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ARCHAEOLOGICAL MATERIAL

A LEAD-GLAZED *ATRAMENTARIUM* DISCOVERED AT APULUM

Abstract: Recently, in the Southern necropolis of *Apulum*, an inkwell with lead-glaze was discovered, which had been deposited as funerary inventory in a cremation tomb. Only one other ceramic inkwell from the pottery centre from Micăsasa was known in Dacia. The shape of the piece is unique and represents a transposition in pottery of metal-made inkwells. Various technological aspects suggest a local production in the area of the ancient cities of *Apulum,* where two workshops in which glazed pottery was also manufactured are known. In parallel, glazed pieces are a relatively frequent presence in the necropolises of this urban centre, being deposited in tombs with a rich inventory. The presence of the find is a professional symbol that reflects certain professions or intellectual pursuits. It was possible to determine through a paleo-technological experiment the manner in which the artefact was manufactured.

Keywords: *Apulum, funerary context, atramentarium, lead-glaze, modelling techniques, experiment.*

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THE PLACE OF DISCOVERY

The southern necropolis of *Apulum* (*Podei - Dealul Furcilor*) represents the largest burial area belonging to the two Roman cities that form this great urban centre (Fig. 1/1).

Adalbert Cserni recalls that, as early as 1860, south of the city of Alba Iulia, in the upper part of the modern cemetery, several walls and the Roman necropolis were discovered, too which add some ornate sarcophagi found during some research conducted in 1899.[1]

The research will be resumed between 1956-1958 when tombs specific to several funerary rituals were discovered: cremation-type *ustrinum* graves, burial in a pit or brick *cista*[2]. A new archaeological campaign will be carried out in the years 1970-1971, on this occasion being identified other 77 graves similar from the typological point of view to those discovered in the years 1956-1958.[3]

Starting from 1995 and until now, the research in this necropolis continued in the context of carrying out preventive archaeological excavations as a result of the expansion of the modern city of Alba Iulia. The inventory discovered is diverse and relevant to funeral rites and objects used during the funeral banquet or deposited as an offering[4], the results of the 2008-2012 campaigns being published in a monograph paper.[5]

[1] CSERNI 1901, 238-239.
[2] MACREA/PROTASE 1959, 437.
[3] PROTASE 1974, 134.
[4] OTA 2009, 23-47; BOLOG 2017, 16-18.
[5] BOLOG 2017.

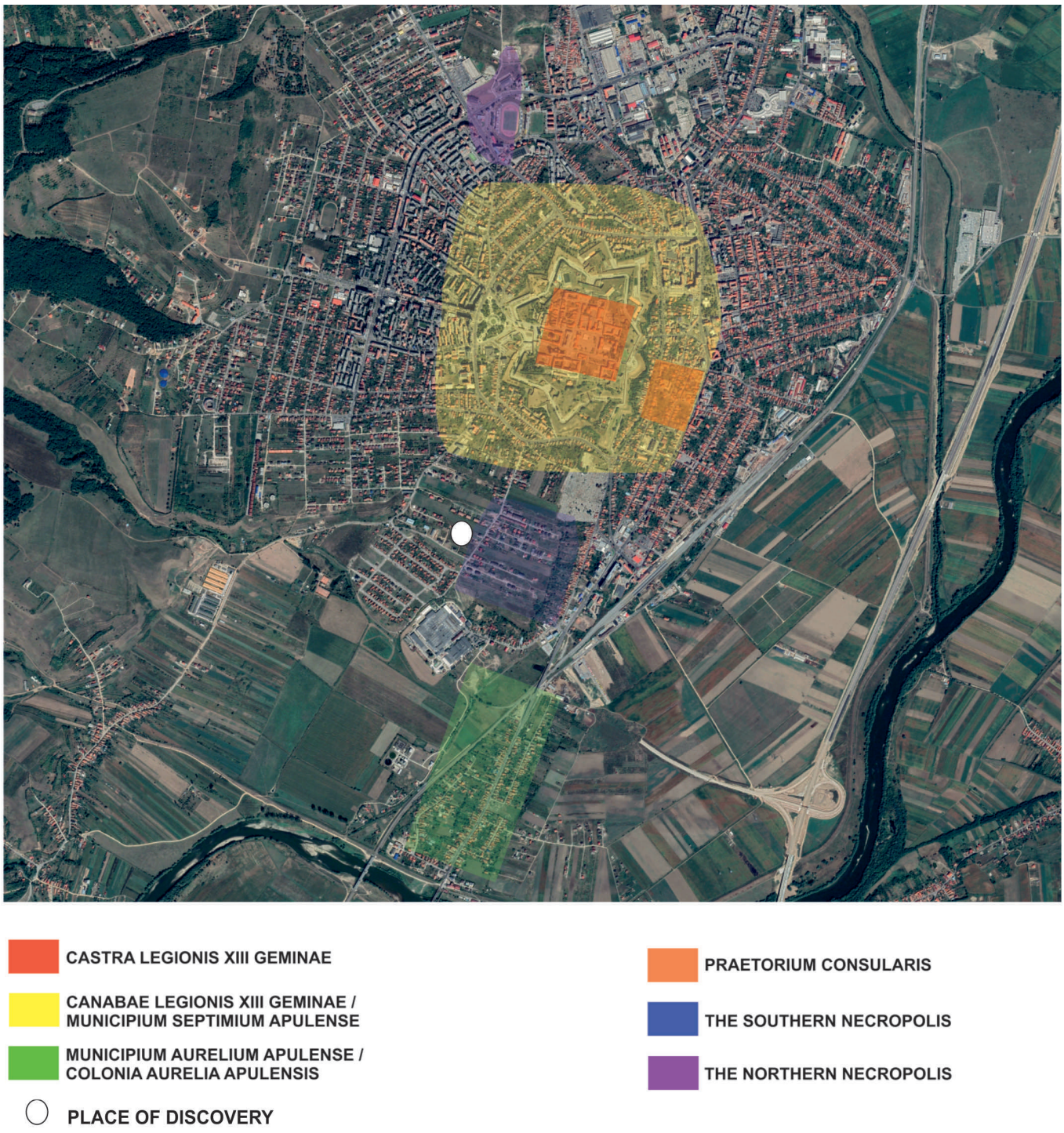

Fig. 1. Archaeological map of *Apulum* with the area where the inkwell was discovered.

In November 2022, a new preventive archaeological research was carried out on Victor Hugo street, no. 27, an area known for the high concentration of archaeological complexes, especially tombs (Fig. 2), and which consists of an extension of the surface available for construction, as a result of the modification of the project, in a previously archaeologically researched area (Fig. 2).

On the occasion of this archaeological excavation, 4 complexes were observed and investigated, namely, two pits of late Roman or post-Roman origin (Cx.1 and Cx. 2) and two tombs from the Roman period, one burial (M. 1) and one cremation (M. 2) (Fig. 3).

We will refer to the funeral inventory discovered within M. 2, the southern half of which is affected by the complex Cx. 1. It is a cremation grave, with the burning taking place in the pit (*ustrinum*). The pit has a rectangular shape oriented on the NE-SW axis. The base is flat, the walls straight and the corners rounded, and the walls were ritually fired. It was observed at a depth of 0.70 m and has the following dimensions: L=1.70 m, l = 0.80 m, A. t. = 0.70 m, A. b. = 1.02 m (Fig. 3).

