

Goranka Lipovac Vrkljan & Ana Konestra

POTTER'S TOOLS FROM THE WORKSHOP OF *SEXTUS METILIUS MAXIMUS* (CRIKVENICA, CROATIA): AN APPROACH TO THE RECONSTRUCTION OF THE PRODUCTION TECHNOLOGY

The paper tackles the problem of the potter's tool drawing on the examples uncovered at Crikvenica (Croatia), where a pottery workshop inserted within the saltus of Sextus Metilius Maximus has been excavated. These objects, only sporadically addressed within specialised literature, offer the possibility for interpretations based on their manufacture or sourcing methods, their usage in the manufacturing process and within the single production centre.

*Objects identified as tools have been classified by function and techniques of manufacture, but also by different materials in which they were made. The analysis gave us the possibility to discuss production technology and potter's know-how, and to try to reconstruct certain cultural practices which might be signals of differences occurring within the pottery production industry of the region at the passage from protohistory to the Roman era. In fact, Crikvenica style pottery and ceramics, and the technology utilised to manufacture them seem to be foreign to the region, and are probably to be connected to the very set up of the *figlina*.*

Introduction

Sextus Metilius Maximus' pottery workshop has been identified at Crikvenica (north-eastern Adriatic, Croatia) (**fig. 1**), and excavated for the past ten years¹, being the first and, so far, the only thoroughly studied pottery workshop of the province *Dalmatia*. The complex of the *figlina* comprises of an enclosed space featuring larger covered areas, smaller rooms, ample open space, a road and other production features such as a clay basin (**fig. 2**), while so far four kilns have been identified and excavated.²

During the excavation, more than 50 tons of pottery, amphorae and ceramic building material wasters have been recovered, among which more than 90 types of household pottery³, 13 types of amphorae and a wide array of CBM, including stamped *tegulae*, have been identified. The workshop was active from the end of the 1st century BC to the end of 2nd century AD.⁴ In the 3rd–4th century frequentation of the area seems to be sporadic, with major evidence being a couple of children's burials⁵ and finds of late Antique coins.

A selection of potter's tools has been isolated from the workshop's waste. Being ceramic, they are hard to identify within the large amount of pottery fragments, so far mainly

primarily sorted (by class and vessel part or CBM class)⁶, and more examples are to be expected with further find's processing. Other objects, made of different materials (bone, metal), but for which we might suggest the same function, have been isolated from the bulk of the site's small finds⁷.

The findspot of most of these objects does not help their interpretation (**fig. 2**), as they were mostly found within levelling layers, such as SU 004, 005, 002⁸. Nevertheless, the clustering of tools in the western part of the *figlina*, within the covered area and around the kiln, could be linked to activities going on in this area. Although the area to the west of the largest kiln is also a refuse accumulation space, this clustering could be indicative of the provenance of the waste from the larger covered space located to the north (**fig. 2**), which is interpreted as a potter's working area, while no object could be definitely linked to the other workshop features identified on the site (smaller rooms, roofed open spaces, etc) where some of the production activities could have been taking place as well.⁹ Therefore, the interpretation of presented objects will be mainly

¹ LIPOVAC VRKLJAN 2009, LIPOVAC VRKLJAN ET AL. 2016.

² LIPOVAC VRKLJAN ET AL. 2016, 145. Other kilns are supposed in the non-excavated areas.

³ OŽANIĆ ROGULJIĆ 2012.

⁴ LIPOVAC VRKLJAN 2009.

⁵ A. KONESTRA/I. OŽANIĆ ROGULJIĆ, Illuminating the Way: Later Roman Factory Lamp from a Grave Context in Crikvenica. In: G. Lipovac Vrkljan/M. Ugarković/I. Ožanić Roguljić (eds.), *Roman and Late Antique Lamps: Production and Distribution, Contacts on the Mediterranean*. Proceedings of the international round table, Zagreb 2nd February 2015 (Zagreb 2016) 128–136.

⁶ G. LIPOVAC VRKLJAN/I. OŽANIĆ ROGULJIĆ, Approach to the study of ceramic material from the workshop of *Sextus Metilius Maximus* (Crikvenica – Igralište, Croatia). *Quad. Friulani Arch.* 25, 2015, 129–133.

⁷ Some of the finds were unavailable for detailed analysis as are currently being restored (i.e. **table 1,27**).

⁸ A similar situation has been noted in Scoppieto (BERGAMINI/GAGGIOTTI 2011, 344).

⁹ G. LIPOVAC VRKLJAN, Osnutak i djelovanje keramičarske radionice. In: 845°C *Ad Turres*, exhibition catalogue (Crikvenica 2016) 43–44. For spatial organisation of ancient pottery workshops see E. HASAKI, *Crafting Spaces: Archaeological, Ethnographic and Ethnoarchaeological Studies on Spatial Organization in Pottery Workshops in Greece and Tunisia*. In: M. Lawall/J. Lund (eds.), *Pottery in the Archaeological Record: Greece and Beyond* (Aarhus 2011) 12–28. – S. PALLECCHI, Le fornaci romane di Albinia: identificazione delle unità funzionali e prima ricostruzione delle linee di produzione. In: V. Accorcia/C. Rizzitelli (eds.), *Materiali per Popolonia 7* (Pisa 2008) 323–338.



Fig. 1. Location of Crikvenica (basemap by Google Maps/Snazzy Maps).

