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pour l'HISTOIRE du VERRE

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SWISS RESEARCH CENTRE
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SCHWEIZERISCHES MUSEUM
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Cover illustration

Goblets with white filigree decoration, produced in Swiss glasshouses, late 17th to early 18th century. From different Swiss public and private collections. For a detailed discussion see: Erwin Baumgartner, *Reflets de Venise*, Bern 2015, p. 254–272, 322–328 and the contribution of Christophe Gerber in the present volume, page 564.

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A LATE ROMAN GLASS WORKSHOP AT KOMAROV (MIDDLE DNIESTER) AND THE PROBLEM OF THE ORIGIN OF 'BARBARIAN' FACET CUT BEAKERS

Olga Rumyantseva, Constantin Belikov

THE SITE

The settlement of Komarov (Komariv) is situated in the Middle Dniester region, on the right bank of the river Dniester (Western Ukraine) (figure 1). It is known for its late Roman secondary glass workshop, the only one discovered beyond the Roman *limes* on the Barbarian territory. In the late Roman period, this settlement area belonged to the archaeological culture of Chernyakhov (Sântana de Mureș). Its sites occupy the territory between Eastern Transylvania and South-Western Russia, including Moldova and almost the whole territory of Ukraine. The material culture of Chernyakhov is strongly influenced by the provincial Roman culture. The influence becomes manifest not only in numerous Roman imports, but also in the adoption of production traditions and of life style. An important article of Roman imports is represented here by glass vessels of different types.

Komarov is situated in the north-western part of the Chernyakhov culture's area. The late Roman settlement was located 250–300 km north of the Danubian *limes*, but 360 km after the evacuation of the province of Dacia beyond the Danube. This remarkable site has a very big surface area of 30–35 ha, while an average surface of a settlement in this region is of 3–4 ha. The provincial Roman component in the material culture is especially pronounced here. A glass-working complex, a stone construction unusual for local 'Barbarian' settlements, and also the use of special building

materials, such as flat bricks and tiles, confirm the presence of people probably originating from Roman provinces or from the North Pontic region. The large number of glass finds (more than 2000) and the high proportion (up to 20 %) of late Roman pottery (*amphorae*) are also exceptional for a Barbarian site. Different kinds of handicrafts are identified here, such as glass working, pottery production, ferrous and non-ferrous-metal industry. It is likely that Komarov was one of the

Fig. 2: Glass working furnace from the settlement of Komarov. A: after: SMÍŠKO 1965. 1 – bricks, tiles; 2 – pieces of clay plastering, covered by melted glass; 3 – strongly burned clay; 4 – lightly burned clay; 5 – dark yellow clay; 6 – humus. B: after: RUMYANTSEVA 2014. Photo from the Archive of the Institute for Ukrainian history of the National Academy of Science (Lviv, Ukraine).

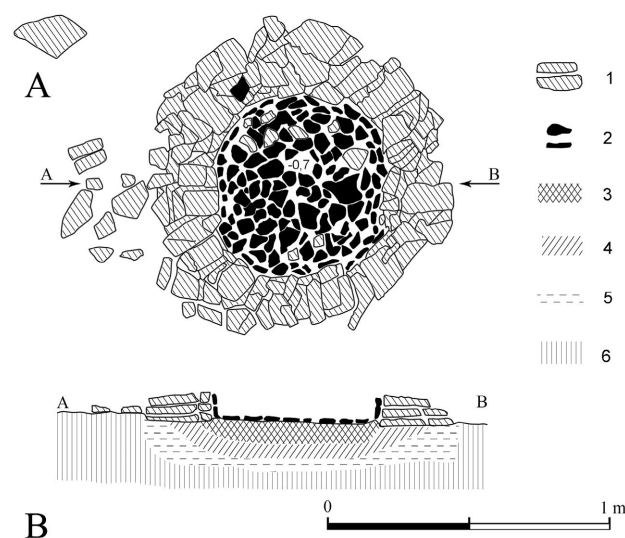
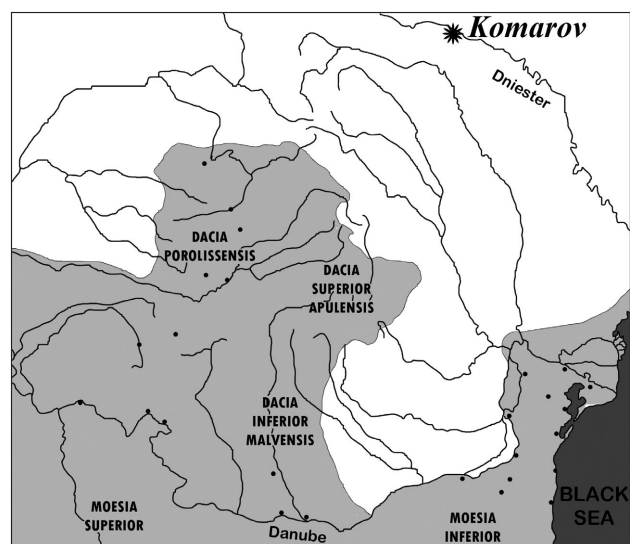


Fig. 1: Location of the settlement of Komarov. © authors.