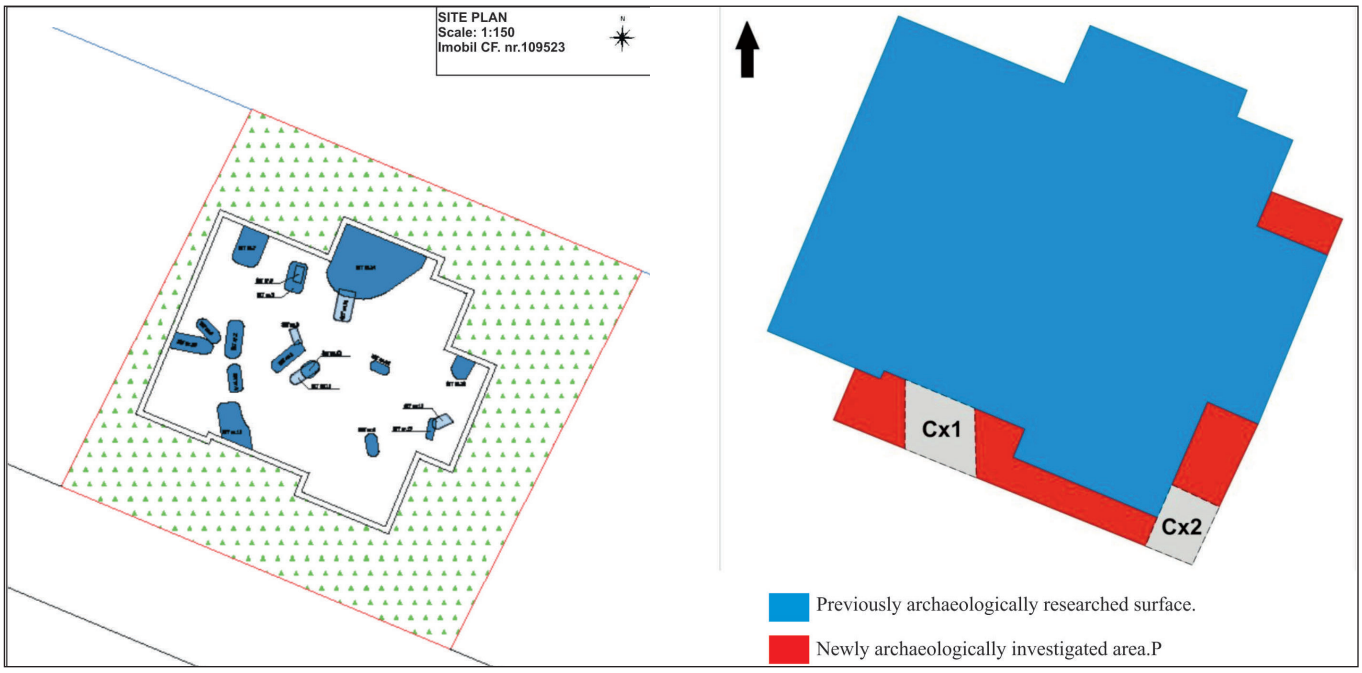

Fig. 2. Topographic plan of the investigated surface.

The burial inventory consisted of funerary remains, deposited in the south corner of the pit, coal, and a centrally positioned glazed ceramic inkwell at the southern boundary in close proximity to the area affected by Cx.1.

DESCRIPTION

The inkwell is thrown on the potter's wheel, has a tronconic shape, the annular base is marked by a narrowing towards the base, with the dimensions: D. max. = 6.7 cm, H. max. = 6.8 cm, H. edge = 6.2 cm, D. base = 3.5 cm (Fig. 4/1).

In the upper part, it shows a convex, slightly deformed cap with an ovalized central perforation, 1.5 cm in diameter, bounded by a vertical rim, 1.2 cm high and 0.3 cm thick. The upper part is ornamented with three miniatural, trilobate anses. The inner edge of the protuberances is decorated with obliquely-arranged parallel impressions. At the point of contact between the cover and the rim, a 0.25 cm hole was made to recover the leaked ink. On the outside, the rim is ornamented with two parallel lines, and under each anse a perforation with a diameter of 2 mm is present. The piece is covered with brown plumbiferous glaze (Munsell 10YR5/6) and unevenly distributed spots in a lighter shade (Munsell 7.5YR6/6). On the inside, at the point of contact of the cap with the rim, an accumulation of vitreous material formed following the leakage of the glaze during the firing process (Fig. 4/2a). On the outside, on the same part of the vessel, a similar accumulation in the form of a drop is present (Fig. 4/2b)[6]. The overflow perforation was partially obstructed as a result of the glaze flowing while in a fluid state. Technological defects also include the crackling of the vitreous layer, a crack of the ceramic body at the demarcation between the cap and the rim and a point of contact with another object, probably the combustion support (Fig. 4/2c)[7]. The fact that the crack is not covered with glaze indicates the application of glaze on the surface of the artefact prior to the firing, a technique that is generalized in Gallia, then in the areas related to the Danube from the 1st century AD,[8] to the detriment of the microasian method, of firing the vessels in two stages.[9] The same technological defect was also reported for an oil lamp also discovered at *Apulum*, where the glaze penetrated, during combustion, in the crack that appeared at the joint of the two valves that form the piece.[10]

INKWELLS IN THE CONTEXT OF WRITING INSTRUMENTS

The inkwell is part of a much greater inventory of utensils used in antiquity for writing on various materials.

Writing as an occupation and related instruments are found in the information of ancient authors, images rendered on sarcophagi, funerary reliefs[11] or frescoes, such as those from Herculaneum, Pompeii (House of Julia Felix[12], Glass Vase House[13] - Fig. 5/2, House Marco Lucrezia[14], the

[6] These accumulations are formed as a result of the leakage of the vitreous paste while in the liquid state, under the effect of gravity, and indicate the position of the vessel in the furnace (ARTHUR 1978, 298, Fig. 8.12 b, 9.1).

[7] HÖPKEN/DÖHNER/FIEDLER 2009, 132, Fig. 4; GOHIER 2018, 39-40, Fig. 12-13; ANGHEL/TĂNĂSELIA/BOER 2021, 428, Pl. III/3b; IV/1a-1d.

[8] WALTON/TITE 2010, 754.

[9] The method involves shaping the dishes and firing them in the oven, a phase called biscuit making. Subsequently, the glaze is applied, and the pottery is fired again. This avoids the appearance of tensions between the vitreous layer and the ceramic body by reducing the contraction-expansion coefficients that occur during the combustion and cooling of the pottery in the furnace (GOHIER 2018, 208; CERDAN/MORAIS/CANELLO 2019, 152).

[10] ANGHEL/TĂNĂSELIA/BOER 2021, 250, Pl.VII/5

[11] SPEIDEL 1996, 57 and the next. Fig. 25-31; BOŽIČ/FÈUGERE 2004, 22, Fig. 16-17, 19, 23; ÁLVAREZ/RODRIGO 2007, 530, Fig. 7; WILLI 2021, 27, Fig. 13.

[12] MARTINI 2018, 29.

[13] BOŽIČ 2002, 33; MARTINI 2018, 29; ALONSO *et alii* 2019, 252.

[14] ÁLVAREZ/RODRIGO 2007, 528, Fig. 2-3.

