The Time of Extravagance and a "Crescent-Shaped Glass Bottle" from the Collection of Classical Antiquities of the National Museum, Prague

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ABSTRACT
The collection of the National Museum in Prague contains also an atypical crescent-shaped glass bottle (inv. no. H10-142). It is one of the oldest acquisitions in the collection and it was no longer possible to find any information concerning its provenance. It is a vessel of a curious shape and unknown function, with no known comparanda. Analysis of its elementary composition has shown that it is made of natron glass. In comparison with other samples taken from Roman glass of the 1st–3rd centuries AD from the collection of the National Museum, the difference is minimal; it differs only by a slightly lower concentration of CaO, MgO, TiO_2 and MnO. Therefore, it may probably be considered another experimental product of the Roman glassmakers, such as, for example – the rhyta, the flask with doves from Cologne or the small vessels in the shape of various animals.

KEYWORDS
Glass vessel; blown-glass; crescent-shaped vessel; composition of glass; Roman glass.

INTRODUCTION

In the collection of the National Museum, is kept an atypical glass vessel. The vessel with inv. no. H10-142 (**Fig. 1**; **Pls. 6/1–2**) belongs to the oldest acquisitions; it was impossible to find out its provenance from the entries in the inventory book. It was presented at the comprehensive exhibition "Ancient glass" – organized in 1970 at the National Museum and it was described in its catalogue as a "Crescent-shaped bottle, Rhineland, 4th century AD" (Čadík 1979, 31).

The intact vessel is made of thick colourless glass with a light yellowish brown tint, it has a flattened bulge in the middle part – towards the tip; the rim and the neck have a circular cross section. The overall length of the vessel is 41 cm; the diameter of the upper rim is 2 cm. The way this blown vessel was shaped unambiguously attests the usage of a mould with a consequent forming (elongation, flattening of the crescent-shaped body). The neck was refined by cutting after cooling. It was applied to the finishing of the rim and the three ringlets placed 0.5 cm, 4 cm and 8.5 cm below the rim. The transition between the neck and the body of the vessel is 7 cm below the rim and was also cut (**Pl. 6/3**). The surface of the glass is slightly corroded – on the inner side of the vessel there are apparent thin corrosive layers with iridescence which are flaking off. The outer surface is damaged by a local pitting corrosion, clogged with impurities and corrosive particles of a dark brown colour. The extent of the pitting corrosion is relatively large and corresponds to the long term effects of the adverse conditions due to its deposition in the soil (Vandiver 1992, 398).

It is a vessel of a curious shape, whose function is not clear and to which a close parallel has not been found – which led us to the question as to its dating to the Roman period.