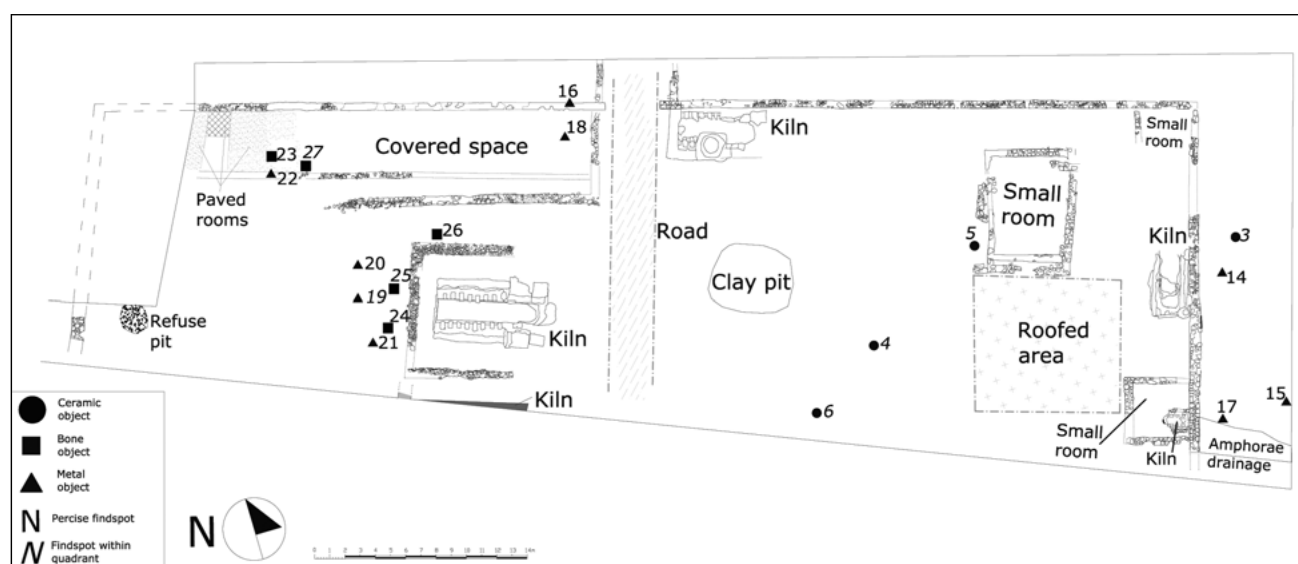


Fig. 2. Schematic layout of the workshop (simplified from excavation ground plan) with the findspots of potter's tools (drawing: K. Turkalj, M. Grgurić; re-elaboration: A. Konestra).

based on their shape, craftsmanship, analogies and comparisons with some workshop's products, in an attempt to get a glimpse of the technology and organisation of production within this provincial early Imperial workshop. In addition to hand tools¹⁰, we have considered other implements, such as kiln spacers, in order to showcase the whole range of objects which artisans used during various phases of the manufacturing process.

Potter's tools: morphology and functionality (table 1)

Functionally, identified potter's tools can be broadly divided into tools for forming/decorating/puncturing (ribs/scrapers, pins and needles) (figs. 3–5) and implements used in the

kiln (spacers) (figs. 3,10–13; 5,3), though the evidence also shows the adaptation of unlikely objects to perform some yet unidentified activity within the workshop (i.e. the bovine ulna with smoothed surface¹¹, fig. 5,26).

On the other hand, analysis of the manufacturing of these objects has highlighted two main modes of acquisition: *ex novo* manufacture and reuse, sometimes with reshaping, of objects initially meant for other purposes.

Within the first group, featuring objects produced on site, we could further elaborate a distinction between objects with the potential to be used more than once (i.e. potter's ribs/polishers) and object produced at the moment of need (i.e. amor-

¹⁰ See MURPHY/POBLOME 2012, 200 for a definition of tool.

¹¹ K. MICULINIĆ, Arheološka analiza faune lokaliteta Crikvenica-Igralište. Keramičarska radionica Seksta Metilija Maksima (unpublished report, Zagreb 2008) 5.

N.	Image	Description and function	Find spot	Analogy
1	Fig. 3,1	Bronze scraper/potter's rib	/	Sagalassos: MURPHY/POBLOME 2012, 20 fig. 2c; 3d. – Scoppieto (slightly different shape): CASTELLANI/NICOLETTA/SPERANZA 2011, 455–456 fig. 4,4–6.
2–4	Fig. 3,2–4	Convex ceramic potter's ribs	/, Q d19/SU 004, Q d14/SU 004	For ceramic analogies in ARS production: MACKENSEN 2009.
5–6	Fig. 3,5–6	Concave ceramic potter's ribs/polishers	Q e16/SU 375, Q c13/SU 490	In ARS production: MACKENSEN 2009. – Sagalassos: MURPHY/POBLOME 2012, 201 fig. 2d; 3;
7–9	Fig. 3,7–9	Ceramic potter's ribs - reuse of vessels' wall fragments	/	Sagalassos: MURPHY/POBLOME 2012, 205 fig. 4. – Albinia (based on description): PALLECCHI 2014, 22.
10–13	Fig. 3,10–13	Fan-shaped or triangular ceramic potter's ribs or kiln spacers	/	
14–22	Fig. 4/14–22	Bronze pins and needles/ <i>styli</i> /scoops		Sagalassos: MURPHY/POBLOME 2012, 202 fig. 2f.g. – Corfu: KOURKOU-MÉLIS/ DÉMESTICHA 1997, 558–561 fig. 8, 9, 19. – Micāsasa: MITROFAN 1995 pl. 5,3. – Scoppieto: CASTELLANI/NICOLETTA/SPERANZA 2011, 455; 457 fig. 4,2–3.
		PN 64	Q d19/SU 004,	
		PN 81	Q b19/SU 005,	
		PN 94	Q h11/SU002,	
		PN 155	Q b18/SU 005	
		PN 3129	Q h11/SU 562	
		PN 3507	Q f/g 7/8/SU 612	
		PN 3485	Q g8/SU 612	
		PN 3509	Q f8/596	
		PN 3115	Q h8/SU056	
23–25	Fig. 5,23–25	Bone hairpins/ <i>styli</i>		Scoppieto: CASTELLANI 2011, 440–442 fig. 1,4–7. – Corfu: KOURKOU-MÉLIS/DÉMESTICHA 1997, 561 fig. 15. – Micāsasa: MITROFAN 1995 Pl. 5,3.
		PN1351	Q i7/SU043	
		U 948	Q f8/SU055	
		U 989	Q g8-f8/SU596	
26	Fig. 5,26	Bovine ulna (U 341)	Q g9/SU053	Corfu: KOURKOU-MÉLIS/DÉMESTICHA 1997, 557–558 fig. 4; 6.
27		Iron hoe/adze (PN 3730)	Q h9/SU572	Corfu: KOURKOU-MÉLIS/DÉMESTICHA 1997, 561 fig. 16.
28	Fig. 6,3	Amorphous kiln spacers	/	Scoppieto: BERGAMINI/GAGGIOTTI 2011, 356–355 fig. 6. – Giancola: PALLECCHI 2012a, 288 fig. 3,59.