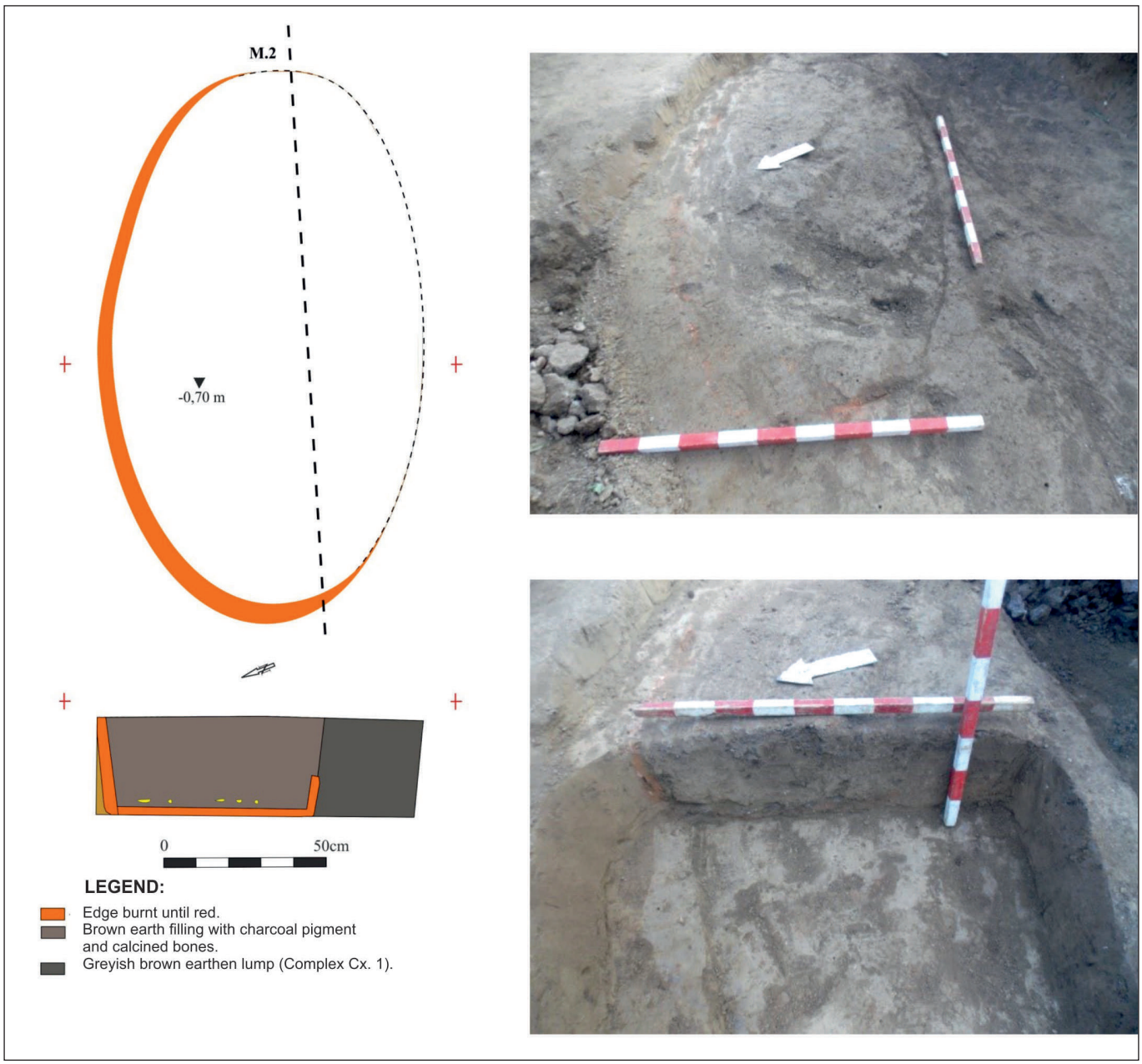

Fig. 3. The cremation grave where the inkwell was discovered.

tomb of Vestorinus Priscus[15] etc.) and Stabia (House Ariana) (Fig. 5/1).[16] In Dacia, two funerary stelae are known; they were discovered at Zam (Fig. 5/3) and *Porolissum* (Fig. 5/4), where the male character is depicted holding in his left hand a scroll of parchment, and at the waist, on the right side, the box for writing instruments is attached to the belt (*theca calamaria* or *grapharia*)[17], which could contain several pens, *stilus*, inkwell and other utensils used in writing.[18]

Writing instruments (*instrumentum scriptorium*), *theca calamaria*, *calamus* (pen), *stilus* (*graphium)*, *tabulae ceratae, tabula, tabella* (waxed tablets), *spatulae* (spatulas for wiping and renewing the surfaces of waxed tiles)[19], *scalprum*, *scalprum librariaum* (knife for sharpening the pen)[20], *regulus* (rulers for row spacing)[21] are frequently found deposited as funeral inventory[22] alongside both male and female bodies.[23] These pieces represent "professional symbols" depicting activities that confer a certain social status to the characters.[24]

The inkwells were made of glass and various metals[25], such as gold, silver, bronze, sometimes with sophisticated decoration made by intarsias of silver and copper[26],

[15] HOUSTON 2014, 201, Fig. 13.
[16] ÁLVAREZ/RODRIGO 2007, 529, Fig. 4.
[17] BAJUSZ 2004, 315; BAJUSZ 2004a, 368, Fig. 3-4.
[18] ALONSO et alii 2019, 252.
[19] SPEIDEL 1996, 17.
[20] ROSENFELD 2002, 162.
[21] LA FRAGOLA 2015, 248-249.
[22] BOŽIČ 2001, 19, Fig. 3; BOŽIČ 2001a, with the mentioned bibliography; BOŽIČ 2002; BOŽIČ/FÈUGERE 2004, 23; ALONSO/JEREZ/GONZÁLES 2012, 184; LA FRAGOLA 2015; MARTINI 2018.
[23] HOUSTON 2014, 199, Fig. 11; LUGINBÜHL 2017, 53-58.
[24] SPEIDEL 1996, 576 and the next; BAJUSZ 2004, 318.
[25] ECKARDT 2016.
[26] RÉMAZEILLES/CONFORTO 2008, 111-112.

imitations of *niello*[27], and enamel[28]. Less common are those made of lead, stone, bone[29] or earthenware[30]. Ceramic artefacts are very diverse and cover parts from the sigillata category[31] of pottery, thin-walled dishes[32], modest containers made of common paste[33] or coated with lead-glazed[34]. They are processed by pressing into patterns[35] or thrown on the wheel.[36]

The Latin name of the inkwell is *atramentarium*, *atramentale*, but it is also found in the forms *atramentario*, on a wall *grafitti* from Pompeii[37], or *atramentarii* and *atramitari*, in the lists of ceramic products incised on fragments of vessels discovered at Graufensenque[38], the root of the word being *atramentum* (ink).[39]

Unlike incising words in wax on *tabulae ceratae,* the ink allowed cursive writing using pen on various organic materials, such as papyrus, vellum/parchment (*membrana, pergamena*), wooden tablets (*pugilares*)[40], the documents having a permanent character on these surfaces.[41]

The black inks of antiquity[42] were obtained from carbon contained in soot (combustion products accumulated around the fuse hole of the lamps (*llychnium*)[43], or deposited on different surfaces) in water suspension, to which a binder was added to fix the ink on the writing medium after drying[44]. Following archaeometrical investigations, the generalized use of Arabic gum, an exudate of some acacia species (*Acacia Senegal*, *Acacia Seyal*) originating in Africa[45], was identified. The recipe recorded by the Greek physician Dioscorides in the work *De materia medica*, written in the second half of the first century AD, contained a part (*uncia*) Arabic gum and three parts carbon black[46]. Similar information is given to us by Vitruvius in the work *De Arhitectura*[47] and by Pliny The Elder in *Historia Naturalis*.[48] In the case of the coloured inks, carbon black was replaced by various pigments based on metal oxides (iron oxide Fe_2O_3)[49], but especially cinnabar (HgS mercury sulphide for red colour)[50], or obtained from plants.[51] The parallel use of two shades (black and red) is also documented by the Biebrich-type double inkwells, made of metal, equipped with a movable hinge and a circular handle.[52] The second container was called *cinnabaris*[53]. For territories further away from the Mediterranean basin, the use of other organic binders, such as plum or apricot resin or the albumen of *Gallus gallus* eggs is not excluded.[54]

Writing was done with a pen (*calamus*) fashioned from wood, plant stems, bone, to which a metal tip was sometimes fixed that could be sharpened by friction on a sandstone plate until the desired thickness of the line was obtained.[55]

INKWELLS IN DACIA

Inkwell finds in Dacia are relatively rare, the vast majority being made of bronze. Three such pieces are documented at *Porolissum*, one at Bucium, Romita[56] and *Micia*[57] each, five at *Potaissa*, of which two that are mentioned in the collection of I. Téglás are lost[58]. So far, in Dacia, we know only one ceramic inkwell discovered at Micăsasa, made of fine paste and red engobe. The lower half is tronconic, the body cylindrical and has a wide opening of the central orifice (Fig. 8/5).[59]

Writing with ink on wooden tablets is indirectly attested by three wooden tablets discovered in the Roman mines of Roșia Montană (*Alburnus Maior*)[60] and various other pieces belonging to specific instrumentation from varied contexts[61]. None of the inkwells was identified in the funerary context, they came mainly from forts and fortresses (*Potaissa*, *Porolissum*, Bucium, Romita[62]), *canabae* (*Potaissa*[63]) and sacred enclosures (*Porolissum*[64]).

