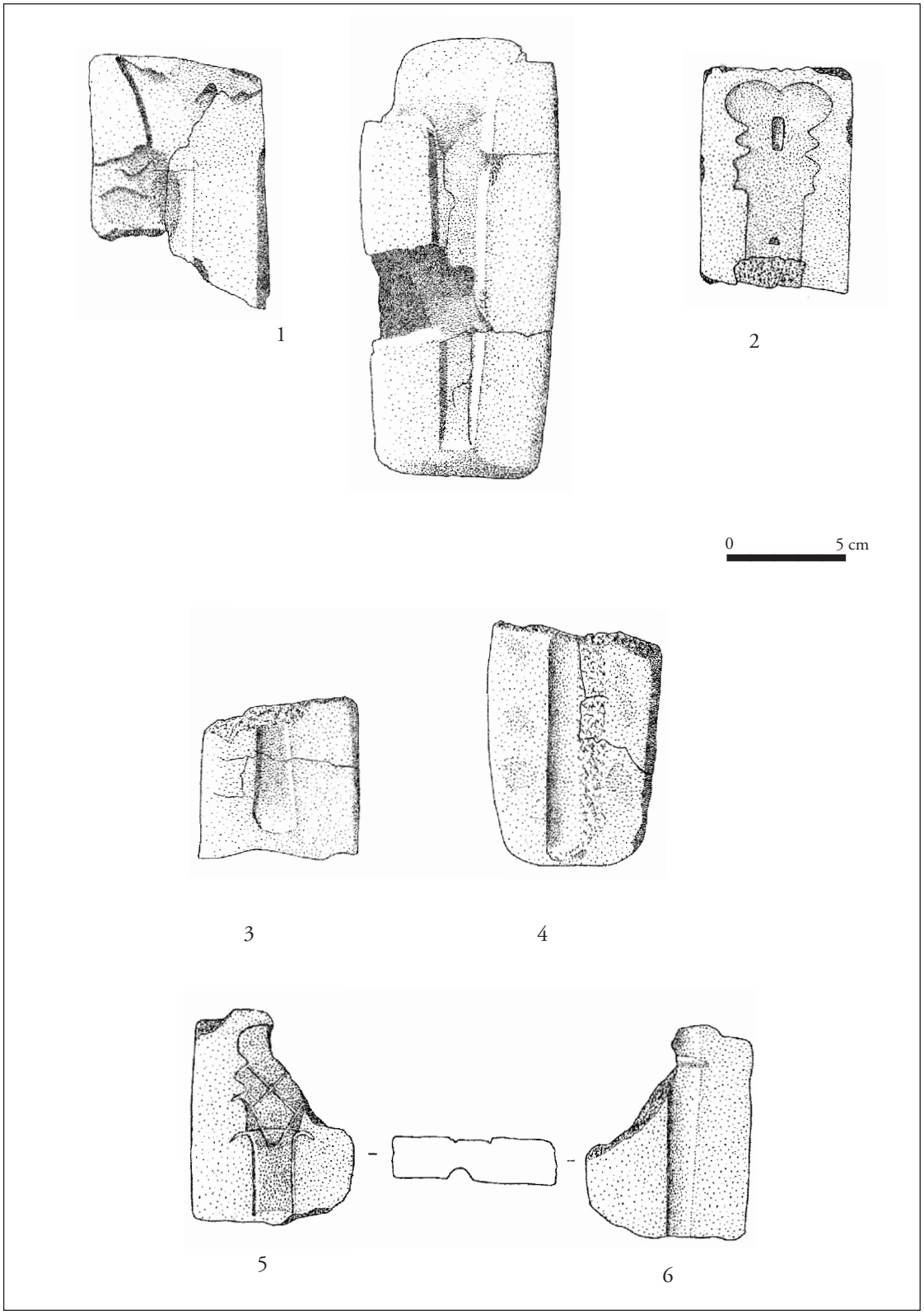


Pl. VIII. 1–8 – Pecica–"Şanţul Mare" (after GOGÂLTAN 1999).



Pl. IX. 1–6 – Pecica–"Şanţul Mare" (after GOGÂLTAN 1999).