Table 1. Potter's tools from *Sextus Metilius Maximus*' workshop
(Findspot column: Q = quadrant, SU = stratigraphic unit, *italic* - uncertain, / - lacking data).

phous kiln spacers). The bad state of conservation of most ceramic objects uncovered on the site, particularly regarding the objects' surface, mostly precludes the identification of use-wear signs such as incisions or polished areas. Ceramic objects manufactured within the workshop to be used as tools could be interpreted as potter's ribs (**table 1; fig. 3,2–6**) or polishers, as they sometimes resemble pebbles, known to have been used for this purpose (**table 1; fig. 3,2–4**).¹² Reshape is evident in the case of vessel wall fragments, while these objects, the only ones showing use-wear signs in the form of an oblique smoothing of the cut, could be interpreted

as potter's ribs (**table 1; fig. 3,7–9**). A group of objects (**table 1; fig. 3,10–13**), clearly made out of vessel walls, do not have analogies, so their usage is tentatively proposed as potter's ribs or kiln spacers. The latter is also proposed for a number of amorphous clay lumps which sometimes bare more or less regular impressions, possibly derived from the objects they were attached to during firing.¹³ The technique of manufacture of the bronze potter's rib (**table 1; fig. 3a,1**) is hard to assess with certainty, but it was probably reshaped from another bronze object. Particular attention seems to have been paid to the manufacture of this object, which shows a curved and a linear edge, allowing a plurality of usage¹⁴.

¹² Sagalassos: MURPHY/POBLOME 2012, 202 fig. 2a. – Scoppieto: BERGAMINI/GAGGIOTTI 2011, 348 fig. 2,8. – Rossington Bridge: BUKLAND/HARTLEY/RIGBY 2001, 28. fig. 30. – Corfu: KOURKOU-MÉLIS/DÉMESTICHA 1997, 562 fig. 21.

¹³ Examples from Giancola in PALLECCHI 2014, 29–30.

¹⁴ A similar versatility has been noted within scrapers from Sagalassos:

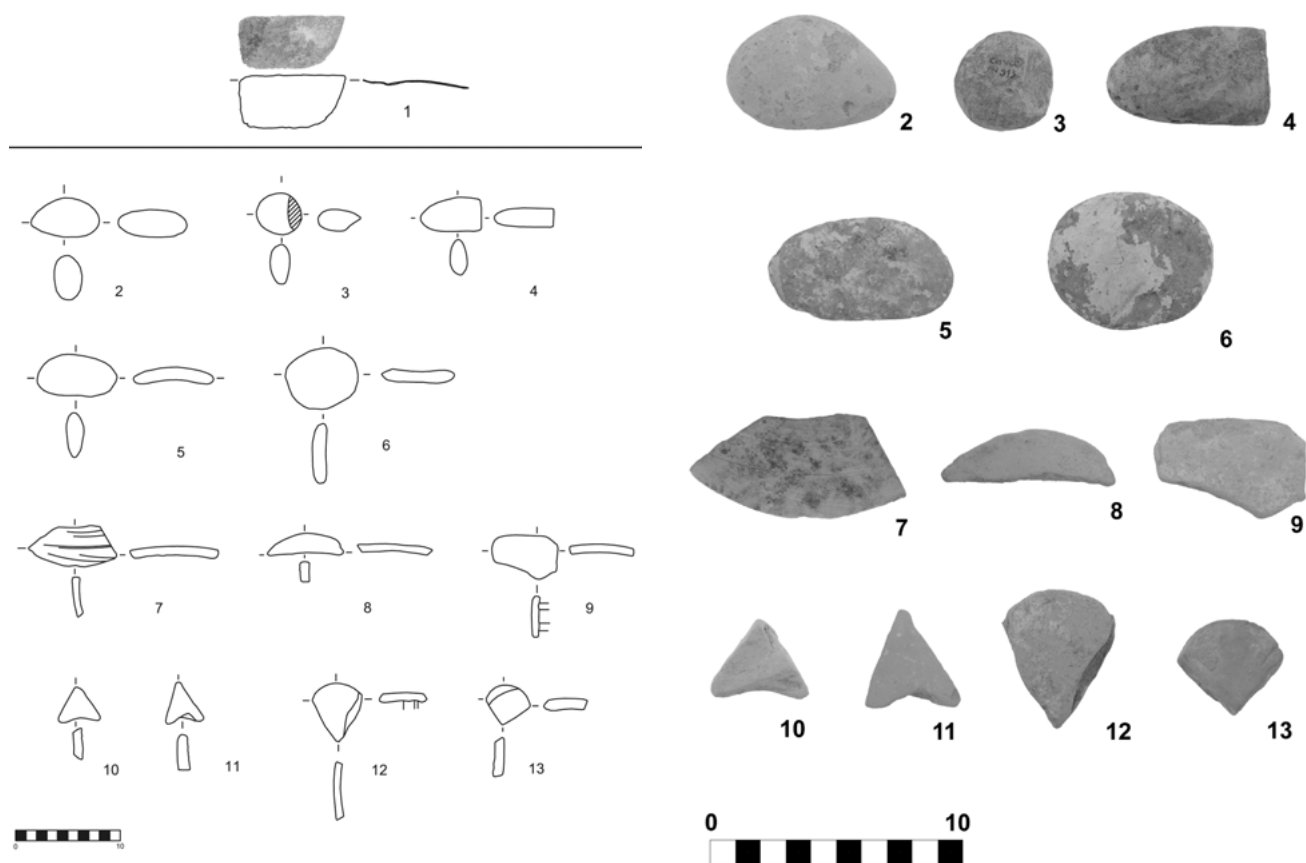


Fig. 3. a–b. Bronze potter's rib/scrapper (1) and ceramic potter's tool/kiln implements (2–13) (drawings and photographs: A. Konestra).

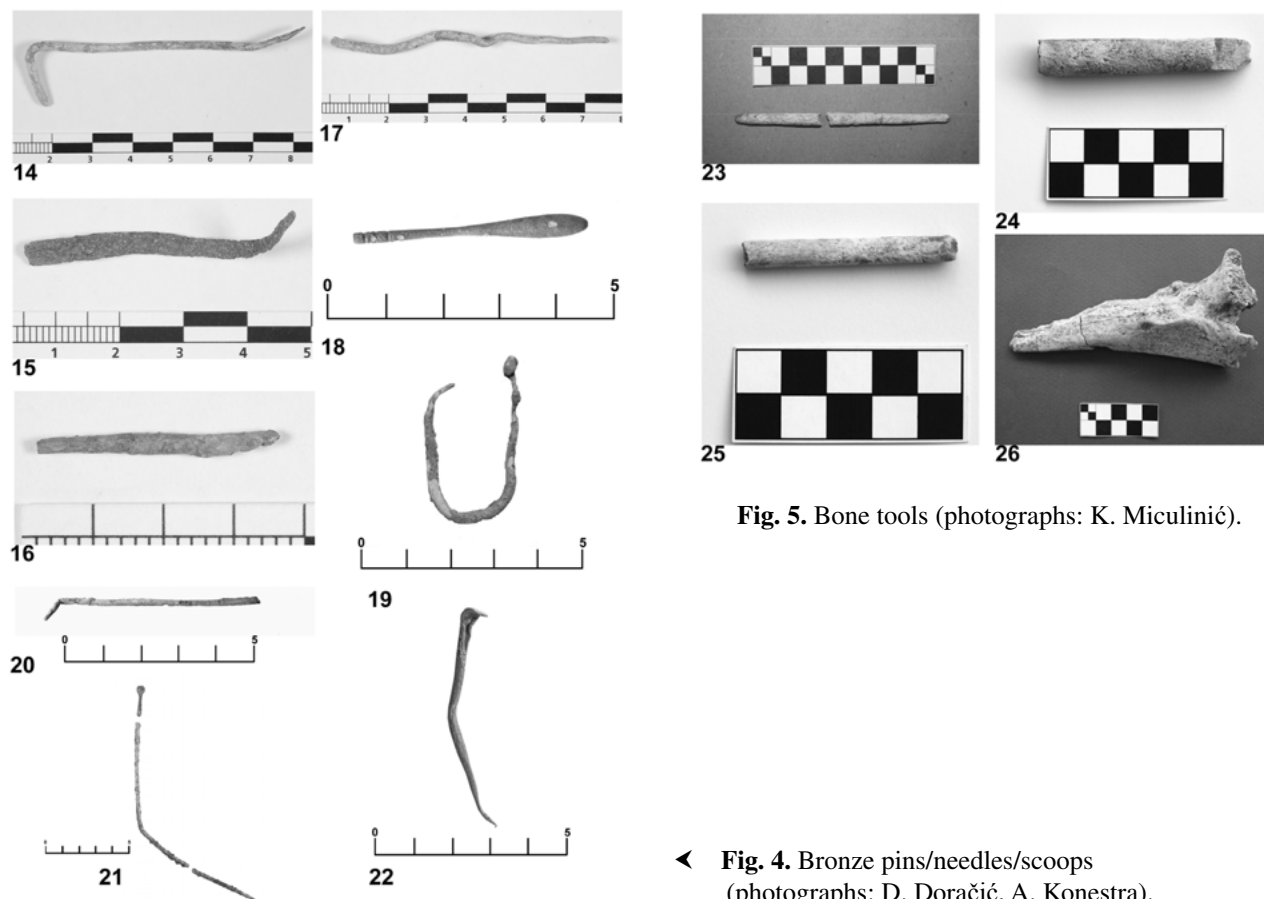


Fig. 5. Bone tools (photographs: K. Miculinić).

Fig. 4. Bronze pins/needles/scoops (photographs: D. Doračić, A. Konestra).