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[27] GIUMLIA-MAIR 2021.
[28] ALONSO/JEREZ/GONZÁLES 2012, 178.
[29] ECKARDT 2018, 54, Fig. 4.1.
[30] GREENE 2007, 658, Fig. 6.
[31] MEZQUIRIZ DE CATALÁN 1961, 492, Tav. XXXVII/2-4.
[32] ÁLVAREZ/RODRIGO 2007, 534, Fig. 9; ALONSO/JEREZ/GONZÁLES 2012, 184.
[33] ÁLVAREZ/RODRIGO 2007, 524, 534, Fig. 9; HAYES 2009, 7, Fig. 3; STRECKERT/SEEVERS 2019, 52, Fig. 2-3.
[34] GOHIER 2018, 436.
[35] MARTINI 2018, 30, Fig. 2.
[36] ETTLINGER *et alii* 1990, 139-140, Taf. 45.
[37] BILKEI 1980, 62; for interpretation of the text see MOELLER 1968.
[38] BILKEI 1980, 62; ECKARDT 2018, 56. A percentage of 0.19% of inkwells fired in batches containing various containers from the category of Samian ware is noteworthy (BOŽIČ/FEUGÉRE 2004, 33).
[39] MOELLER 1968, 52.
[40] BOŽIČ/ FEUGÉRE 2004, 22, 32.
[41] After drying, the inscriptions could no longer be removed without affecting the support. Mistakes could be corrected before drying by wiping with a water-soaked sponge (HOUSTON 2014, 204). In the case of waxed tablets, the resistant support also allowed the archiving of extensive texts by binding the tabs in notebooks (diptychs, polyptychs, multiplex-bound codex in the form of bellows) (SPEIDEL 1996, 19; BOŽIČ/ FEUGÉRE 2004, 22; ALONSO 2013, 214; WILLI 2021, 46, Fig. 26).
[42] Until the fourth century AD, when the use of ferro-gallic ink produced from iron sulfate ($FeSO_4.7H_2O$) mixed with oak gall distillate is generalised (JANČOVIČOVÁ *et alii* 2007, 391).
[43] HOUSTON 2014, 203. Carbon obtained directly from the combustion of wood or other organic materials does not produce very fine particles (GUNEWEG 2018, 9).
[44] Carbon is amorphous and does not dissolve in water.
[45] RAMUSSEN *et alii* 2012, 2967; SIBILIA *et alii* 2021.
[46] „μείγνυνταιδὲπρὸςοὐγγίανα΄τοῦκόμμεωςοὐγγίαιγ΄λιγνύος" (DIOSCORIDES 5, 182).
[47] VITRUVIUS 7. 10. 4-5 „*inde collecta (scil. fuligo) partim componitur ex gummi subacta ad usum atramenti librarii, reliquum tectores glutinum admiscentes in parietibus utuntur*" (Gathered from there is combined partially with gum by kneading to be used as writing ink, and the rest, mixed by the stucco with glue, is used by them on the walls).
[48] PLINIUS, *Historia Naturalis*, 35, 25, 43.
[49] NIR-EL/BROSHI 1996, 164. An inkwell discovered in the port of Voorburg-Arentsburg (Netherlands) contained iron-based ink (DRIESSEN/ BESSELSEN 2014, 187, Fig. 8.17).
[50] ALONSO/JEREZ/GONZÁLES 2012, 177.
[51] RABIN 2021, 72. Black obtained by pyrolysis from vine branches (RAMUSSEN *et alii* 2012).
[52] SPEIDEL 1996, 18; BOŽIČ 2001a, 31; ÁLVAREZ/RODRIGO 2007, 518; ECKARDT 2018, 72, Fig. 5.2.
[53] MARTINI 2018, 29.
[54] NIR-EL/BROSHI 1996, 165; RAMUSSEN *et alii* 2012, 2967.
[55] ALONSO/JEREZ/GONZÁLES 2012, 177; FÜNFSCHILLING 2012, 177-179.
[56] BAJUSZ 2004, 317; BAJUSZ 2004a, 368-369, Fig. 7-11.
[57] CVJETIĆANIN 2004, 120, cat. no. 16; VARGA/CHIOREAN 2020, 125.
[58] BAJUSZ 2004a, 368-369, Fig. 12-13; VARGA/CHIOREAN 2020, 128, Pl. III/1.
[59] CERAMIC GOODS 2018, 136, cat. no. 361.
[60] TabCer DIII, XXIII, XXIV, the TabCer DIII tablet shows only a note on the external face, the text of the contract being incised in wax (IDR I, 201-205).
[61] VARGA/CHIOREAN 2020, 131.
[62] BAJUSZ 2004a, 368-369; VARGA/CHIOREAN 2020, 128.
[63] VARGA/CHIOREAN 2020, 129, Pl. III/2-3.
[64] BAJUSZ 20004a, 369.

LEAD-GLAZED AND INKWELLS

The preferential use of metal inkwells lies in the fact that they do not absorb ink, permeable parts being difficult to handle especially when one does not want to stain the medium on which it is written. A similar impermeability is conferred by the sintered varnish specific to sigillata.[65] The advantages of glazing lie precisely in the fact that the vitreous layer provides impermeability to the containers, and the specific gloss is attractive and similar to metal containers.[66]

Ceramics with lead-glaze[67] begin to be produced from the first century B.C. in Asia Minor centres such as *Tarsus*, Pergé, Çandali (*Pergamum*), Smirna (Izmir), *Mythilene* (Lesbos)[68], and by maritime dispersion glazed vessels spread as imported products throughout the entire Mediterranean basin[69]. From the late Republican and Augustan eras they begin to be manufactured in Italic workshops in the central area (Janicule and Nuovo Mercato Testaccio in Rome)[70] and the northern one (d'Aco Acastus, d'Aco Antiochus).[71] The migration of potters in the 1st century AD will lead to the spread of the production of this category of fine ceramics in the centers of southern Gaul (Capitou, Lyon, Saint-Romain-en-Gal, Vienne)[72], central Gaul (Vichy, St.-Remy-en-Rollat, Gannat, Lezoux, Begues, Saint Pourçain sur Besbre)[73] and Germania Inferior, on the Rhine Valley (Kunln, Bonn, Soller)[74]. From the second half of the 1st century AD it begins to be manufactured in Spain (Tricio-Meseta, *Emerita Augusta*)[75], in *Britannia* (Usk/Caerleon, Holt/Chester)[76], then in *Moesia Inferior* (*Durostorum*)[77], in *Moesia Superior* (*Viminacium-Margum, Singidunum*, Kosmaj, Landol, *Novae*, *Diana*)[78] and in *Pannonia* (in the centers set up in the first half of the 2nd century AD at *Brigetio*, *Aquincum*, *Poetovio*, *Sirmium*).[79] Most of the workshops are located near mines exploiting lead-containing polymetallic ores[80]. However, glazed pots represent one of the least common ceramic categories produced by Roman potters between the 1st century BC and the 3rd century AD[81].

The pieces with lead-glaze enter Dacia as imports alongside the Roman legions and in the middle of the 2nd century AD they begin to be produced in various centers such as Micăsasa[82], *Ampelum*[83] and *Apulum*[84].

The production of glazed inkwells is attested in the Italian peninsula by scraps and specific technological instruments[85] starting with the Flavian-Trajan period in the workshops in the area around Rome (Fig. 9/4-6)[86]. These pieces are made by pressing in patterns and are ornamented with vegetal motifs[87], the manufacturing technique, the globular, flattened shape (Hayes 124, 1[88], form 14 after Hochuli-Gysel[89]), the ornamental style continuing traditions from Asia Minor (Fig. 9/1).[90]

DISCUSSIONS

If a standardization of the form can be observed in the case of metal inkwells, the typology of ceramic inkwells[91] is much more diverse[92] and covers especially low shapes (the ratio of height to maximum diameter being about 1/1 for better stability) sometimes similar to wheel-thrown oil lamps[93] (Fig. 6/6-7), spherical derivatives with the upper part slightly concave and demarcated by a rim specific to Italic productions:[94] Conspectus 51.3.1[95] (Fig. 7/3), Gallic types Hermet 18=Ritterling 13[96] (Fig. 7/9A-10), Ludovici Aa[97] (Fig. 7/8), Loeschcke 38 (Fig. 8/2)[98]), Iberian imitations (Hispanica 51) (Fig. 9/8-9)[99], cylindrical, Huld 3 (Fig. 7/7)[100] and variants (Fig. 8/1)[101] Conspectus 51.4.1 (Fig. 7/5)[102], Morel forms 102-103a-b (Fig. 6/1-2[103]) with a slightly accentuated tronconic