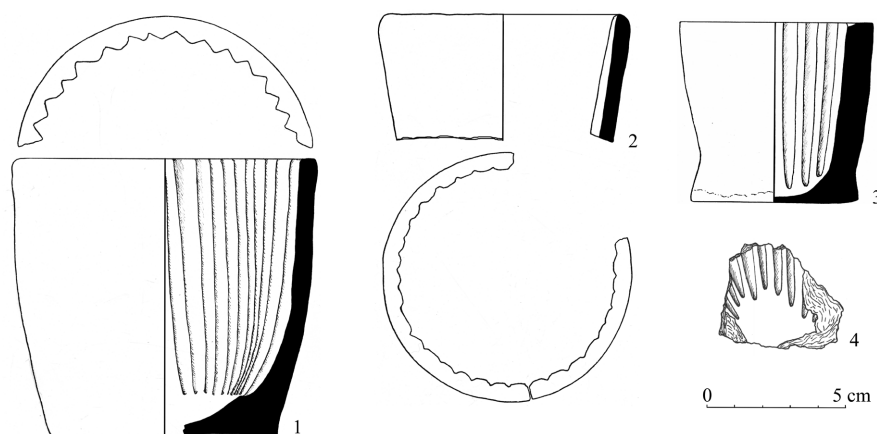


Fig. 3: Ceramic dip moulds for the production of ribbed glass vessels. After: RUMYANTSEVA 2014. 1, 2 – Drawings made after objects from the collection; 3, 4 – drawings made after photos from the Archive of the Institute for Ukrainian history of the National Academy of Science and description of M. Yu. Smishko (SMIŠKO 1956). Drawing: A. Efremova.

main industrial, commercial and administrative centres of the district. It is interpreted also as a late Roman trading post (*factoria*).¹

The site has been excavated since 1956. Since then, three different teams worked here.² The remains of a glass workshop were investigated by the expedition under the direction of Prof. M. Yu. Smishko. During the excavation campaigns in 1956, 1957, 1962, 1965 and 1969 this team has investigated an area of 3732 m² with 39 structures, but only a small part of these materials was published.³ The aim of our project is the complete study of the materials related to glass working, coming from Prof. Smishko's excavations. In this article we present some preliminary results of the current research.

EVIDENCE FOR GLASS WORKING

Evidence for glass working was discovered in the eastern part of the settlement, where the industrial zone was situated. It includes remains of a circular furnace, chunks of raw glass, moils, fragments of vitrified bricks and other different kinds of glass working wastes.

The circular furnace is made of flat bricks and tiles (figure 2) and has an inner diameter of 60 cm. Only the lower part of the construction up to a height of 15 cm has survived. The inner surface of the furnace chamber was coated by clay mixed with sand, and was covered by a layer of glass. It is likely that the structure represents the remains of a melting chamber, in which the glass was directly melted. In the western part of the Roman Empire, such constructions were typical up to the 3rd century. In the 4th century, or possibly slightly earlier, a technological change came about, and melting pots came in general use.⁴

Of particular interest are four fragments from at least three ceramic dip moulds for blowing ribbed glass vessels (figure 3), which were already mentioned by different scholars.⁵ Two of them are still in the collection (figure 3,1,2), two others are known only from photographs and drawings of the 1950s (figure 3,3,4). Their shape is almost cylindrical, with vertical concavities on the inside. They measure 6.5–10.1 cm height, the diameter at the rim is 7–10.6 cm, and 6–8 cm at the bottom. In spite of the exceptional number of dip moulds originated from the site, finds

of ribbed glass are represented in Komarov only by a few fragments.