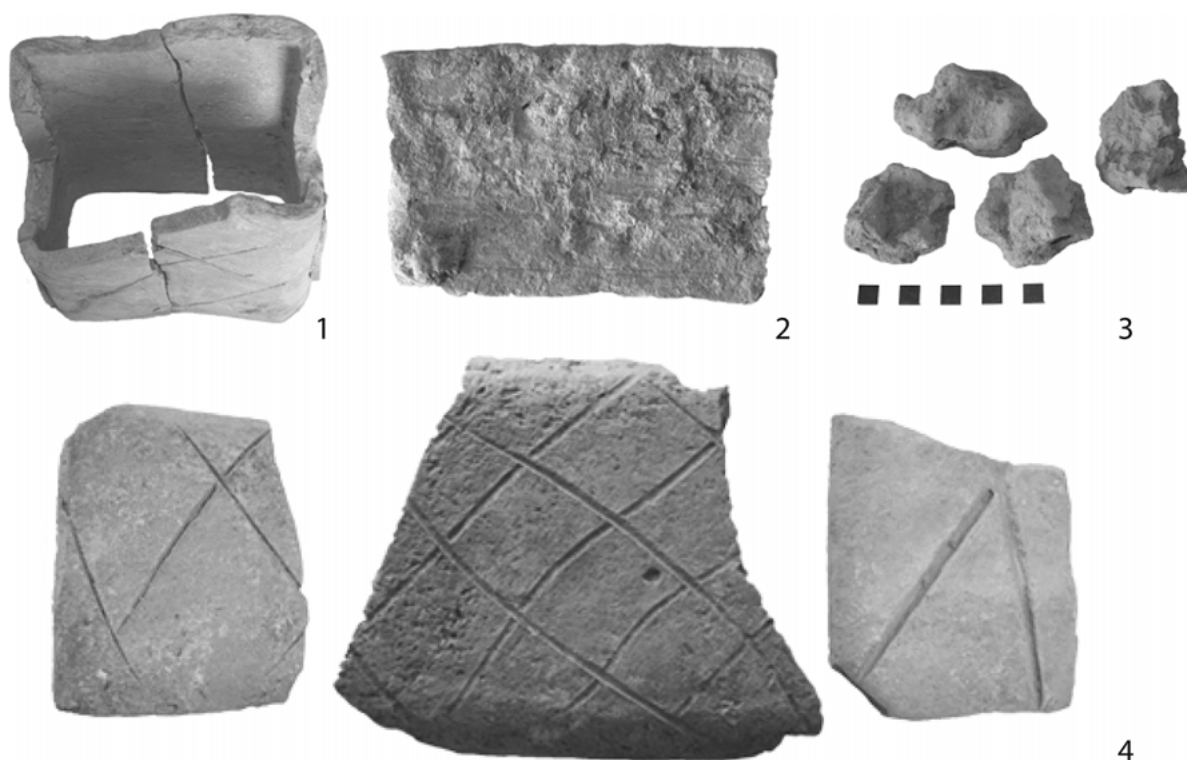


Fig. 6. Ceramic building materials with evidence of wooden mould and point tool usage (1–2; 4); amorphous kiln spacers (3) (photographs: A. Konestra, G. Lipovac Vrkljan).

The group of reused objects is mainly composed of metal and bone objects (non-ceramic objects) (table 1; fig. 4,14–26), and none seems to have been originally intended as potter's tools. Some of these are of a particular interest, as they seem to have been brought in from a settlement context, and can sometimes be associated with female users (hairpins, pins and needles), while some could be parts of *styli*, often reused in pottery shaping.¹⁵ Lastly, two of the tools could have originally served as medical instruments (table 1; fig. 4,20.22).¹⁶ Objects uncovered on the site, such as fragments of a bronze sifter, rather than being used within the manufacturing process, could have provided the raw material for tools manufacture.¹⁷

One object made of iron (table 1,27) could be interpreted as a potter's tool, although iron is regarded as an unsuitable material due to rusting occurring in humid conditions, making bronze a far better choice for potter's tool.¹⁸ Nevertheless, iron objects do occur within pottery workshop tool assemblages¹⁹, while similarly shaped tools occur made of bronze as well²⁰. For this object we propose two possible functions: the first being within clay sourcing or preparation processes (tentatively interpreted as a hoe), the second could be that of wood processing (tentatively interpreted as an adze), including mould manufacture.²¹

Clear evidence of tool usage has been established for the purpose of incising/decorating/puncturing, the first being evident on *tubuli* (fig. 6,4) and thin-walled ware rim grooves, and the second appearing on loom weights, ceramic sifters, some lid types and vessels with perforated grid²². Surface leviga-

Tools production and usage within the workshop

Clear evidence of tool usage has been established for the purpose of incising/decorating/puncturing, the first being evident on *tubuli* (fig. 6,4) and thin-walled ware rim grooves, and the second appearing on loom weights, ceramic sifters, some lid types and vessels with perforated grid²². Surface leviga-

MURPHY/POBLOME 2012, 205–206. – A bronze tool interpreted for the same purpose but different in shape has been uncovered at Fréjus: D. BRENTCHALOFF, L'atelier du Pavadou. Une officine de potiers flaviens à Fréjus, *Rev. Arch. Narbonnaise* 13/1, 1980, 106.

¹⁵ SCHALTENBRAND OBRECHT 2012, 58; 79.

¹⁶ Medical instruments have been recovered at Scoppio as well, but are not interpreted as repurposed tools: CASTELLANI/NICOLETTA/SPERANZA 2011, 458–459 fig. 5.

¹⁷ A large number of metal objects has been recovered on the site, mostly iron nails, but also a number of fragmentary utilitarian objects such as vessel handles, a spoon, bronze and iron sheets, etc. We chose not to interpret them all as tools since their original shape is often impossible to reconstruct rendering their function unclear and hindering the possibility to identify analogies.