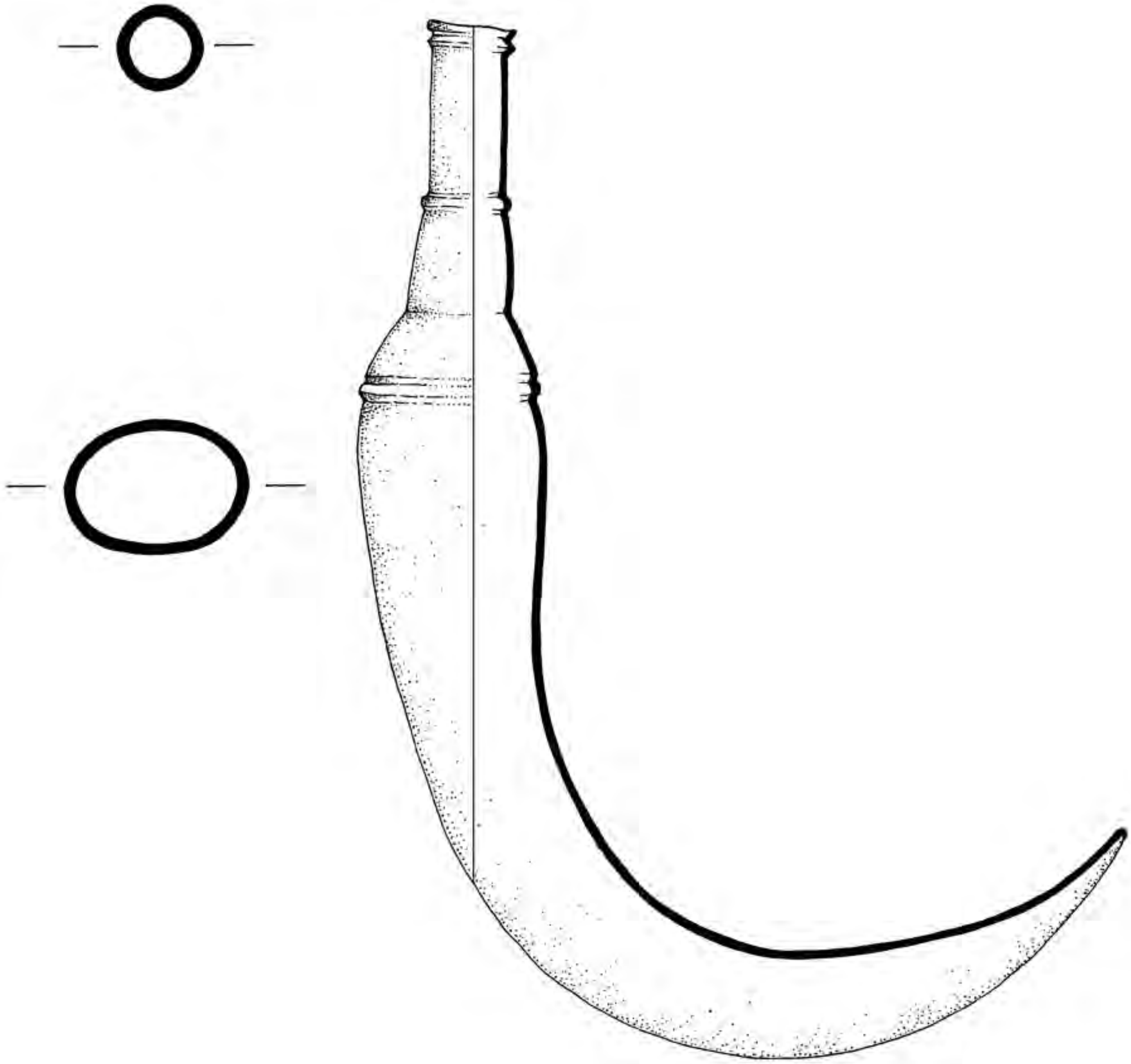

Fig. 1: The crescent-shaped glass bottle (drawing E. Jirsová).

BLOWN GLASS, VESSEL SHAPES AND EXTRAVAGANCE

As soon as glassblowing took hold on the soil of central Italy (during the reign of Augustus) but also in a few towns in the north including Aquileia, rapid development of the craft occurred. It is supposed to be a merit of Syrian craftsmen who came to Italy either as slaves – part of the booty from the wars in the East – but they also could have been enterprising individuals who saw new economic opportunities. During the reign of Tiberius, the production of blown glass was experiencing such a rise that it caught the attention of Strabo who commented on it by saying that “a glass cup can be bought for a copper coin” (*Geography* XVI, 2). At that time, it was possible to make vessels of any possible shape from blown glass. It caused no problem to make a small vessel with an extremely long neck, such as the pipette-shaped unguentaria – in the middle of its length bulbously widened; round vessels with a narrow neck, etc. Glass in a viscous state can be further shaped by means of various tools, such as glass shears, cat's eye shears, pincers and various kinds of shaping tools. Moreover, glass offered more possibilities than potter's clay and that is why the possibilities of additional work with a blown product led – in the time of the Roman glass manufacturing boom – to the creation of a great variety of products. It was simple to create, for example, a vessel of a lenticular body – it sufficed to squeeze a round semiproduct of the vessel between two flat slabs; but even at this point the work with the lenticular body did not end and the fun with glass could go on – the flat bottle could be perforated in the middle. Even a more complex product is the Flask with Doves found in Cologne and dated to the 3rd century AD. From each opening an opaque-white dove with a blue head is peeping out (Harden 1987, no. 140). Perhaps a dovecote served as inspiration for the glassmaker. This dove bottle has no direct parallels – it was made for decorative purposes only. The zenith of this tendency is represented by a bottle with four mutually interconnected tubes (Harden 1987, no. 141), found in the Roman cemetery in Cologne. The excesses sometimes border on kitsch. Similar playful ways of producing glass are well attested in Cologne and it is possible to denote them as a specific style of the local glass workshops. Another trend was not to divide a vessel, but on the contrary, to join together several vessels of the same size – into twins, triplets, etc.