Most of the ancient dip moulds are known for the Islamic period. One of them, made of limestone, originates from Kirbet al-Hadra (Israel), from a 8th century AD context;⁶ three others, metallic and possibly dating to the Early Islamic period, seem to come from the Middle East.⁷

In the *Barbaricum*, bowls with ribbed decoration (type Eggers 201) are known from the phase C2⁸ of the Central European chronology⁹. However, it should be stressed that for materials originating from the Vistula region, the definition of the phase C3 is complicated.¹⁰ Isolated finds of ribbed beakers were identified in Chernyakhov graves of the late period, i.e. from the 2nd half of the 4th to early 5th century AD.¹¹ In Komarov, all the fragments of dip moulds were concentrated in an area near the settled part of the site (figure 4), at a certain distance from the furnace. Fragments of one dip mould (figure 3,2) originate from a pit with finds dated to the phase C3, including a piece of a beaker of the Kowalk type. However, it cannot be excluded that they got into the pit from the earlier layers when it was filling up: they were identified in the upper part of the pit.

Raw chunks of colourless or naturally coloured glass (light green, blue-green, olive), measuring up to 6–7 cm, are represented by 334 finds (1065 g). Chunks of coloured glass are scarce: 31 finds of dark blue (17.5 g) and one piece of emerald green glass (3 g) originate from the site. Semi-finished products of black glass are represented by 40 pieces of flat cakes (71.5 g).

1 PETRAUSKAS 2014.

2 PETRAUSKAS 2014.

3 SMIŠKO 1964; ŠČAPOVA 1978; ŠČAPOVA 1983.

4 FOY 2003, 39.

5 SMIŠKO 1964, 74, table 1,12.13; ŠČAPOVA 1983, 71, 72, fig. 13,9-10; STERN 1995, 24, fig. 8.

6 FREESTONE et al. 2015, p. 47–48; fig. 6.

7 VON VOLSACH and WHITEHOUSE 1993.

8 Dates for the phases of the Central European chronological system, developed by K. Godłowski (1970) and J. Tejral (1997 et al.), mentioned in the text, are as following: phase C2 – 250/260–300/320; C3 – 300/320–350/370.

9 EGGERS 1951, 179, pl. 15; RAU 1972, 167; STAWIARSKA 1999, 260–261, cat. N 70.

10 GODŁOWSKI 1970.

11 GAVRITUKHIN in print, fig. 15,1.17.

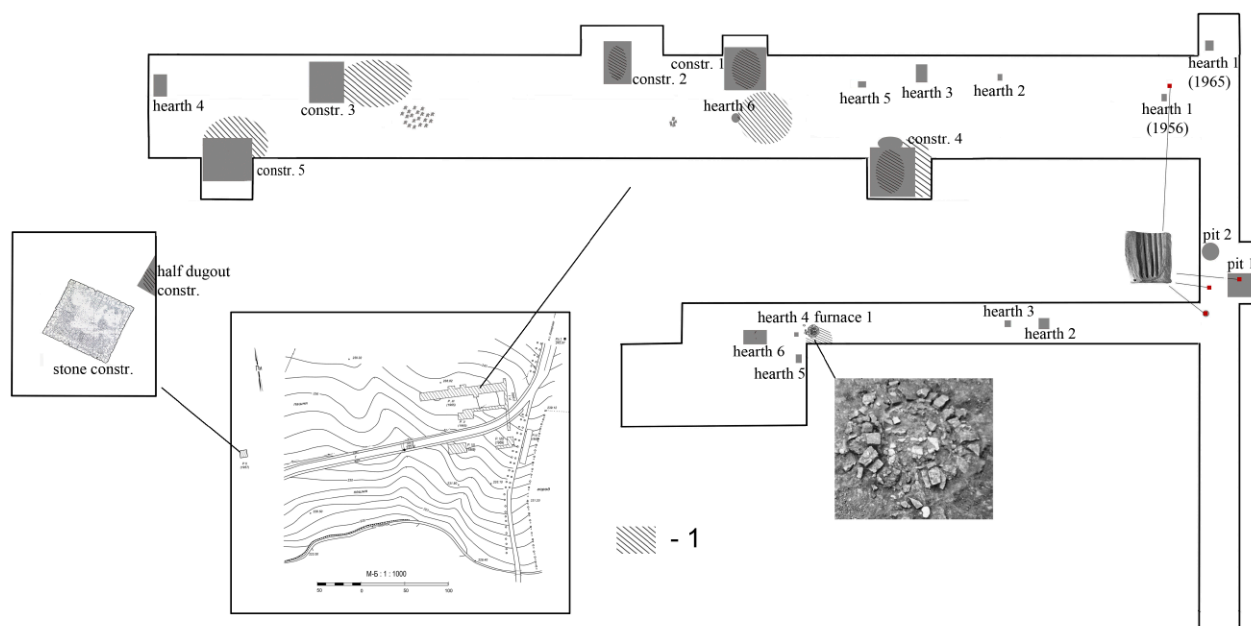


Fig. 4: Plan of the excavated area of the Komarov settlement. The situation plan and the location of the excavations are given after: SMIŠKO 1969; PETRAUSKAS 2014. The location of objects is reconstructed by using the descriptions in: SMIŠKO 1956; SMIŠKO 1957; 1 SMIŠKO 965. 1 – areas with high concentration of glass finds.