¹⁸ SCHALTENBRAND OBRECHT 2012, 79.

¹⁹ P. MESPLÉ, L'atelier de potier gallo-romain de Galane à Lombez (Gers). *Gallia* 15/1, 1957, 41–71 pl. 5,16. PEACOCK 1997, 81 fig. 45,2,3; MURPHY/POBLOME 2012, 201–202 Tab. 1.

²⁰ KOURKOUMLIS/DÉMESTICHA 1997, 561 Fig. 16.

²¹ For similar objects associated with amphorae and pottery production, and carpenter's tools within pottery workshops see PALLECCHI 2014, 14–16; 27; 32 fig. 1,2.

²² I. OŽANIĆ ROGULJIĆ, Terra sigillata i keramika tankih stijenci s lokaliteta Crikvenica-Igralište. In: G. Lipovac Vrkljan/I. Radić Rossi/B. Šiljeg (eds.), *Roman Pottery and Glass Manufactures. Production and Trade in the Adriatic region*, Proceedings of the 1st International Archaeological Colloquium, 23–24 October 2008, Crikvenica (Croatia) (Crikvenica 2011) 31–38; I. OŽANIĆ ROGULJIĆ, Keramičko posuđe. In: 845°C *Ad Turres*, exhibition catalogue (Crikvenica 2016) 113, n. 77; 115, n. 83; G. LIPOVAC VRKLJAN/I. OŽANIĆ ROGULJIĆ/A. KONESTRA, Tappi d'anfora dall'officina ceramica di Crikvenica. *Quad. Friulani Arch.* 22/23, 2013, 132 fig. 3,9; I. OŽANIĆ ROGULJIĆ, Vessels with perforated grids from Crikvenica. In: G. Lipovac Vrkljan/I. Ožanić Roguljić/ B. Šiljeg/A. Konestra (eds.), *Roman Pottery and Glass Manufactures. Production and Trade in the Adriatic region*, Proceedings of the 2nd International

tion is evident on most vessel types, and the shape of some potter's ribs suggests they might have been used to produce features such as sharp wide grooves on the incense burner walls²³. Nevertheless, traces of tool usage on *tubuli* allow for the most precise tool identification. In fact, the crisscrossed pattern of grooves applied to the surface of the object could only have been made, as shape, depth and grooves endings suggest (fig. 6,4), with a sharp and point tool, most probably made of metal. Moreover, the varied shape of these grooves on the same type of object (variations in depth, straightness, endpoints shape), suggests that different tools have been used, though metallic point tools are supposed for all variants.

Other evidence of tool usage, but lacking preserved objects, is that of wooden tools associated with CBM manufacture in the form of moulds and formers, and whose traces can be seen on the materials (fig. 6,2–3), but other wooden tools were certainly used for the manufacture of vessels²⁴.

The analysis of these artefacts has highlighted some similarities with tools recovered in other ancient pottery workshop (see table 1 for analogies), both morphological and at the level of manufacture and materials used, indicating the same variety of all three features, usually interpreted as a lack of standardisation in their manufacturing process and creativity in object's reuse and adaptation.²⁵ In fact, tools needed for the same purpose were produced in two ways (reshape and purposeful production) and using several materials (metal, bone and clay).

This evidence for different techniques of manufacture shows that potters possessed a "tools production know-how", applying it to different materials at hand, but aiming to produce an object of a precisely specified shape meant to fulfil a determined need within the pottery production process. In the case of ceramic objects, the artisans utilised both skill and workshops furniture to produce an object to be used for their trade. Pottery production is a highly specialised craft, and as such possesses a complex and particular toolset, one that apparently could not be acquired outside of the artisan's niche. This might be the reason why the potters themselves devoted some of their time, skills and resources to produce and source objects that would compose their toolset.²⁶

Such choices are all indicative of a technological system that Crikvenica's potters developed, which must have been able to accommodate a wide range of different types of products, from thin-walled ware to *tegulae*.

On-site production of tools, certainly occurring for the ceramic ones, was also an economically viable solution²⁷,

while elsewhere it has also been noted that local or locally available materials, other than clay itself, were used for tools' manufacture, making their production just as convenient²⁸.

Conclusion

Crikvenica pottery workshop, active from the end of the 1st century BC to ca. the Antonine era, produced a variety of ceramic objects and pottery classes. What typological analysis highlights is the morphological and technological divergence from previous pottery production in the region²⁹, at least as the current state of research allows to assess. This is evident in wares variety, vessel shapes, firing temperature and atmosphere, clay treatment and, with all probability, products' distribution. Further geochemical analysis could shed light on the aspect of raw-material sourcing as well.

New shapes, such as amphorae or CBM, previously only imported to the region, are now produced within it, in a workshop that, in its spatial organisation, technology and toolset, finds analogies in many similar installations from different regions of the Roman world³⁰. This shift happened in such a definitive manner that no pre-Roman shape seems to have survived within the early Roman pottery repertoire of Crikvenica's workshop, as it would be expected during such cultural contacts³¹ and is well evident in other regions (e.g. early Roman pottery production in Gaul, *Noricum*, *Pannonia*, etc³²).

Certainly, potter's tools must have been used in pre-Roman pottery production of northern *Liburnia* as well, some probably featuring similar shapes³³, but tools, and other evidence of tools usage, recorded at Crikvenica are indicative of a change in technology, and as such of cultural practices initiated with the production of Roman style pottery and

²⁸ BERGAMINI/GAGGIOTTI 2011, 343.