The experiments with glass led unavoidably to the glassmakers' attempts to manufacture three dimensional figurines; what was impossible before the invention of the blowpipe developed now – at the time of the boom of glassmaking and the technique of blown glass – into perfect artistry. A beautiful dolphin and a blue suckling-pig from Cologne are the best known examples of it (Doppelfeld 1966, Abb. 101–103). There are no known counterparts of the four glass boar tusks set in a bronze fitting; they could have been pendants belonging together and perhaps forming part of a necklace. Moreover, none of the tusks has the same size and also the glass is different; one is made of greenish glass, another is dark green and the other two are almost transparent. Perhaps they were used in a ritual connected with hunting ceremonies (*Ancient Glass* 1957, no. 295). Also, vessels in the shape of a phallus were produced (Whitehouse 1997, no. 353); according to the shaping of the rim, they can be perhaps dated to the 1st century AD. Bottles in the shape of a sandal (Harden 1987, 65–66) found in Cologne in a female grave are small vessels for perfumes, dated back to the end of the 2nd century and the beginning of the 3rd century AD. Small bottles in the shape of a dove (Doppelfeld 1966, Abb. 23) usually have the remains of a red or white powder inside; perhaps they served for the preparation of cosmetics or they could also have contained perfumes. The vessels were completely sealed; the tip of the tail had to be broken off in order for the owner to get to its content. Also, bottles in the shape of heads were made (Harden 1987, nos. 93–94), as is the grotesque head from the repertory of the Italian comedy found in Cologne, or a vessel in the shape of a squatting monkey. Glass rhyta represent a cheaper version of prototypes made from silver or bronze. The simplest form has a short neck with a rim bent outwards, the body of a circular cross section narrowing towards the bent tip (Zampieri 1988, no. 340). In northern Italy, rhyta decorated with grains of glass of different colours appear. Some researchers believe that it is a specific decorative element of the workshops in Aquileia in the 1st century AD (Bonomi 1996, no. 450). A rhyton with a zoomorphic ending corresponds to the form Isings 73b (Bonomi 1996, no. 449). In the late imperial period their place was taken up by very similar drinking horns. These drinking horns later became the prototype for the early medieval drinking horns (Harden 1987, no. 49). The technical dexterity during the Roman imperial period went hand in hand with the imagination of the Roman glassmakers and the range of the possible shapes is, therefore, huge.

CHEMICAL COMPOSITION OF GLASS – THE HISTORY AND THE ANALYSES

The chemical composition of glass is influenced by the employed raw materials and has a great influence on the properties of this material. Contemporary analytical methods permit a relatively precise determination of the main and minority components of the glass batch, so the acquired results can help us to discern more closely the production technology. First of all, they are clues to the specifications of the used raw materials, and consequently serve to localize their sources or eventually the production centres. They can point out the chemical resistance of glass, the purity of the raw materials, the quality or the price of the production (Hulínský – Černá 2007, 146).

Early glass is in most cases soda-lime-silica glass. Soda-based glass can be divided, according to the type of the flux used, into two kinds – plant ash glass and natron glass. The composition of plant ash glass is typical for its relatively high content of magnesium and potassium, usually more than 2 % in the case of both oxides. As a flux, in this case, the ash of halophytic plants is used which grow on the sea coast and in the desert, or that of seaweeds which contain sodium from seawater. Chemically they are heterogeneous mixtures with a major proportion of Na_2CO_3. These sodium ashes are considered to be the first raw material source. They were used in the Near East and Egypt in the production of faience and later also in that of glass – as early as the 4th millennium BC (Tite *et al*. 2007). The second type is the so called natron glass which is typical for the Roman production. The source of the sodium flux is in this case natron – mixtures of hydrates Na_2CO_3 and $NaHCO_3$. This raw material of mineral origin was mined in Egypt (Freestone 2005, OO8. 1. 2.), in Syria, and other areas of dried up lakes. Natron glass has, in contrast to ash glass, a low content of MgO, K_2O and P_2O_5 and thanks to this, the compositions of these two types of glass are markedly different (more Wedepohl 2003). It is interesting that these two raw materials were not used simultaneously (e.g. locally different). A relatively quick change in the raw material composition occurred practically in all the production locations with the exception of some eastern regions. Scholarly works (e.g. Brill 1999) basically agree with each other that the change in the raw material source occurred during the first half of the 1st millennium BC, at the beginning of the millennium in the Levant and Egypt, and afterwards in the western world (Hartmann *et al*. 1997, 556).