There are almost 80 moils of colourless or naturally coloured glass. One emerald coloured glass object could also be a moil. Most of the moils are cylindrical, but a few lid-shaped moils prove also the production of open-shaped vessels in Komarov.

EVIDENCE FOR GLASS RECYCLING

M. Yu. Smishko mentions several excavation areas in the eastern (industrial zone) and central parts of the settlement, where the concentration of glass finds was exceptionally high (figure 4). The numbers range between 30 and more than 500 items, including numerous fragments of blown vessels and a few fragments of cast vessels and window panes, as well as raw glass and glass working waste.¹² One of the concentrations containing about 320 finds is situated near the furnace and could be associated with glass working. In four cases, numerous glass finds were identified in constructions, which are associated with dwelling houses.

Construction N1 was most likely the house of a merchant. Five amphorae found here enable us to date the construction to the 4th century AD.¹³ About 40 fragments of vessel glass and a fragment of a window pane also originate from the house.

Construction N2, also a dwelling house, yielded eight fragments of a cast dish of deep blue glass (figure 5,10), typical for the period up to the middle of the 1st century AD.¹⁴ A find of a piece of a facet cut vessel decorated by an oval facet, confirms however that it belongs to the period no earlier than late 3rd / early 4th century AD (see below).

Construction N4 contained more than 30 vessel glass fragments, including a piece of a facet cut 'Barbarian' beaker, also typical for the late period.

A pile of glass from a half-excavated house in the central part of the site comprised more than 200 vessel fragments and more than 40 glass chunks. A fibula and a fragment of a beaker of the type Straume VII originating from it make possible to date the house to the middle or the third quarter of the 4th century AD.

All these heaps of glass are related to the typical local constructions of the 'Barbarian' population. Only some pieces of glass were found in the unique stone construction typical for antique sites.

Large heaps of glass were also discovered in the cultural levels of the industrial zone of the settlement. They included a total of more than 500 items, mainly glass cullet, furthermore raw chunks and some pieces of glass working waste. In most cases, the glass cullet makes up 73–92 % of the finds; the finds of glass working debris are not numerous. Some of these zones, at least, could be associated to the practice of glass recycling. It seems that the local population collected glass for this purpose. It is possible that part of the glass was gathered locally. However, with the exception of Komarov, the sites of the region are generally not rich in glass finds. Finds of window glass and fragments of cast vessels confirm that at least part of the material was collected for recycling and imported to the site. In this context, a find of a round window pane (figure 5,11) is of particular interest, because it helps us to date the glass working activity at the site. Such window panes seem to be unknown before the 4th century AD.¹⁵

The areas with a high concentration of glass finds in cultural deposits look very enigmatic. If the glass was collected for recycling, it is unclear why it was left in the soil.

¹² SMIŠKO 1956; SMIŠKO 1957; SMIŠKO 1965.

¹³ DIDENKO 2015, 24–25.

¹⁴ GROSE 1989, 254–256, fig. 135.

¹⁵ FOY 2005, 113.

