Roman Glass Finds from Yurta-Stroyno. A Preliminary Report*

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Abstract: During the first two excavation seasons (2014–2015) at Yurta-Stroyno site numerous glass items were found – approximately 510 fragments. The majority of the glass pieces found have higher fragmentation that could be caused by material deposition in Antiquity or in modern time. The glass items were divided into several basic groups: glass vessels, window glass, personal decoration, glass production waste. The typological classification of the glass beads and vessels is listed below. Several massive glass pieces in blue-green color were identified as examples of raw glass that was used for secondary glass production. Moreover, there are a number of so-called production wastes (threads and trails) from various stages of the glass-working processes. The method of XRF analysis was chosen in order to complete the data needed to interpret the finds.

Key words: Yurta-Stroyno, Roman glass, Late Roman / Early Byzantine glass, raw glass, XRF analysis.

INTRODUCTION

During the first two excavation seasons (2014-2015) at Yurta-Stroyno site, located in Elhovo Municipality, Southeastern Bulgaria¹, different glass fragments were found that could be divided into several main groups: glass vessels, window glass, personal decoration, glass production waste, and others. From the first two seasons, approximately 510 glass items were found, with a predominant amount of glass vessel body fragments. Most of the glass found during the excavation of Yurta-Stroyno comes from disrupted contexts – either from the levelling layer of the site, or from the soil excavated by treasure hunters which could have caused high fragmentation of all material. The higher fragmentation, however, could be caused also by material deposition in Antiquity, making the identification of different glass objects and reconstruction of vessel shapes difficult. However, based on repeated refinement of the morpho-typological, compositional and contextual data (Shepherd 1999, 41-48), specific groups of identifiable fragments were proposed. Every glass fragment was documented into the primary database; consequently, every significant fragment had its own unique SF (small find) number, and appropriate documentation. The method of XRF analysis was chosen in order to complete the data needed to interpret the finds. The general amount of glass items suggests that, beyond pottery, glass vessels were frequently used in Yurta-Stroyno during the Roman and Late Roman periods (Gomolka-Fuchs 1992, 264).

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¹ For more details on the site, see: Бакърджиев / Козарев 2014; 2015; Tušlova et al. 2014; 2015; forthcoming.
1.1. **Glass beads**

We have a collection of Roman glass beads from both seasons: a cylindrical bead with hexagonal section, a flat round bead, and an annular bead with eyes. The colours of the cylindrical and flat round beads are limited to white and light blue; the glass mass, based on visual assessment, is opaque. These types were extensively spread all over the territory of Roman provinces, with a higher concentration in the area of the Western and Balkan provinces; the popularity of these beads grew higher during Late Antiquity (Swift 2000, 90-94). The establishing of the chronology of these beads, considering the expansive territory and the long period of occurrence, could be problematic.

Flat round beads (Tempelmann-Maczyńska Group IX/89-90 Type, Benea Type I), usually produced from matte glass (fig. 2, SF14_177). The beads were ablated by knife or other flat instrument. This type was found in Barbaricum, where the beads are usually dated to the 2nd century AD and are connected with the Wielbark culture (Tempelmann-Maczyńska 1985, 33). In the context of the Western Roman provinces, flat round beads continued to be produced during Late Antiquity (4th–5th c. AD) (Swift 2000, 90).

![Fig. 1. Selected glass finds from Yurta-Stroyno (drawing: V. Doležálková)](image-url)
Cylindrical beads of a hexagonal section (Tempelmann-Maczyńska Group XVI/145, Benea Type II; Гопкало 2008 Monochromic beads VIII/2), of matte and translucent glass (fig. 2, SF14_203). The glass is entwined on a stick and is formed to a hexagonal shape and cut to the requested size. These beads have a long chronology: in Barbaricum Period C2 (2nd – beginning of 4th c. AD) until D (5th c. AD), in the Tibiscum workshop this type appeared after the Marcomannic wars (late 2nd–3rd c. AD) and probably continued throughout the 4th century (Tempelmann-Maczyńska 1985, 35; Benea 2004, 100-101; Гопкало 2008, Tabl. II).

The round shape bead with decorative dots (Tempelmann-Maczynska Group XX/198, Benea Type IX; Гопкало 2008 Polychromic beads I/10) (fig. 2, SF15_236). The annular beads with decorative dots appeared in B2 (the end of the 1st till the 2nd c. AD) and continued until C2 (mid-3rd c. AD). During the Roman period this type was not very popular in Barbaricum (only 15 examples found), however, similar beads are often found in archeological context dated to the Migration...
Period. In Balkan territory these beads are mainly dated to the period after the Marcomannic wars – the 2nd–3rd centuries AD (Tempelmann-Maczyńska 1985, 47-48; Benea 2004, 107-110; Іопкало 2008, Tabl. I). Big annular beads with dots are known from Pannonia, a territory along Rhine river and mainly beyond Roman borders during the period of Late Antiquity (Swift 2000, 107).

The glass beads used to be distributed over a large area, a fact that led to the diffusion of these types all around the Roman world. The extremely homogeneous “Roman fashion” could be another reason for the widespread occurrence of the same types across the Roman Empire. One of the closest glass beads workshops was found in Roman Tibiscum (Dacia), where the glass making atelier was part of the vicus. Based on epigraphic sources, it is reasonable to assume that craftsmen from the Eastern provinces, particularly from Palmyra, worked in Tibiscum (Benea 2004, 144-145; Stawiarska 2014, 30).