Natron glass experienced its greatest boom in the Roman period and was produced until approximately the 9th century AD when medieval production started to use ash again. Roman glass vessels from the 1st to the 5th century AD show a very homogeneous chemical composition. The majority of raw glass produced during the Roman and the late Roman period was imported from Syria, Palestine and Egypt (Degryse ed. 2014, 115). In the time of the organized Roman world, a long distance trade developed which managed to supply distant regions with raw materials, semi-finished goods and glass products. The analyses showed (Freestone *et al*. 2002) that a relatively small number of so called primary workshops – located mainly in Egypt and Palestine near the raw material sources – produced raw glass in big ingots weighing several tons (Bass 1986). The slabs were broken up into smaller pieces which were distributed to a great number of secondary workshops for further processing. They re-shaped the glass and made from it the final products. Therefore, a number of different workshops could produce vessels, beads and other objects from raw glass made in one primary workshop and thus practically of the same composition. And vice versa, the secondary workshop could receive raw materials from several different primary workshops (Freestone 2005).

After the fall of the Roman Empire, the ancient tradition was maintained in the so called Rhineland glass workshops. From the chemical point of view, the glass is very similar to ancient models; however, the common production of the Frankish glass has almost a twice as high content of iron than the Roman glass which causes its brown-yellowish tint. Similarly, the producers of the Carolingian and Anglo-Saxon raw glass used the same formula as the Roman glassmakers, only with a smaller amount of soda (ca. 6 % less) which they compensated for with a greater amount of calcareous component (Wedepohl 2003, 89). Contrary to the European production area, in Sasanian Persia and its surrounding regions, ash of plants was used in glass production as it was before in Mesopotamia. Also workshops of the Islamic period accepted this formula which therefore, around the years 800–900 AD, spread throughout the Near East and Egypt and other regions of the Mediterranean (including Venice), where a return to ash glass occurs. Also in the Transalpine area the imported natron glass is then gradually displaced by the local wood-potassium ash. The oldest wood-ash glass appeared at the end of the 8th century (e.g. in Paderborn, in the ruins of Charlemagne's castle destroyed by the Saxons in 778 AD; Wedepohl 2003, 91).

In order to make a distinction between natron and ash soda-lime glass, the decisive factor is the content of MgO up to 1 wt% and at the same time K_2O up to 1.1 wt% for natron glass (Freestone 2005). Natron glass also has a markedly lower proportion of minority components, most of all the colourless glass which required a very high purity of raw materials. For comparison, let us state that the values considered usual in ash glass are: the content of MgO around 2–4 wt%, K_2O ca. 1.5 wt% and P_2O_5 in tenths or units of % (cf. **Tab. 1**, sample H10-7959 and H10-5810). With regards to a very variable composition of ash, it is clear that also ash glass has a wide range of minority components and there are marked differences in the final chemical composition. On the other hand, natron glass has a very homogenous composition, as is shown by several analyses carried out in the collection of the National Museum (**Tab. 1**). Only with respect to the younger natron glass (5th–10th century AD), five groups were distinguished (Ramadan 2010).

In order to determine the kind of the flux used, also the ratios of the isotopes of O, Sr and Pb were studied (Henderson *et al*. 2005). The differences were most evident in the content of the isotopes Sr which differs in natron and ash glass. Natron glass exhibits a narrow range of concentration (385 to 409 ppm) also in mutual ratios (0.7088 to 0.7092) of isotopes Sr; the ash types of glass have a wide range of results. Further, the ratio of strontium and neodymium was used for the differentiation of the origin of natron glass itself. The ratio of the isotopes of these two elements differs substantially in the Mediterranean sediments, thanks to which it is possible to distinguish the primary workshops in Egypt and the Levant from the other primary workshops – under the condition that the workshops located in the western Mediterranean or in the north-west of Europe used local sand. The primary eastern workshops have the isotope Nd higher than −6.0, while from the primary workshops of the western Mediterranean and north-west Europe, they should have the isotope Nd lower than −7.0 (Degryse – Schneider 2008). Suitable sands for the production of natron glass – corresponding to the Greco-Roman composition – are rare. Despite the Pliny the Elder (*NH* XXXVI, 26) statement, the sand on the coast near the Volturnus estuary is not suitable for glass production (Degryse ed. 2014, 37). Nevertheless, according to the conducted experiments, there are other regions in the western Mediterranean where glass production would be hypothetically possible, such as for example the beach sand in the region of Basilicata and Apulia (Degryse ed. 2014). Most of the suitable sands are thought to be found in the eastern Mediterranean region.