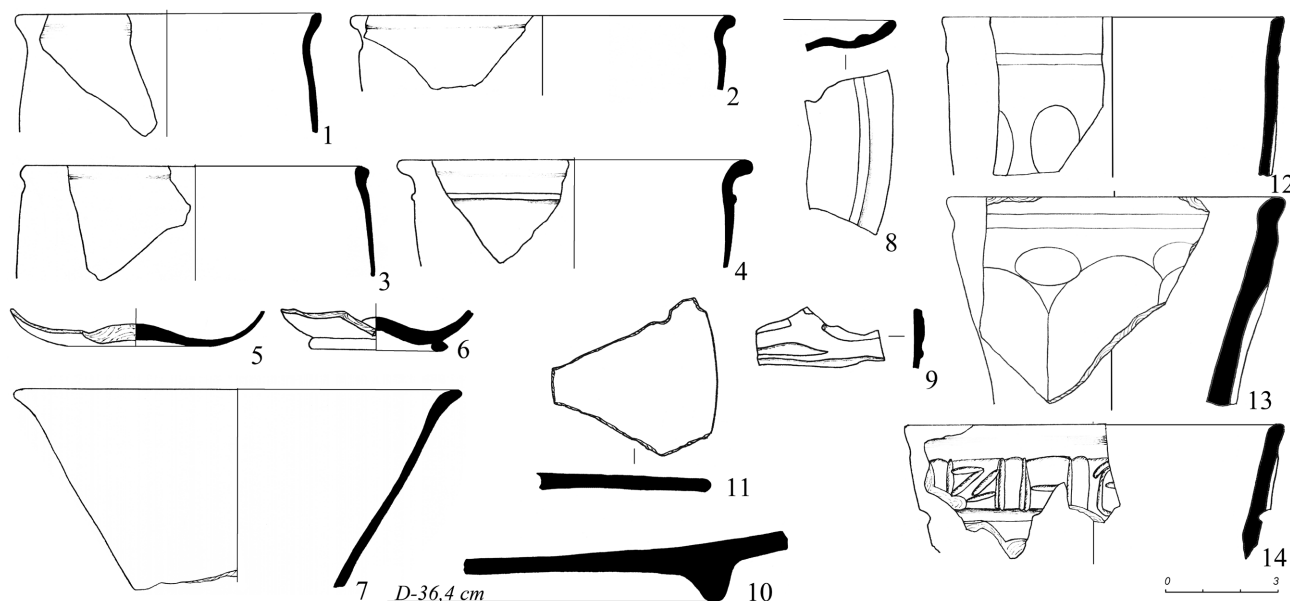


Fig. 5: Glass finds from the settlement of Komarov. © authors.

THE PRESUMED PRODUCTION OF THE GLASS WORKING PLACE OF KOMAROV

Taking into account the described piles of glass, possibly intended to be recycled, and also the current state of the collection, it is rather difficult to identify the types of glass objects/vessels made at the workshop. Regarding the kind of glass working wastes, blown vessels of open forms should be among them. It is likely that ribbed vessels were also produced here.

The most representative glass finds from the site are fragments of cups or bowls with fire-rounded rim, either undecorated or with applied strips (figure 5,1-4). They originate apparently from cylindrical and hemispherical forms like the types Is. 85/AR 98 and Is. 96.¹⁶ They represent more than a half of upper parts of vessels in the collection (57,5 %). Numerous bottoms with a coil base ring (figure 5,6) or with a concave base (figure 5,5) could have belonged to the presumed types Is. 85/AR 98 and Is. 96. On the territory of the Roman Empire, the cylindrical cups like the types Is. 85/AR 98 are typical for the period from the 2nd to the 3rd century AD, whereas the Is. 96, including those with fire-rounded rims, were also in use later, at least during the 4th century AD.¹⁷ In the *Barbaricum*, cylindrical and hemispherical bowls, known as types Eggers 202 and Eggers 211-213, are the most frequent types of glass drinking vessels in phase C2.¹⁸ In Crimea, closed forms are dated to the 2nd half of the 3rd and to the 4th century AD, mainly the first half of the 4th century. On the sites of the Chernyakhov culture, such vessels were discovered in graves dated to the period corresponding with the Central European phases C2 and C3.¹⁹ Although a part of vessels of these types could be related to glass cullet, it is likely that they were among the production of the local workshop. Some rare pieces of discarded objects confirm it.

Cups with out-splayed sides and rounded rims (Is. 80/AR 79.1) are not numerous (figure 5,7). However, a piece of a discarded object makes possible to suggest the production

of such vessels at Komarov. Vessels of this type are rare and they are not typical for the area beyond the Roman *limes*. Most of them are dated to the 2nd century AD or earlier.²⁰ A few rare finds are of later date. In Gorgippia, they originate from the house N30 burned down in the settlement conflagration of 239/240 AD.²¹ In Augst, bowls with out-splayed sides are known up to the 3rd century AD.²²

Among the discarded objects there is also a fragment of a dish or a plate (figure 5,8).

Numerous glass strips, blue, colourless or naturally coloured, were found among the workshop glass waste. In Komarov, the waste could have been used for the production of base rings or for the linear or wave-shaped applied decoration of vessels.