65 WILLIS 2005, 97.
66 MARTINI 2018, 28.
67 To obtain the vitreous start, a solution of litharge (PbO lead oxide) is applied on the vessels with the role of fondant that lowers the melting temperature of the silicon in the ceramic mass or added to the suspension from 1670°C-1723°C to 717°C (PRADELL/MOLERA 2020). Specific colours are obtained by adding metal oxides to the suspension or by reacting with the minerals in the clay composition (WALTON 2004; WALTON/TITE 2010, 735).
68 HOCHULI-GYSEL 2002, 309-312; GOHIER 2018, 31.
69 WALTON 2004, 2.
70 GOHIER 2018, 31, 106, Fig. 53.
71 GOHIER 2018, 54.
72 GOHIER 2018, 204, Fig. 1.
73 DESBAT 1986, 33; VILVOLDER 2010a, 288; GOHIER/DESBAT/BONNET 2018, 478.
74 HÖPKEN/DÖHNER/FIEDLER 2009.
75 BELTRAN LLORIS 1990, 188; CERDÁN/MORAIS/CANELLO 2019, 155-156, Fig. 2.
76 ARTHUR 1978, 294; PEACOCK 1982, 64; WALTON 2004, 15.
77 MUȘEȚEANU 1993.
78 CVJETIĆANIN 2010, 37, Fig. 72-73; WALTON/TITE 2010, 734.
79 NAGY 1945; MARTIN 1995, 65; WALTON/TITE 2010, 734; KÖLCZE 2018, 20; CERDÁN/MORAIS/CANELLO 2019, 154, Fig. 2.
80 PEACOCK 1982, 64; ANGHEL/TĂNĂSELIA/BOER 2021, 244.
81 DESBAT 1986; FÜNFSCHILLING 2012, 194.
82 Here, discarded fragments, lead residues and a foot fragment belonging to a firing support were discovered (MITROFAN 1990, 137, Fig. 33/3; 35/1; ANGHEL/TĂNĂSELIA/BOER 2021, 237, Pl. I/3).
83 A significant number of discarded pieces were discovered in the context of three potter's furnaces belonging to the officina of the ceramist Caius Iulius Proclus (LIPOVAN 1983-1984; LIPOVAN 1990).
84 There have been identified two areas of production of glazed ceramics documented by scraps and firring supports that can be dated from the middle of the 2nd century AD (ANGHEL/CIULAVU/BOUNEGRU 2021; ANGHEL/TĂNĂSELIA/BOER 2021; ANGHEL/IÓZEF-GÁBOR/BALTEȘ 2022).
85 PORCARI *et alii* 2010, 306, Fig. 5.
86 COLETTI/CONTINO/GOHIER 2017.
87 CONTINO *et alii* 2011; MARTINI 2018, 30, Fig. 2.
88 MARTINI 2018, 30.
89 HOCHULI-GYSEL 2002, 310, Fig. 3/14).
90 BILKEI 1980, 68.
91 The forms are perfections of Hellenistic pieces of globular shape with a central perforation stored as export cargo in a wreck from the fifth century BC researched at Porticelo, near the Strait of Messina (EISEMAN 1975, 374-375, Tav. 70, Fig. 1-3). Similar pieces, but with an oversized base and red varnish were discovered in a funerary context at Salvi and kept at the Municipal Museum of Vitebo (FIORENTINI/STERPA 2016, 30, Fig. 8) and on the Palatine Hill, but with black varnish, dated in the 1st century AD (MOREL 1965, 221, form 104, BELTRÁN LLORIS 1990, 338, Fig. 19/170).
92 https://www.antike-tischkultur.de/keramikformtintenfass.html.
93 HAYES 2009, 7, Fig. 3. They are similar in shape to Loeschcke XIII, but without the specific small handle (REGEP-VLASCICI 2008).
94 HANUT 2010, 41, no. 51.
95 ETTLINGER *et alii* 1990, 140, Taf. 45; ÁLVAREZ/RODRIGO 2007, 532.
96 Produced by the Graufesenque centres (about 40-110 AD) (WILLIS 2005, 102; DELAGE 2010a, 63, 78, 84) and Lezoux (about 120-200 AD) (WILLIS 2005, 102-103).
97 Produced at Rheinzabern (DELAGE 2010, 177, cat. no. 43).
98 OSWALD/PRYCE 1920, 210, Pl. LXX/1.
99 MEZQUIRIZ DE CATALÁN 1961, 492, Tav. XXXVII/2-4; ÁLVAREZ/RODRIGO 2007, 529, Fig. 3-4; ALONSO/JEREZ/GONZÁLES 2012, 171, 183, Fig. 11; GODARD 1992, 241, Pl.II/26.
100 Produced in the Trier centre in northwest Gaul (VILVOLDER 2010, 196).
101 DRIESSEN/BESSELSEN 2014, 118, Fig. 8.17.
102 ETTLINGER *et alii* 1990, 140, Taf. 45.
103 MOREL 1965, 220.

shape Conspectus 5.1.1 (Fig. 7/1)[104] or rectangular Conspectus 51.2.1 (Fig. 7/2).[105] The inkwells made in large workshops are relatively standardised as a result of serial production, with no major changes to the shape for long periods of time.[106] In parallel, personalized pieces coexist, such as those discovered in Rome (Forum and Palatine), dated in the 3rd century AD, with the container fixed on a leg with a wide, circular base (Fig. 6/4-5)[107], as well as imitations of fine paste following specific sigillata forms (Fig. 8/4).[108]

We encounter the tronconic profile with small subvariants in association with lead-glaze (Gohier types 10.2-10.4) (Fig. 9/3d)[109] in the category of imitations made after the African sigillata Lamboglia 16 bis (Fig. 7/6)[110] documented by finds at Oroli in Sardinia[111], Ostia (*Terme del Noutatore*) (Fig. 9/3d-3g)[112], Rome[113], dated in the 1st-2nd centuries AD, Conimbriga (Portugal)[114] and Arles (*Cirque, Cimitière de Trinquetaille*) (Fig. 9/3a-c).[115] The difference from the Samian vessels consists in the replacement of the red varnish with the vitreous layer and a reduction in the curvature of the walls. The slightly pronounced tronconic profile is also found in an inkwell discovered in Pannonia, made of semi-finished clay, kept at the Hungarian National Museum (Fig. 6/9)[116] and a preserved piece at the Römisch-Germanisches Zentralmuseum in Mainz (Fig. 8/7).[117] The same tronconic profile, but without a rim, in the glazed version, also comes from Pannonia, in the area of Sopron, dated in the 4th century AD (Fig. 9/2).[118] Metal inkwells have a predominantly cylindrical shape[119], tronconic shapes are also uncommon for this category (Eckardt G2 type).[120]

In some cases, metal inkwells are equipped with a chain attached to the lid (Eckardt 12[121] type), on one of the sides or by means of three suspension rings located on the edge (types Jones I, Jones II, Eckardt 14)[122]. Various clamping/handling systems consist of rings located on the sides (Eckardt types 1-2, 5, 10) or that unite the two containers (Biebrich type).[123] In the case of the ceramic artefacts, the handling or transport systems are equally rare, with the exception of the application of some handles to inkwells from the sigillata category (Conspectus 51. 4. 1) (Fig. 7/5)[124], a piece produced by pressing in a mould, preserved at the Albertin Museum in Dresden (Fig. 8/3)[125], or one made of common paste, like the early pieces, discovered in Israel (Fig. 6/8).[126] Three or four attachment points, in the form of miniature handles, are found, instead, in the inkwells made of glass (Isings 77 form).[127] At the same time, ceramic inkwells, with the exception of those moulded in patterns[128], are not ornamented, except for some horizontal lines on the outside (Fig. 9/2)[129], or decoration made with the wheel.[130] We can mention an inkwell with red varnish of unknown origin, kept at the Metropolitan Museum of Art in New York, with the lid ornamented with three tragic masks in relief (Fig. 8/6).[131] The small volume of the inkwell of 72 ml is similar to that of the metal artefacts, the volume of these specimens varying between 21-59 ml.[132] The vast majority of pieces in the sigillata category have an average volume of approx. 352 ml[133], but smaller containers are also present.[134] The dimensions, presence or absence of adaptations also indicate how they could be used, as static items in scriptoria, or as mobile ones that could be transported, for different purposes, without the risk of spilling the content.[135] The presence of the three perforations may be related to the transportation of the piece, a string could be attached through them to which a cap made of organic material was attached.[136] Similar to the metal ones, inkwells made of ceramics had to be equipped with a lid to prevent the ink from drying out.