²⁹ Pre-Roman pottery production in northern *Liburnia* has not been a subject of dedicated research, though the topic has been tackled in neighbouring areas (i.e. Istria, southern *Liburnia*, *Dalmatia*): K. BURSIC MATUŠIĆ, The Monkodonja Hillfort (Pula 1998) 26; 49–50; V. BARBARIĆ, Tipologija lončarije iz kasnoga bronzanoga i željeznoga doba s područja Dalmacije (unpublished PhD Thesis Univ. Zagreb 2011); B. KIRIGIN/J. HAYES/P. LEACH, Local pottery production at Pharos. In: N. Cambi/S. Čače/B. Kirigin, Greek influence along the East Adriatic Coast. Proceedings of the International Conference held in Split, September 24–26, 1998 (Split 2002) 247–248. CARLTON 2002, 75–78; L. ŠEŠELJ/M. VUKOVIĆ, Liburnian settlement in Radovin. Preliminary analysis of pottery assemblage. *Diadora* 26/27, 2012/2013, 333–350; K. MIHOVIĆ, Pottery. In: K. Mihović (ed.), The Histri in Istria (Pula 2014) 304–312.

³⁰ For an overview of the organisation of similar workshops in Italy and the Roman West see S. PALLECCHI 2012b, 475–477.

³¹ V. ROUX, Lecture anthropologique des assemblages céramiques. Fondements et mise en oeuvre de l'analyse technologique. *Nouvelles Arch.* 119, 2010, 6–7.

³² E. SCHINDLER KAUELKA, Gobelet celtique, forme romaine. Adaptation ou création d'un nouveau répertoire par les potiers du Norique?. In: S. Lemaître/C. Batigne Valle (eds.) *Abécédaire pour un archéologue lyonnais. Mélanges offerts à Armand Desbat* (Autun 2015) 325–328.

³³ Scrapers/potter's ribs display virtually unchanged shapes thought history, which is evident from many ethnological examples (PEACOCK 1997 fig. 1,10.16), and also in traditional pottery production from the area of ancient *Liburnia* (CARLTON 2002, 69; P. PETROVIĆ, Traditional pottery production of Veli Iž. In: G. Lipovac Vrkljan/I. Ožanić Roguljić/B. Šiljeg/A. Konestra (eds.), *Roman Pottery and Glass Manufactures. Production and Trade in the Adriatic region*, Proceedings of the 2nd International Archaeological Colloquium, Crikvenica [Croatia], 28th–29th October 2011 [Crikvenica, Zagreb 2014] 79–83 fig. 4).

Archaeological Colloquium, Crikvenica (Croatia), 28th–29th October 2011 (Crikvenica-Zagreb 2014) 279–286.

²³ OŽANIĆ ROGULJIĆ 2012, 125 fig. 23–24

²⁴ PEACOCK 1997, 25; N. CUOMO DI CAPRIO, *Ceramica in archeologia 2. Antiche tecniche di lavorazione e moderni metodi di indagine* (Roma 2007) 173; P. WARRY, *Tegulae. Manufacture, typology and use in Roman Britain* (Oxford 2006) 33–37.

²⁵ MURPHY/POBLOME 2012, 200, 202; 207.

²⁶ Tools' self-production and sourcing has been noted ethnographically as well: O. P. GOSSELAIN, *Ethnographie comparée des trousses à outils de potiers au sud du Niger*. *Bull. Soc. Préhist. Française* 107/4, 2010, 667–689).

²⁷ MURPHY/POBLOME 2012, 205.

ceramics³⁴. Technological novelty in this aspect is perhaps mostly evident in wooden tools utilised for CBM production, itself a novelty within the region³⁵.

Tools, as indicators of technological choices but also of know-how within a craft, allow us to follow the introduction of new craftsmanship, not only in the sense of new formal choices, but also in the aspect of people and skills involved in the manufacturing process³⁶ and the organisation of production areas and products' distribution. Evidence of foreign know-how introduction seems to support the arrival of foreign workforce, active at least at the moment of production set up and organisation.

Finally, the technological change in pottery production does show a shift to Roman style production and the introduction of a different tradition, but it also shows that the market was ready to accept these products, probably due to the numerous imports from Italy which started to appear in greater numbers a few decades before³⁷, and which encom-

pass foodstuffs as well³⁸. This commercial component is a key to understanding why syncretism in pottery technologies seems to be lacking in the case of early-Roman northern *Liburnian* pottery industry, as previous pottery productions seem to be absent from the late 1st century BC market as well, indicating the emergence of new consumption patterns during the late Iron Age.

Acknowledgments

This paper stems from the work carried out within the Croatian Science Foundation project *RED – Roman economy in Dalmatia: production, distribution and demand in the light of pottery workshops* (IP-11-2013-3973). Authors would also like to thank the Crikvenica City Museum for allowing work on the finds, Kazimir Miculinić involved in bone finds study for providing us with additional information and pictures, and Suzana Čule for proof-reading the draft.

gorankalv@gmail.com
ana.konestra@gmail.com

³⁴ For a discussion on the transmission of technological knowledge see E. MURPHY/J. POBLOME, *From Formal to Technical Styles: Production Challenges and Economic Implications of Changing Tableware Styles in Roman to Late Antique Sagalassos*. *Am. Journal Arch.* 121, 2017, 61–84.

³⁵ R. MATIJAŠIĆ, *Le tegole bollate romane nel territorio della Liburnia Settentrionale*. In: *Arheološka istraživanja na otocima Krku, Rabu i Pagu i u Hrvatskom primorju*, Izdanja Hrvatskog arheološkog društva 13 (Zagreb 1989) 61–71.