The latter (figure 5,9), typical for bowls types Eggers 199 and Eggers 200, is known in Central Europe during the phase C2.²³

CHEMICAL COMPOSITION OF RAW GLASS

The chemical composition of 33 samples of raw glass was studied by energy-dispersive X-ray fluorescence (EDXRF) (table 1; figure 6). The precision of the measurements was checked by using Corning glass standards A and C, and the standards of National Institute of Standards and Technology (NIST). All the glass has a soda-lime-silica composition typical for 'Natron' glass, with low concentrations of potassium and magnesium. Fourteen samples have slightly elevated concentrations of copper, tin and lead (more than 100 ppm), testifying the use of recycled glass in the production. It is very likely that these

16 ISINGS 1957, 101-102, 113-114; RÜTTI 1991, 66; 90-99, pl. 56,77-84.

17 BARKÓCZI 1988, 70-71; RÜTTI 1991, 66; 90-99; COOL and PRICE 1995, 217-220.

18 EGGERS 1951, 180, pl. 15; STAWIARSKA 1999, 130; 138.

19 PETRAUSKAS 2003, 238; 265.

20 ISINGS 1957, 96.

21 ALEKSEEVA and SOROKINA 2007, 26, fig. 21,1-6.

22 RÜTTI 1991, 84.

23 EGGERS 1951, 179, pl. 15; RAU 1972, 167; STAWIARSKA 1999, 118.

Group	Decolourizer	M, s	Na ₂ O	MgO	Al ₂ O ₃	SiO ₂	P ₂ O ₅	K ₂ O	CaO	TiO ₂	MnO	Fe ₂ O ₃	Sb	Co	Ni	Cu	Zn	Sr	Zr	Sn	Ba	Pb
Kom-1 n=5	Sb	M	19.23	0.74	2.14	65.83	0.03	0.47	6.78	0.05	0.01	0.54	7092	9	25	33	62	526	27	bd	226	84
		s	0.81	0.16	0.24	1.43	0.01	0.05	0.63	0.01	0	0.09	1223	3	7	8	10	79	5	bd	67	17
Kom-2 n=5	Mn	M	17.66	0.86	2.42	66.7	0.12	0.43	6.62	0.09	1.62	0.61	bd	9	33	87	51	498	30	bd	477	54
		s	0.7	0.13	0.2	1.89	0.03	0.08	0.79	0.03	0.23	0.16	bd	10	7	67	12	72	3	bd	170	10
Kom-3 n=9	Mn	M	19.68	0.96	2.24	66.58	0.07	0.37	5.86	0.12	1.32	0.68	21	7	31	53	50	480	36	bd	628	52
		s	1.22	0.14	0.15	1.34	0.03	0.11	0.96	0.06	0.29	0.23	23	7	7	21	11	67	8	bd	207	28
Kom-4 n=3	Mn+Sb	M	18.4	0.8	2.6	65.16	0.1	0.54	7.43	0.07	0.68	0.6	2922	15	28	117	62	479	28	bd	378	237
Kom-5 n=7	Mn+Sb	M	20.07	0.88	2	65.94	0.08	0.4	6.42	0.09	0.9	0.71	2430	13	31	293	60	552	39	37	348	472
		s	0.44	0.11	0.11	0.68	0.03	0.07	0.47	0.03	0.35	0.15	650	6	6	179	13	80	7	-	94	313

Table 1: Chemical composition of raw glass from Komarov
Concentrations: in wt% (for oxides), in ppm (for elements)
bd – below detection level