Returning to our piece, we consider that it represents an attempt by a skilled craftsman to imitate metal inkwells in ceramics and to adapt specific techniques for modelling ceramics, as a less expensive alternative to the final product.[137] The existence of very rare glazed pieces is not an isolated case, they are modelled after specific orders or according to the inspiration of each craftsman as a single piece or as part of a limited series, with a more or less restricted dispersion from geographical or temporary perspectives.[138]

[104] BILKEI 1980, 68; ETTLINGER *et alii* 1990, 140, Taf. 45.
[105] ETTLINGER *et alii* 1990, 140, Taf. 45.
[106] WILLIS 2005, 102-103.
[107] MOREL 1965, 221, form, 105; BELTRÁN LLORIS 1990, 338, Fig. 19/168-169.
[108] GOMEZEL 1994, 768
[109] GOHIER 2018, 436-437.
[110] BELTRÁN LLORIS 1990, 344, Fig. 62/517.
[111] MARTINI 2018, 30, Fig. 1.
[112] GOHIER 2018, 438, Pl. 170; MARTINI 2018, 33, Fig. 6/15-17.
[113] MARTINI 2018, 31-32, Fig. 3-5, 7.
[114] QUINTEIRA 1984, 105, Fig. 2.
[115] GOHIER 2018, 437-439, Pl. 169-170.
[116] BILKEI 1980, 69, cat. no. 147, Abb. 8, Taf. IV/147.
[117] FÜNFSCHILLING 2012, 194, Abb. 64.
[118] BILKEI 1980, 69, cat. no. 34, Taf. III/34.
[119] BILKEI 1980, Taf. III-IV.
[120] BILKEI 1980, 71, 75, cat. no. 24, 143, Taf. III/24; IV/143.
[121] ECKARDT 2018, 68-98.
[122] BILKEI 1980, 70, cat. no. 60, Taf. III/60; BOŽIČ/ FEUGÉRE2004, 35; ECKARDT 2016, cat. no. 8, 11, 22, 25.
[123] BOŽIČ/FEUGÉRE 2004, 36, Fig. 31.
[124] ETTLINGER *et alii* 1990, 140, Taf. 45; ALONSO/JEREZ/GONZÁLES 2012, 171, Fig. 1.
[125] OSWALD/PRYCE 1920, 210, Pl. LXX/8.
[126] STRECKERT/SEEVERS 2019, 53, Fig. 3. The wearing of inkwells by means of a chain or string passed through a support system is also found in a paragraph in the Book of Ezekiel (Ezekiel X, 11). *"Et ecce vir, qui erat indutus lineis, qui habebit atramentarium in dorso suo, respondit verbum, dicens: Feci sicut praecepisti mihi*("And behold, the man who was dressed in linen clothes, who had an inkwell on his back, answered the word, saying, I did as you commanded me" (MARTINI 2018, 29).
[127] MERTEN 1982, 14, Fig. 2; COOL/PRICE 1994, 116-117, Fig. 7-11.
[128] BILKEI 1980, 68, Abb. 7, cat. no. 86.
[129] BILKEI 1980, 69, cat. no. 147, Abb.8, Taf. IV/147.
[130] Glazed inkwell preserved at the Historisches Museum Berlin (https://www.antike-tischkultur.de/keramikformtintenfass.html).
[131] THOMPSON 2007, cat. no. 37. A similar piece is preserved at the Archaeological Museum in Brescia (https://www.antike-tischkultur.de/keramikformtintenfass.html)
[132] ALONSO *et alii* 2019, 258, Fig. 7; VARGA/CHIOREAN 2020, 129.
[133] ECKARDT 2018, 109-112; MARTINI 2018, 31, Fig. 4, 5b; VARGA/CHIOREAN 2020, 129. Starting with the Flavian period, the dimensions of the ceramic inkwells begin to decrease (ÁLVAREZ/RODRIGO 2007, 535).
[134] MOREL 1965, 220, form102; 138 ml (BERNAL-CASASOLA *et alii* 2020, 71).
[135] ECKARDT 2018, 111.
[136] WILLIS 2005, 97.
[137] ECKARDT 2018, 55.
[138] RUSU-BOLINDEȚ 2007, 324-325, Pl. XXXIV/396. A number of the known artefacts and adaptations are made in the workshop *Gaius Iulius Proculus* from *Ampelum* (LIPOVAN 1983-1984; LIPOVAN 1990) or come from *Apulum* (GLAZED 2021, cat. no. 13, 93). For Gallia see GOHIER 2018; GOHIER/DESBAT/BONNET 2018.

The production workshop cannot be precisely identified, but it is not excluded the manufacture of the inkwell in the local *officinae* attested by elements related to the operational chain (scrapes, firing supports), waste pits and a significant amount of glazed ceramics discovered at *Apulum*.[139] The presence of spots with a lighter shade is a signature specific to local productions and characterizes a significant number of artefacts originating from this site.[140] Archeometrical investigations[141] indicated the use of lead oxide coming from the mining centre at *Ampelum*, resulting from the reduction of galena (PbS) for silver extraction.[142]

The presence of the inkwell in a funerary context is symbolic, a reflection of professions such as *amanuensis*, *libraria*, *notarius*, various other civil or military officials and archivists (*tabellarius*, *tabularius*)[143] or spheres of personal interest with intellectual inclinations of the character.[144] It should be noted that the glazed pieces represent the most numerous category of fine ceramics discovered in the necropolis of *Apulum*, they outnumber other types of vessels considered "luxury" (*terra sigillata*, thin-walled vessels), most of which came from graves with a rich inventory.[145]

TECHNOLOGICAL DATA HIGHLIGHTED BY PALEO-TEHNOLOGICAL EXPERIMENT

The analysis of the inkwell has raised some questions about how it was manufactured and the steps that led to the definition of the shape. Generally, pieces of this type are thrown on the wheel from a single piece of clay. After obtaining a tronconic then hemispherical shape, the walls are folded inwards to achieve the cap by manipulating the clay through the central hole. The rim is completed by pressing outward, so as to maintain the convex profile of the lid. Then the piece is turned over and the ring base is modelled by reshaping the leg left after shaping. As a result of these operations, a cylindrical extension, base-oriented of the edge of the central opening and a fold with a triangular profile at the point of incidence of the lid with the walls of the container is formed. This technique is specific for the artefacts made in series by the large workshops producing sigillata (Ritterling forms 13=Hermet 18 (Fig. 7/9-10), Ludovici Aa (Fig. 7/8), Lamboglia 16 bis (Fig. 7/6), Hispanica 51 (Fig. 8/8)). In all of these cases, the large diameter of the central opening allows the manipulation of the clay, the working steps being similar to the modelling of the body of a jug up to the base of the neck.[146] If the closing of the hole is continued, the pressure exerted will result in a lid with a concave centre, similar in shape to piggy banks, or Morel 104 inkwells (Fig. 6/3).

In this case, the piece being complete, the steps taken during modelling cannot be visualized, but these can be deduced by form analysis and the small technological flaws highlighted earlier.

In order to determine the operational chain, several containers with a similar tronconic shape were thrown on the wheel[147]. In the first case, it was opted to close the lid from a single piece of clay and maintain the opening with the help of a wooden cylinder (Fig. X/1a). In this case, the pressure exerted led to a much higher wall thickness in the hole area, different from that of the original piece, where a thinning of the ceramic body is observed. Later a clay strip was applied and the rim was created (Fig. 10/1b), then after its turning over on the wheel, the annular base was completed.

The second technique applied consisted of modelling the container (Fig. 10/2a) and inserting inside it the separately manufactured lid in the form of a disk with a convex and perforated profile. It was placed perpendicularly in the container and blocked by the tronconical shape at about 1 cm below the rim (Fig. 10/2b). Later, the edges were glued together, a painstaking operation, the workmanship being hampered by the small size of the container. In this case, the wall thickness of the lid is much smaller, similar to the original piece. This approach is also confirmed by the crack and slight deformation of the lid of the original artefact (Fig. 10/3a, 3c).

The formation of handles is possible both by the additional application of clay, as well as by cutting out the rim, regardless of how the part was shaped.

The glaze was made from lead oxide (an industrial product) mixed with copper oxide to give a more intense shade of green, in oxidizing combustion performed in an electric furnace at 850°C. Accidentally, on one of the parts modelled by applying the cap, a crack was formed in the junction area with the rim, which was only partially covered with glaze, a technological defect that appeared precisely as a result of the assembly difficulties (Fig. 10/4).

The obvious technological flaws highlight, once again, the unique or limited series character of the piece, for which the potter adapted different working methods, without them being the easiest approach method.