Inv. no. H10-	colour	shape	method	SiO_2	K_2O	Na_2O	CaO	MgO	Al_2O_3	P_2O_5	SO_3	Cl	TiO_2	MnO	Fe_2O_3	CuO	ZnO	Co_3O_4	Cr_2O_3	SrO	RbO	BaO	PbO	Sb_2O_3
142	colorless	bottle	SEM	72.85	0.46	17.85	5.05	0.16	1.85	0.18	0.02	1.16	–	0.02	0.42	–	–	–	–	–	–	–	–	–
142			XRF	68.09	0.27	22.9	4.24	–	1.34	0.12	0.78	1.10	–	–	0.08					0.07			0.31	0.70
1062	aqua	bottle	XRF	71.22	0.58	15.42	7.29	0.49	2.71	0.13	0.20	1.10	0.06	0.31	0.40	0.01	0.01	–	–	0.06	–	0.04	0.01	–
1064	greenish	bottle	XRF	70.96	0.38	15.59	8.15	0.45	2.29	0.10	0.18	1.23	0.06	0.12	0.32	0.01	0.01	–	–	0.06	–	0.05	–	–
1081	aqua	unguentar.	SEM	69.75	0.77	15.80	8.29	0.40	2.50	0.28	–	0.96	0.07	0.39	0.80	–	–	–	–	–	–	–	–	–
1109	yellow	beaker	XRF	70.08	0.52	16.43	7.87	0.48	2.34	0.09	0.23	1.33	0.06	0.13	0.34	0.01	–	–	–	0.07	–			–
1797	greenish	faltenbech.	SEM	68.39	0.85	17.00	7.18	0.91	2.38	0.43	–	0.97	0.10	0.90	0.87	–	–	–	–	–	–	–	–	–
1802	aqua	bottle	XRF	70.42	0.55	16.45	6.62	0.38	3.28	0.12	0.19	1.24	0.09	0.13	0.40	0.01	–	–	–	0.05	–	0.05	–	–
1983	y.-greenish	beaker	XRF	68.04	1.16	15.51	9.52	0.68	2.88	0.27	0.06	0.70	0.11	0.11	0.66	0.03	0.01	–	–	0.07	–	0.06	0.09	–
3140	greenish	bottle	XRF	66.43	0.42	19.74	5.97	0.86	2.40	0.05	0.38	1.24	0.17	0.78	1.03	0.02	0.01	–	0.01	0.01	–	0.03	–	0.32
3143	aqua	cover	XRF	70.48	0.51	16.22	7.59	0.44	2.48	0.11	0.15	1.24	0.06	0.25	0.37	0.01	–	–	0.01	0.06	–	0.02	–	–
3845	aqua	bottle	XRF	69.20	0.55	17.45	6.53	0.52	2.43	0.15	0.20	1.11	0.09	0.51	0.49	0.03	0.01	–	–	0.07	–	0.06	0.11	0.48
3848	blue	unguentar.	XRF	67.04	0.81	17.09	7.88	0.61	2.70	0.13	0.31	0.94	0.06	0.74	1.10	0.16	0.02	0.04	–	0.06	–	0.04	0.25	–
5198	greenish	beaker	SEM	70.86	0.48	15.80	7.73	0.36	2.49	0.23	0.09	1.19	0.04	0.84	0.60					–	–			–
5810	colorless	nodus	XRF	60.56	4.90	17.17	7.64	2.52	4.12	0.32	0.15	1.11	0.12	0.52	0.64	0.01	0.01	–	0.01	0.06	0.007	0.05	0.02	–
7959	dark green	jug	XRF	68.60	2.72	12.85	5.57	2.25	4.75	0.27	0.12	0.54	0.25	0.05	1.89	0.03	0.01	–	0.04	0.04	0.004	–	–	–
7960	greenish	jug	XRF	71.46	0.58	15.00	7.58	0.43	2.57	0.17	0.15	1.02	0.06	0.41	0.39	–	0.01	–	–	0.07	–	0.04		–

Tab. 1: Chemical composition of glass samples from the collection of National Museum in Prague; analysed by X-ray fluorescence and scanning electron microscopy coupled with energy dispersive X-ray spectrometry (in wt.%).