³⁶ For technological variability and identity see O. GOSSELAIN/A. LIVINGSTONE SMITH, *The ceramics and society project: An ethnographic and experimental approach to technological choices*. In: A. Lindhal/O. Stilborg (eds.), *The Aim of Laboratory Analysis in Archaeology* (Stockholm 1997) 147–160.

³⁷ A. KONESTRA, *Ricerche nei musei della Liburnia settentrionale* (Quarnero, Croazia): potenzialità, nuove attestazioni e aggiornamenti sulla diffusione di alcune tipologie ceramiche. *Quad. Friulani Arch.* 25, 2015, 117–122.

³⁸ M. JURIŠIĆ, *Ancient Shipwreck of the Adriatic. Maritime transport during the first and second centuries AD* (Oxford 2000) 6, 104–105.

Bibliography

- BERGAMINI/GAGGIOTTI 2011 M. BERGAMINI/M. GAGGIOTTI, Manufatti e strumenti funzionali alla lavorazione dell'argilla e alla cottura. In: M. Bergamini (ed.), *Scoppieto II. I materiali* (Firenze 2011) 343–377.
- BUKLAND/HARTLEY/RIGBY 2001 P. C. BUKLAND/ K. F. HARTLEY/V. RIGBY, The Roman Pottery Kilns at Rossington Bridge. Excavations 1956–1961. *Journal Roman Pottery Stud.* 9, 2001.
- CARLTON 2002 R. CARLTON, Comments on the technology of prehistoric pottery in the Western Balkans in the light of ethnographic research. In: *Fire in Archaeology. Papers from a session held at the European Association of Archaeologists 6th Annual Meeting in Lisbon 2000* (Oxford 2002) 63–81.
- CASTELLANI 2011 D. CASTELLANI, Osso lavorato. In: M. Bergamini (ed.), *Scoppieto II. I materiali* (Firenze 2011) 439–446.
- CASTELLANI/NICOLETTA/ SPERANZA 2011 D. CASTELLANI/N. NICOLETTA/S. SPERANZA, Metalli. In: M. BERGAMINI (ed.), *Scoppieto II. I materiali* (Firenze 2011) 447–473.
- KOURKOU MÉLIS/DÉMESTICHA 1997 D. KOURKOU MÉLIS/S. DÉMESTICHA, Les outils de potier de l'atelier de Figaretto à Corfou. *Bull. Corr. Hellénique* 121/2, 1997, 553–571.
- LIPOVAC VRKLJAN 2009 G. LIPOVAC VRKLJAN 2009, L'officina ceramica di Crikvenica. In: S. Pesavento Mattioli/M.-B. Carre (eds.), *Olio e pesce in epocaromana: produzione e commercio nelle regioni dell'alto Adriatico. Atti del convegno* (Padova, 16 febbraio 2007) (Padova 2009) 309–314.
- LIPOVAC VRKLJAN ET AL. 2016 G. LIPOVAC VRKLJAN/I. VALENT/A. KONESTRA/I. OŽANIĆ ROGULJIĆ, Antički proizvodni keramičarski kompleks u Crikvenici – zaključna istraživanja 2015. godine / Roman pottery production complex in Crikvenica – conclusive research in 2015, *Ann. Inst. Arch.* 12, 2016, 144–151.
- MACKENSEN 2009 M. MACKENSEN, Technology and organisation of ARS ware production-centres in Tunisia. In: J. H. Humphrey (ed.), *Studies on Roman Pottery of the Provinces of Africa Proconsularis and Byzacena* (Tunisia). *Hommage à Michel Bonifay. Journal Roman Arch. Suppl.* 76 (Portsmouth, Rhode Island 2009) 17–44.
- MITROFAN 1995 I. MITROFAN, Matériaux et ustensiles utilisés par les potiers romains. *Apulum*, 32, 1995, 175–188.
- MURPHY/POBLOME 2012 E. A. MURPHY/ J. POBLOME, Technical and social considerations of tools from Roman period ceramic workshops at Sagalassos (Southwest Turkey). Not just tools of the trade? *Journal Mediterranean Arch.* 25/2, 2012, 197–217.
- OŽANIĆ ROGULJIĆ 2012 I. OŽANIĆ ROGULJIĆ, Pottery from the workshop of Sextus Metilius Maximus (Crikvenica-Igralište/Ad Turres, Northern Dalmatia). *Acta RCRF* 42, 2012, 125–132.
- PALLECCHI 2012a S. PALLECCHI, I processi produttivi: produttività, infornate, scarti. In: D. Manacorda/S. Pallecchi (eds.), *Le fornaci romane di Giancola* (Brindisi) (Bari 2012) 287–292.
- PALLECCHI 2012b S. PALLECCHI, Appunti sull'organizzazione del lavoro negli stabilimenti romani per la produzione di ceramica pesante. In: A. Ciacci/P. Rendini/A. Zifferero (eds.), *Archeologia della vite e del vino in Toscana e nel Lazio. Dalle tecniche dell'indagine archeologica, alle prospettive della biologia molecolare* (Firenze 2012) 469–484.
- PALLECCHI 2014 S. PALLECCHI, Strumenti da lavoro, macchine e apprestamenti funzionali negli impianti per la produzione di anfore dell'Italia romana: riflessioni preliminari. *HEROM* 3, 2014, 11–37.
- PEACOCK 1997 D. P. S. PEACOCK, La ceramica romana tra archeologia ed etnografia (Bari 1997).
- SCHALTENBRAND OBRECHT 2012 V. SCHALTENBRAND OBRECHT, Stilus. Kulturhistorische, typologisch-chronologische und technologische Untersuchungen an römischen Schreibgriffeln von Augusta Raurica und weiteren Fundorten (Augst 2012).