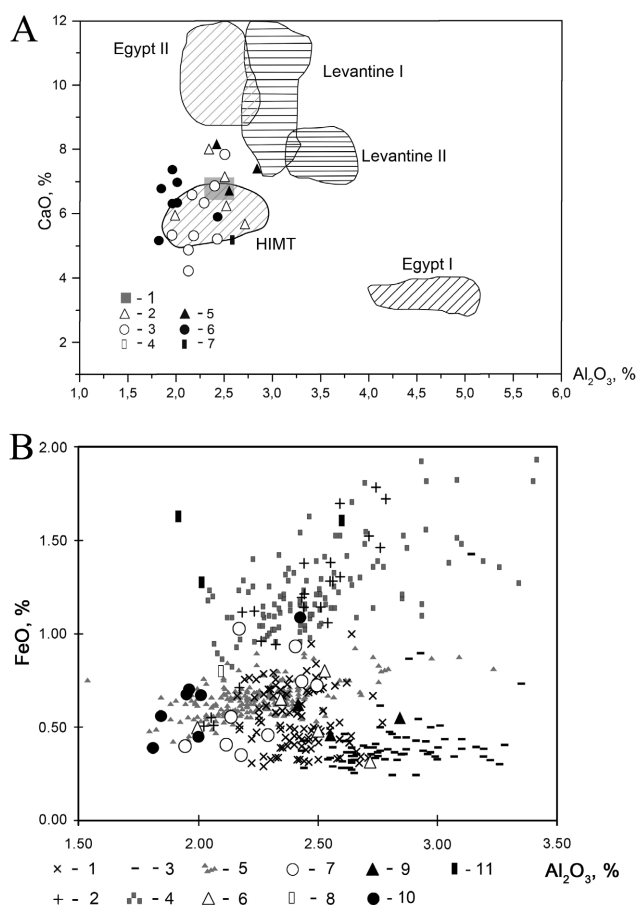


Fig. 6: Raw glass from the Komarov settlement and the groups of 'Natron' glass of the 1st millennium AD. A. Lime – aluminium ratio. After: DRAUSCHKE and GREIFF 2010; HIMT – with additions after FOSTER and JACKSON 2009. 1 – average composition for 'Roman' blue-green glass (after JACKSON et al. 1991; DRAUSCHKE and GREIFF 2010); 2–4 – glass from Komarov, decolourized by manganese: 2 – close to 'Roman' composition (group Kom-2); 3, 4 – close to HIMT (group Kom-3); 5–7 – glass from Komarov, containing manganese and antimony: 5 – close to 'Roman' blue-green and Levantine I (group Kom-4); 6 – close to HIMT (group Kom-5); 7 – 'indefinite' composition. B. Aluminium – iron ratio. 1 – 'Roman' blue-green; 2 – HIMT; 3 – Levantine (I) (1–3 – after FREESTONE et al. 2000); 4 – HIMT 1; 5 – HIMT 2 (4, 5 – after FOSTER and JACKSON 2009); 6–8 – glass from Komarov, decolourized by manganese: 6 – group Kom-2; 7, 8 – group Kom-3; 9–11 – raw glass from Komarov, containing manganese and antimony: 9 – group Kom-4; 10 – group Kom-5; 11 – 'indefinite' composition.

samples represent not primary glass but re-melted material broken out of a furnace or of melting pots.²⁴

Raw glass, decolorized by antimony, is represented by five samples of colourless glass of a very high quality, without signs of use the cullet (table 1,1). Concentrations of lime, alumina, magnesium and iron are slightly higher than in the glass of the group 4.²⁵ They are more similar to the Budastis glass (1st–3rd centuries AD),²⁶ and to a sample of raw glass from a secondary workshop in Arles-sur-Rhone of the 4th century AD.²⁷ The high sodium and low titanium concentrations identified in samples from Komarov are however typical for group 4.

The composition of five samples (table 1,2; figure 6) is close to Roman blue-green glass, regarding the concentrations of the elements characterizing raw materials (sand). They contain, however, higher concentrations of manganese (1.6 wt.% MnO on average). The most representative group is the HIMT glass (nine samples: table 1,3); 'weak' HIMT²⁸ predominates (figure 6).

Thirteen glass samples contain both antimony (0.13–0.52 wt.%) and manganese (0.31–1.63 wt.%). These elements show a strong negative correlation, which was also noticed for Romano-British colourless glass.²⁹ Eleven of them demonstrate also features that suggest the use of recycled glass. Seven samples, which contain two decolourizers, are close to the HIMT group (table 1,5). A positive correlation between iron, magnesium, manganese, titanium and aluminium, typical for HIMT glass, is observed for them. It is likely that the craftsmen in Komarov mixed the HIMT raw glass with glass, which was decolorized by antimony, under the form of cullet³⁰ or, possibly, raw chunks, accessible on the site. With respect to the concentrations of elements characteristic for the sand used in glass production, three samples take a position between Roman and Levantine (I) glass (table 1,4; figure 6).

THE POSSIBLE CHRONOLOGY OF THE WORKSHOP

According to the archaeological data, the most probable date for the workshop with the phases C2 (250/260–300/320) or C3 (300/320–350/370) of the Central European chronology.

²⁴ FREESTONE et al. 2015, 47.

²⁵ FOY et al. 2003, 61–65.

²⁶ ROSENOW and REHREN 2014, table 2.

²⁷ FOY et al. 2004, 176–177, fig. 4: VRR-711.

²⁸ FOSTER and JACKSON 2009, 192.

²⁹ FOSTER and JACKSON 2010, 3072.

³⁰ FOSTER and JACKSON 2010, 3074.

The early type of furnace as well as the vessel types typically found on the territory of the Empire in the 3rd century AD (not later), suggest that the workshop was active in the earlier part of the period between 250/260 and 350/370.