No.	colour	provenance	date	SiO_2	K_2O	Na_2O	CaO	MgO	Al_2O_3	P_2O_5	SO_3	Cl	TiO_2	MnO	Fe_2O_3	CuO	ZnO	Cr_2O_3	SrO	BaO	PbO	Sb_2O_3
3700	colourless	Kancherai	1st c. BC –1st c. AD	69.77	0.57	18.50	6.71	0.44	2.87	–	×	×	0.05	0.21	0.77	0.001	0.006	–	0.06	0.02	0.005	–
3708	colourless	Kancherai	?	70.05	0.50	16.30	8.67	0.45	1.49	–	×	×	0.05	1.25	0.99	0.005	0.06	0.005	0.10	0.05	0.002	–
468	green	Beth She'arim	4th–7th c. AD	67.67	0.33	19.70	6.71	0.86	1.90	0.03	×	×	0.15	1.14	1.30	0.002	0.02	0.005	0.10	0.02	0.003	–
3027	olive	Cosa	various	72.62	0.89	16.10	6.81	0.44	2.34	–	×	×	0.05	0.08	0.49	–	–	–	0.10	0.02	–	0.01
3028	amber	Cosa	various	73.63	0.51	16.60	5.93	0.28	2.48	–	×	×	0.05	0.06	0.33	–	–	–	0.05	0.02	–	0.01
3024	aqua	Cosa	various	72.00	0.76	17.80	5.02	0.35	2.50	–	×	×	0.17	0.39	0.67	0.10	–	–	0.05	0.02	0.07	0.05
3025	aqua	Cosa	various	74.88	0.61	15.90	4.97	0.28	2.36	–	×	×	0.1	0.36	0.43	0.01	–	–	0.05	0.02	–	0.01
3047	green-aqua	Cosa	various	69.42	0.65	17.70	7.19	0.55	2.82	0.10	×	×	0.06	0.87	0.53	0.001	0.001	–	0.03	0.05	0.001	–
3032	colourless	Cosa	various	73.14	0.46	15.90	5.67	0.32	2.10	–	×	×	0.05	1.25	0.39	–	–	–	0.10	0.05	–	0.01
3033	colourless	Cosa	various	72.69	0.62	16.20	5.51	0.32	2.61	–	×	×	0.05	1.43	0.41	–	–	–	0.10	0.05	–	0.01
6660	aqua	Ed-Dur	50 BC–80 AD	70.78	0.85	16.60	7.16	0.58	2.33	0.21	×	×	0.08	0.41	0.62	0.05	0.008	0.005	0.06	0.03	0.06	0.10
6662	green	Ed-Dur	50 BC–80 AD	74.20	0.63	16.40	5.50	0.37	2.03	0.20	×	×	0.06	0.23	0.31	0.003	0.006	–	0.04	0.02	0.002	–
6666	colourless	Ed-Dur	50 BC–80 AD	72.61	0.61	15.80	7.53	0.47	2.31	0.13	×	×	0.06	0.06	0.31	0.001	0.004	–	0.06	0.02	0.001	–
6680	aqua	Ed-Dur	50 BC–80 AD	73.39	0.65	15.10	7.14	0.46	2.29	0.16	×	×	0.06	0.25	0.34	0.005	0.02	0.005	0.06	0.03	0.005	–
6682	amber	Ed-Dur	50 BC–80 AD	71.75	0.79	17.10	7.01	0.46	2.27	0.13	×	×	0.05	0.03	0.30	0.001	0.02	–	0.06	0.02	0.001	–
11	colourless	Strojnik (Srb.)	2nd–3rd c. AD	67.4	0.45	20.00	6.10	0.84	2.04	–	0.40	1.13	0.09	0.91	0.58		tr.		tr.			0.28
26	colourless	Reka (Srb.)	2nd–3rd c. AD	70.6	0.42	18.20	5.99	0.47	1.65	–	0.90	1.05	0.07	0.01	0.29				tr.			0.26
(Ø from 19)	colourless	Bubastis	1st–3rd c. AD	68.4	0.53	17.20	6.84	0.59	2.00	0.04	0.29	0.98	0.08	0.02	0.48				tr.			0.70

Tab. 2: Chemical composition of analogical glass samples (in wt.%; tr. = trace values; - = not detected; × = not measured) after Brill 1999; Stojanović 2015; Rosenow – Rehren 2014.

THE CRESCENT SHAPED BOTTLE: ITS CHEMICAL COMPOSITION AND FORMAL TRAITS

In the studied object, the surface morphology and structure was examined first. The observations focused, most of all, on finding out the extent of corrosion damage and the traces showing the technology of production – the imprints of a mould, the way of cutting, etc. The studied object further underwent scientific analyses which provided information about the elemental composition of the glass. Because of the intact state of the object, the sampling was limited to the minimum amount of material and two non-destructive analytical methods were preferred – SEM/EDS and micro-X-ray fluorescence. The collected miniature sample was at first measured with micro-X-ray fluorescence.[1] For the SEM/EDS analysis[2] it was afterwards bathed in epoxy resin and polished in order to reveal the original material unaffected by corrosion. The measurement took place at the Faculty of Chemical Technology UCT Prague in cooperation with Z. Zlámalová-Cílová and D. Rohanová.