CONCLUSION

The presence of the inkwell at *Apulum* is not accidental given the economic and administrative importance of the two urban centres (the centre of the imperial administration in Dacia and the seat of the governor), and the military one conferred by the fortress of the XIII Gemina Legion. The fact that it is the only piece of this type identified so far, regardless of the material from which it is made, is most likely due to the difficulty of interpreting fragmentary pieces, which can

[139] ANGHEL/CIULAVU/BOUNEGRU 2021; ANGHEL/TĂNĂSELIA/BOER 2021; GLAZED 2021; ANGHEL/IÓZEF-GÁBOR/BALTEȘ 2022.
[140] GLAZED 2021, cat. no. 19, 38, 46, 51, 71, 73, 75; ANGHEL/TĂNĂSELIA/BOER 2021, 249, Pl. VI/4a-4b.
[141] Results are being published. Project subsidized by the Ministry of Research and Innovation CCCDI-UEFISCDI, (Complex analytical methods to study Roman glazed ceramics from the Dacian Kingdom for establishing the origin of archaeological artefacts, import/local production, at the Eastern border of Roman Empire Glazex. No. 352 PED/2020).
[142] LIPOVAN 1990, 279. From Greek: *λιθάργυρος* (lithargyros), lithos (stone) + argyros (silver). https://hmn.wiki/ro/Litharge.
[143] SPEIDEL 1996, 18-19.
[144] BILKEI 1980, 62.
[145] BOUNEGRU *et alii* 2021.
[146] CUOMO DI CAPRIO 2017, 144, Fig. 62.
[147] Several pieces have been modeled, but only three have been completed, being necessary to perform exercises to learn the specific manual skills, although we have experience in modeling ceramics as part of paleo-technological experiments (ANGHEL 2019; ANGHEL 2020; ANGHEL/BOUNEGRU 2020; ANGHEL/TĂNĂSELIA/BOER 2021).

be assimilated into other categories of products (money box, oil lamps, balsamarium in the case of ceramics) or pyxis if we refer to metal artefacts.

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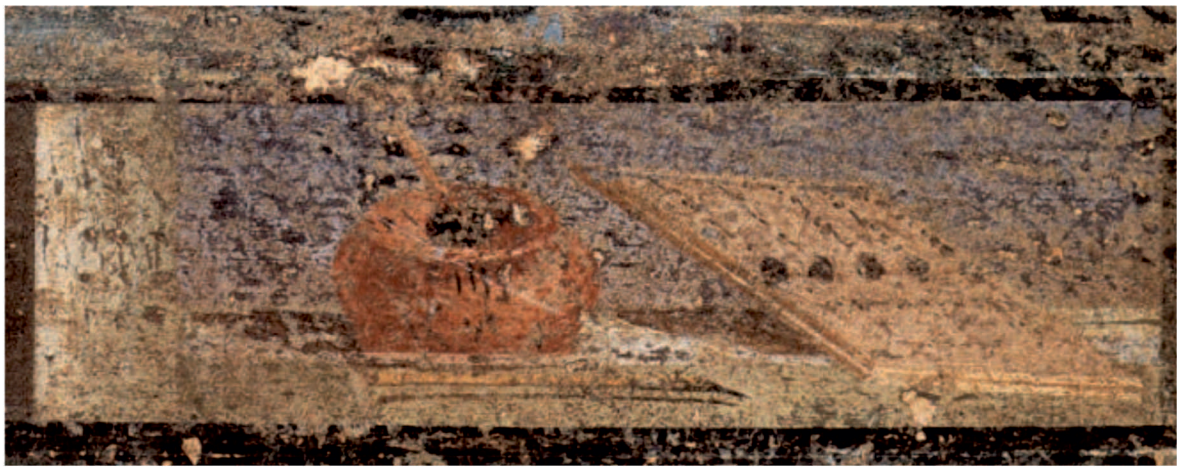
Fig. 4. 1. Inkwell (3D scan) - Gigapixel Art S. R. L.
2a. Accumulation of glaze and crack appeared at the point of incidence of the lid with the rim.
2b. Accumulation of glaze in the form of a drop located in the lower area of the container.
2c. Trace of contact with another object during firing (firing support?).



1

2

3

4

Fig. 5. 1. Hermet 18 type ceramic inkwell, fresco House Arianna (Stabia) (after ÁLVAREZ/RODRIGO 2004, 529, Fig. 4); 2. Fresco from the House of Glass Vessels (Pompeii) that renders, the spatula, waxed tablet, Biebrich-type metal inkwell, pen or stilus and a parchment volume (after ÁLVAREZ/RODRIGO 2007, 28, Fig. 3); 3. Funerary stela at Porolissum (photo Emanoil Pripon); 4. Funerary Stela from Zam (after BAJUSZ 2004b, 370, Fig. 3).

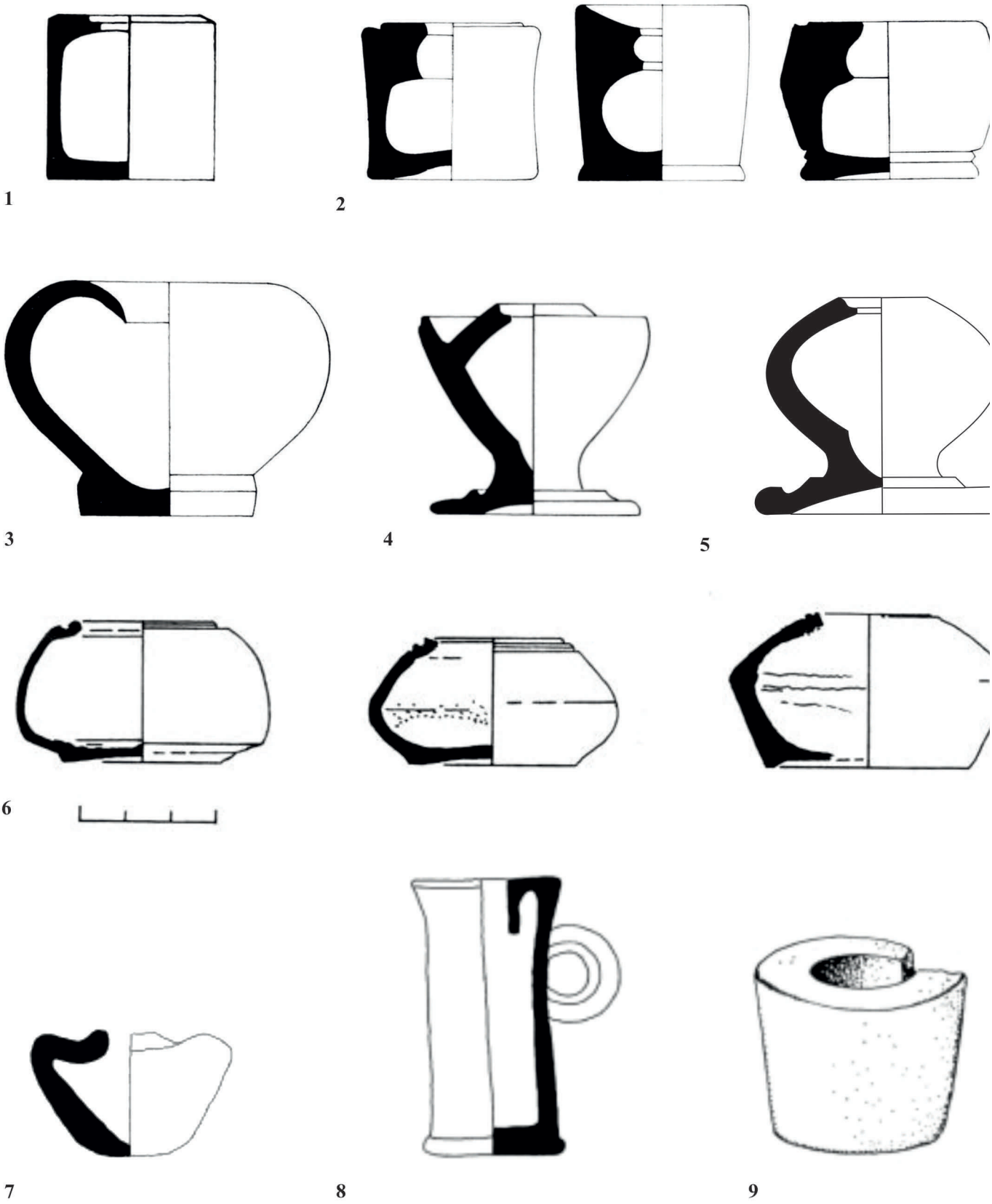


Fig. 6. Ceramic inkwells: 1-5. Fine pottery with black varnish (1-4), red varnish (5), common pottery (6-9), discovered in Rome (1-6), Israel (7-8), Pannonia (9); Forms: 1. Morel 102; 2. Morel 103a-c; 3. Morel 104; 4. Morel 105 (after MOREL 1965, 220-222); 5. redrawn after BELTRÁN LLORIS 1990, 338, Fig. 19/169; 6. after Hayes 2009, 7, Fig. 3; 7-8. after STRECKERT/SEEVERS 2019, 52, Fig. 1, 3; 9. after BILKEI 1980, 77, Pl. III/34.