Nevertheless, more than a half of the studied samples are made from HIMT-based raw glass. This compositional type of glass is considered to be a late introduction to the Roman world. In British assemblages it appears not before the 330–340s, possibly even later.³¹ Two possible scenarios are to be discussed here:

- The workshop existed in the period, when the Roman glass industry went through the most important technological and compositional changes. But in this case, the workshop was not active before the 2nd third of the 4th century AD. The problem is, that this date is not in good accordance with that of the furnace construction. However, it is not exactly known, when and how quickly these furnace constructions have gone out of use here, in the very periphery of the Roman world.
- The workshop was active on the site not only in the 3rd century, but also later. The later production could most likely represent a reactivation rather than a continuation.

THE KOMAROV WORKSHOP AND THE PROBLEM OF THE ORIGIN OF 'BARBARIAN' BEAKERS

In any case, the glass working activity on the site that might have lasted until the mid/late 4th century AD or even slightly later (the settlement is likely to have existed here up to the late 4th – early 5th century AD), is of great significance regarding the problem of the origin of 'Barbarian' facet cut beakers. Well known in the area beyond the *limes* from Romania and Crimea to Scandinavia, they are represented in the Roman Empire itself only by isolated finds looking strange here. The origin of 'Barbarian' facet cut beakers is one of the most intriguing questions in the archaeology of the Chernyakhov and some other 'Barbarian' cultures of Central and Northern Europe, because the Barbarians did not produce glass objects themselves. Among the discussed possibilities for their production areas figure the Rhine provinces of the Roman Empire, the Near East (possibly Iran) and even local production centres.³² Most probably they were custom-made for the Barbarians by provincial Roman craftsmen.³³

In Komarov, finds of facet cut beakers are especially numerous and represented by nearly 120 fragments. According to the statistical data, the number of pieces of the Kowalk / Straume I type³⁴ on the territory of Romania reaches 100 finds³⁵; almost 100 items were also recorded east of the Prut river³⁶. Forty-two more exemplars were found in Komarov (figure 5,12). For the type Straume VII, finds from the 'Chernyakhov-Scandinavian circle' total nearly 60 finds,³⁷ and 24 more originate from Komarov (figure 5,13). The number of finds of Straume VIII beakers (28 pieces, figure 5,14), scarce everywhere, is also significant on the settlement. This data do not reflect a real picture, because a huge amount of finds is unpublished, but it shows that the quantity of beakers of the listed types in Komarov is exceptional.

Different scholars suggested that the Komarov workshop was the possible place of production of such beakers. However, the date for the workshop – the 3rd quarter of the 3rd century – supposed by J. Ščapova, who was studying these materials, is much earlier than the appearance of this kind of beaker.³⁸ Although prototypes for these beakers are known in the Eastern Mediterranean until the 3rd century, the types found and described from Komarov have generally a late chronological position in 'Barbarian' Europe. The earliest of them, of the Kowalk (Straume I) type, emerge in the early 4th (or possibly the late 3rd) century AD, whereas the latest ones (Straume VII and VIII) appear not earlier than in the mid/late 4th century AD.³⁹

The chemical composition of the glass of 29 beakers from Komarov was studied. Only one piece of the Kowalk type has the typical composition of Roman blue-green glass. Fifteen samples are associated with the HIMT group, and 13 – almost half of the samples – with the group of glass decolourized by antimony, which has a composition similar the chunk glass from Komarov. It should be stressed that among the latter samples, there are ten beakers of the latest types Straume VII and VIII. They seem to be among the latest examples known for glass that was decolourized by antimony (mid/late 4th century AD or slightly later).

Obviously, the evidence for glass working in Komarov in the 4th century AD does not prove the production of 'Barbarian' beakers here. However, it confirms the fact of the glass working activity in this region at that time, supporting the idea that the beakers in question could be custom-made for 'Barbarian' people near the *limes*, in the zones of the most active contacts between them and the provincial Roman population, either on the territory of the Empire or at 'trading posts' like Komarov.

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31 FOSTER and JACKSON 2009, 193.

32 For references see: ŠČUKIN et al. 2006, 46–47.

33 GAVRITUKHIN 2011.

34 RAU 1972; STRAUME 1987.

35 LIKHTER and GOPKALO 2007, 6.

36 GAVRITUKHIN 2011, 57–62.

37 GAVRITUKHIN 2011, 62–64.

38 ŠČAPOVA 1983, 148–151.

39 For references see: GAVRITUKHIN 2011.

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Abbreviations

IA NAN – Institut archeologii Nacional'noji akademiji nauk (Institute of archaeology, National Academy of Sciences);
NA IA NANU – Naukovij archiv Institutu archeologii Nacional'noji akademiji nauk Ukraini (Academic archive of the Institute of archaeology, National Academy of Sciences of Ukraine).

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