From the obtained chemical composition (**Tab. 1** – sample H10-142), it is possible to classify the vessel as an example of the so-called sodium natron-based glass for which low contents of minority elements, including K and Mg are typical. In comparison with other samples (**Tab. 1**) the difference lies in the lower concentration of CaO, MgO, TiO_2 and MnO. The absence of TiO_2 could be caused by the detection limits of the SEM/EDS device which is on the edge of 0.02 wt%. For a lower concentration of CaO, numerous equivalents were found (**Tab. 2**). However, all the sought out equivalents have the content of MgO slightly higher. It is possible to link the very low content of TiO_2 and MgO with their source of very pure sand (or quartz pebbles) which was key for the production of colourless glass. For MnO a wide range of values is not unusual. If antimony is used as a decolourant, the intentional addition of manganese compounds is not necessary for discolouration. Its content is related to impurities only. Antimony components oxidised iron (II) to iron (III) oxide, which although yellow, is a much weaker colorant. In Europe, antimony (or a mixture of Sb and Mn) continued to be used well into the 3rd century AD. The content of chlorine around 1 wt% is typical for the usage of natron whose main accompanying mineral is NaCl. The content of phosphorus is related to the usage of wood fuel or to the contamination of natural raw materials. This glass is generally considered to be typical for the Roman glass production (e.g. Brill 1999; Wedepohl 2003), coming closest to the glasses from group 4 of Foy. Group 4 of Foy is yet of unknown origin and its main characteristic is a discoloration by antimony (Vichy *et al*. 2007).

The cutting of vessels has had a long tradition in the history of glass production. It was already used at the beginning of the first millennium BC as is well illustrated e.g. by the Sargon Vase. The greatest visual similarity of the studied artefact was found with cut vessels from the 5th to 10th centuries AD, originating in the Near East, most of all in Egypt. Here, and even in this period, the usage of natron as the main flux is attested. However, the comparison with the published analyses of the Near-Eastern glass vessels from this period (Freestone 2005; Ramadan 2010; Rosenow – Rehren 2014) shows substantial differences in composition, most

1 The measurement was done with a sequential wave-dispersive X-ray spectrometer ARL 9400 XP, fitted with an X-ray lamp with Rh anode of the 4GN type with a terminal Be window of 50 μm thickness. All the intensities of the spectral lines of the elements were measured in vacuum and evaluated by the program WinXRF.

2 For the analysis was used an electronic microscope Hitachi S-4700 – with an SDD detector of photons. The accelerating tension was set at 20 kV. The qualification of the measured spectres was done by the program ZAF.

of all when it comes to the ratio of CaO to Al_2O_3 which is different in the case of the measured vessel (**Tab. 2**).

Also, the Rhineland glass workshops produced unusual forms refined by cutting. For comparison, equivalents from colourless glass were sought out, because stained glass (either on purpose or accidently) contains significant shares of Fe, Mn or P.

Another possibility which had to be taken into consideration for the evaluation of the studied artefact was its modern origin: either as a reproduction or a forgery. Modern glass would be identifiable by the use of either LeBlanck soda, produced till the end of the 18th century, or the more recent Solvay soda. The presence of these components would be revealed by a study of the amount of Cl in the material. These newer glasses contain chlorine only in trace amount (Kirsch *et al.* 2003, 247; Drahotová *et al.* 2003, 384–386). Glasses from the Solvay soda have a markedly lower content of Al_2O_3, P_2O_5 and minority elements, while at the same time they have a higher content of MgO, K_2O and PbO (Popovič 2009). From the above mentioned evidence it is possible to exclude the European origin of the vessel and thus the possibility of a modern European forgery. In the Near East, on the other hand, traditional raw materials and production methods are used practically to this day and therefore we cannot exclude the vessel inv. number H10-142 from being a modern Near Eastern product, possibly a forgery. Nevertheless, even in this case the elemental composition of the modern Near Eastern glasses, available to us, differ from the original Roman formulae in the usage of a great variety of sources of fluxes and decolourizers (Brill 1999; Hasdemir 2015).

CONCLUSION

From the formal point of view, the vessel might belong among the "extravagant" shapes of Roman imperial period though no exact analogy has been identified among the published material. Also a modern date could not be excluded from this standpoint.

The state of the vessel and its chemical composition correspond, however, with the traditional Roman production. From the performed measurements it is impossible to either confirm or refute whether it is directly a product of the Rhineland glass workshops or not.

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APPENDIX – LIST OF GLASS SAMPLES FROM TAB. 1

H10-142. Crescent-shaped bottle. Colourless. Rhineland, 4th century AD (?).
H10-1062. Fragment of a square bottle. 1st–2nd century AD.
H10-1064. Flask-unguentarium with globular body. Isings form 70. 1st century AD.
H10-1081. Unguentarium. 1st century AD.
H10-1109. Hofheim cup. Yellow glass. 1st century AD.
H10-1797. Faltenbecher. 2nd century AD.
H10-1802. Jug with ribbed body. About 4th century AD.