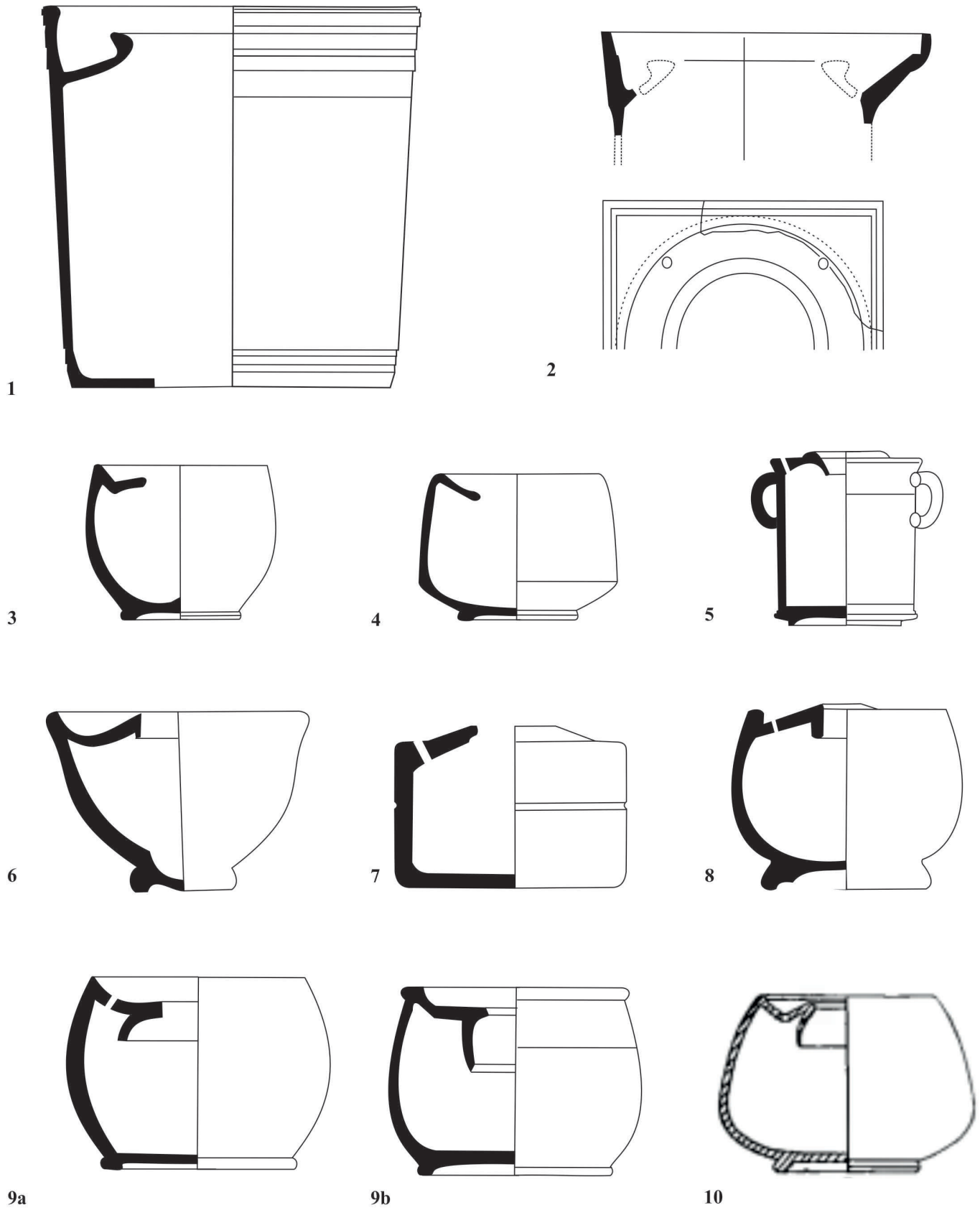


Fig. 7. Ceramic inkwells (terra sigillata): 1-5. Italic forms: 1. Conspectus 51.1.1; 2. Conspectus 51.2.1; 3. Conspectus 51.3.1; 4. Conspectus 51.3.2; 5. Conspectus 51.4.1 (redrawn after ETTLINGER *et alii* 1990, 140, Taf. 45); 6. African sigillate: Lamboglia 16 bis (redrawn after BELTRÁN LLORIS 1990, 344, Fig. 62/517); 7-9. Gallic sigillate: 7. Huld 3 (redrawn after VILVORDER 2010a, 196); 8. Ludovici Aa (redrawn after DELAGE 2010a, 177, nr. 43); 9a-b. Ritterling 13=Hermet 18 (9a. redrawn after Delage 2010b, 63; 9b. redrawn after GODARD 1992, 249, Pl. II/26); 10. Subvariant to type Ritterling 13=Hermet 18 (Long Lawford, Warwickshire. Rugby Museum (after OSWALD/PRYCE 1920, 210, Pl. LXX/5).

Fig. 8. Cylindrical inkwell (terra sigillata), Voorburg - Arentsburg (Netherlands) (after DRIESSEN/BESSELSEN 2014, 118, Fig. 8.17); 2. Loeschcke 38 (after OSWALD/PRYCE 1920, 210, Pl. LXX/10); 3. Inkwell produced in a mould (Albertin Muzeum, Dresden) (after OSWALD/PRYCE 1920, 210, Pl. LXX/1); 4. Fine paste inkwell (imitation of terra sigillata) with the inscription "*A(ulus) Quintius Sp(urii) f(ilius) plebeius fecit*" discovered at Aquileia (after GOMEZEL 1994, 767, Fig. 1); 5. Fine paste Inkwell, Micăsasa (after CERAMIC GOODS 2018, 136, cat. no. 361); 6. Ornate Inkwell (Metropolitan Museum of Art, New York) (after THOMPSON 2007, cat. no. 37); 7. Fine paste inkwell (Römisch-germanisches Zentralmuseum, Mainz), (after FÜNFSCHILLING 2012, 194, Abb. 46); 8. Hispanic inkwells: 1. Italic prototype for Hispanic form 51 (redrawn after ALONSO *et alii* 2012, 183, Fig. 1); 9a. Terra sigillata; 9b. Thin-walled ceramics; 9c. Common ceramics (redrawn after ÁLVAREZ/RODRIGO 2004, 533, Fig. 9).

Fig. 9. Glazed inkwells: 1. Asia Minor productions: Form 14 (redrawn after HOCHULI-GYSEL 2002, 310, Fig. 3); 2. Glazed inkwell discovered in Pannonia, (after BILKEI 1980, 69, Abb. 8). 3. Glazed inkwell discovered at Arles (3a-3c) and Ostia (3d-3g) (types: a-b. Gohier 10.2; c. Gohier 10.3; d-g. Gohier 10. 4 (redrawn after GOHIER 2018, 436-438, Pl. 168-169). 4-6. Glazed inkwells produced in a mould (4. Nuovo Mercato Testacio-Roma, after DE VITO *et alii* 2017, 1782, Fig. 2; 5. Aquincum, after BILKEI 1980, 68, Abb. 7); 6. Metropolitan Museum of Art, New York (https://www.metmuseum.org/art/collection/search/249048).

Fig. 10. Experiments to model some inkwells.
1a-1b Direct modelling of the lid.
2a-2b. Application of the lip that was manufactured separately.
3a-3c. Inkwells after glazing (3a-3B) and firing.
4. Crack appeared on a piece modelled using variant 2.