H10-1983. Bottle with applied thread. 4th century AD.
H10-3140. Flask with globular body. Late 3rd–4th century AD.
H10-3143. Cover of jar. 1st century AD.
H10-3845. Unguentarium. 2nd century AD.
H10-3848. Unguentarium. Blue glass. Middle of the 1st century AD.
H10-5198. Beaker. 1st century AD.
H10-5810. Nodus. Venice (?).
H10-7959. Jug. Islamic glass. 10th–12th century AD.
H10-7960. Jug. 1st century AD.

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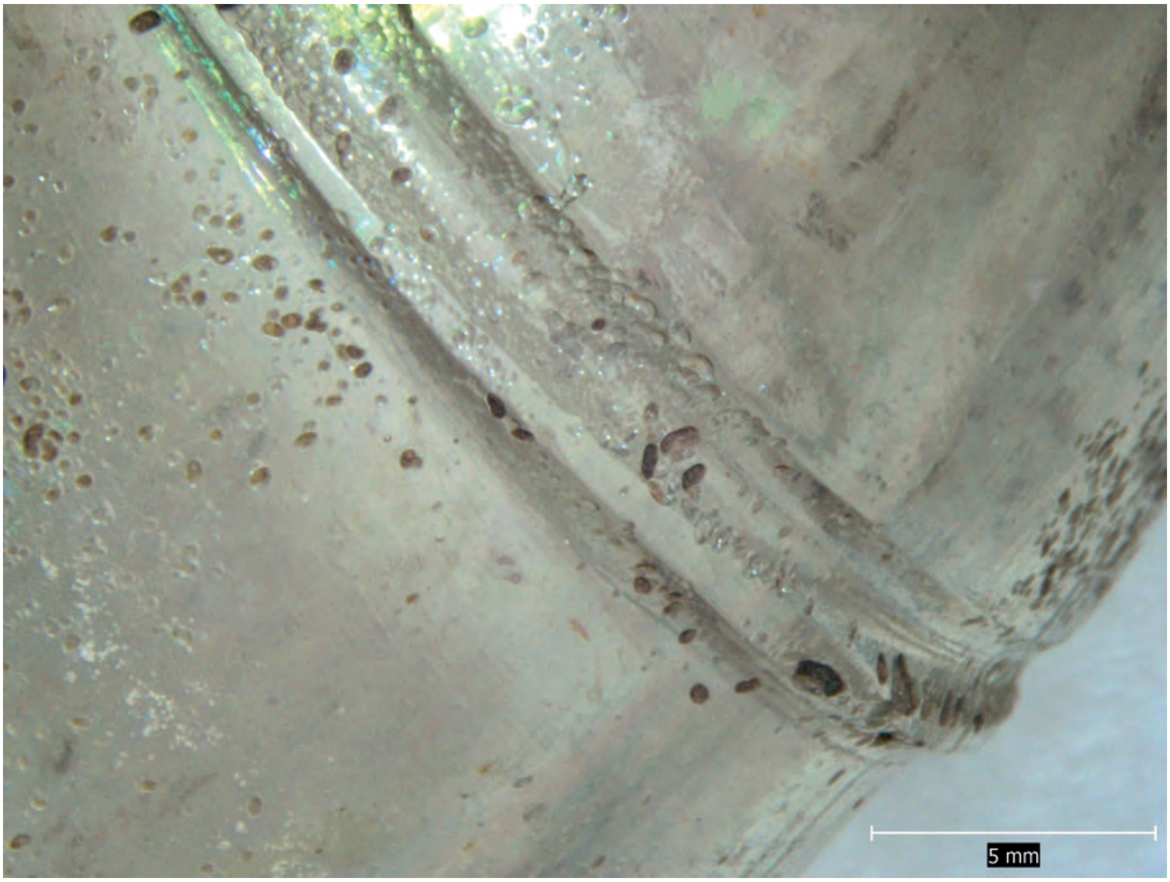
Pl. 6/1: Crescent-shaped bottle. Inv. no. H10-142. Prague, National Museum (Photo O. Tlapáková).

Pl. 6/2: Crescent-shaped bottle. Inv. no. H10-142. Prague, National Museum (Photo O. Tlapáková).



Pl. 6/3. A microscopic detail of the vessel surface (Photo R. Kozáková).