1.2. Glass fragments from Yurta-Stroyno

The majority of the glass fragments have a “natural” green-blue colour, which indicates the natural presence of iron oxide and no use of decolourisers, to which glass owes its transparency and lack of colour. Nevertheless, colourless thin-walled fragments with a low content of inclusions / bubbles belong to a relatively numerous group. The colourless vessels became fashionable during the late 1st – beginning of the 2nd centuries AD, and were commonly used until Late Antiquity, when the quality of glass production was in decline (Shepherd 1999, 301; Shepherd / Wardle 2009, 9, 57). Examples of coloured glass are rare and in most cases are represented by glass beads, but several orange-brown fragments were also found (fig. 2, SF14_232, SF15_312). It is possible to define the group of fragments with greenish or light olive-green tint, the colour that is typical for Late Roman and Early Byzantine glass (Gomolka1992, 162). Most of the glass fragments have no decoration and are free-blown; several fragments have marks of wheel-cut lines or facette decoration that was popular during the 1st and the 3rd centuries AD (fig. 1, SF14_004, SF14_211 (b,c)) and continued to be in use during the Late Roman period (Whitehouse 1997, 221). Just a few fragments have relief decoration and were made in mold-blowing technique, which was still in use during the Late Roman / Early Byzantine period (Whitehouse 2002, 110-111).

A significant number of glass rims belong to the deep or shallow thin-walled beakers or bowls with polished or fire rounded rim (fig. 1). On the site were found fragments of rounded thickened rims made by outwards bending of the wall, the shape is open and slightly everted. Similar rims could belong to the shallow conical bowls that are also known from the context of other Late Roman / Early Byzantine sites in Bulgaria. Fire rounded rims could be part of beakers or small bowls and are recognized by a straight, slightly everted or closed shape. The majority of these fragments are thin-walled, made from colourless or blue-green glass. Due to the high fragmentation, the reconstruction of the original shape is problematic, however, it is possible to assume that part of the rims could be part of forms Isings 1111, Isings 1064, or similar ones (Чолакова 2009, 304), the vessel types that are typical for the Late Roman / Early Byzantine period. Several fragments (for example, fig. 1, SF15_175) with pushed-in profile and outsplayed, flattened hollow tu...

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2 In the context of Gradisheto similar bowls are dated to the 5th c. AD (Чолакова 2009, 304), close types were found in Nicopolis ad Istrum (Sheperd 1999) and Iatrus (Gomolka-Fuchs 2007, Taf. 51).

3 Stemmed goblets (Isings 1957, 139).

4 A large group of conical beakers (Isings 1957).
bular base ring most likely belong to conical beakers; similar finds from Nicipolis ad Istrum were dated to the 2nd–3rd centuries AD (Shepherd 1999, 324). However, analogous glass fragments from Kaiseraugst and other Roman sites were identified as a conical beaker on a foot – type Ising 109a/b, dated to late 3rd–4th centuries (Ising 1957, 136-137; Rütti 1991, 78). To a separate group belong the small toilet bottles – unguentaria, which were widely used throughout the Roman period for perfumes, medicines, oils and other liquids (Stern 1977, 100). The glass material of bottles is of low quality, with a high concentration of bubbles or other inclusions. Several fragments (for example, fig. 1, SF15_281, SF15_128; and fig. 2, SF14_159) from Yurta-Stroyno can be connected with the group of “candlestick unguentaria” – 82 B1-B2, dated from the 1st to the mid-3rd century AD (Isings 1957, 97-99; Шабанов 2015, 19-20). Therefore, one cannot preclude the possibility that the presented fragments belong to a later group. Another fragment belongs to a base which could be part of a stemmed goblet with a pushed-in base – type Ising 111 (fig. 1, SF14_193). The type is a characteristic shape for the Early Byzantine period and is usually dated to the end of the 4th–6th centuries (Stawiarska 2014, 60; Чолакова 2009, 274-277; Shepherd 1999, 337-339). The provenience of the stemmed goblets is disputable, but in North Bulgaria this type could appear during the end of the 3rd–4th centuries AD. The goblets of this type belong to frequent finds in the Late Roman / Early Byzantine contexts (Чолакова 2009, 275).

1.3. Raw glass and glass-working indicators

Among the most important finds are the glass fragments related to local glass production. Several massive glass pieces of blue-green colour were identified as examples of raw glass that was used for a secondary glass production (SF15_335, SF15_350, and SF15_362 in fig. 2). The raw natron glass was a famous trading commodity during the Roman period, which was imported from the primary workshops located in the territory of the Near East – the Levantine coast and Egypt – Alexandria (Gorin-Rosen 2000, 49; Henderson 2013, 351-354). The theory of the existence of primary glass workshops in the territory of the Western provinces has not been proven yet, however, there are several indications that the primary production could have taken place in the territory of the Western provinces and Italy (Nenna 2015, 1-2). The finds of glass production waste is another argument supporting the existence of a local workshop. From Season 2015, there are numbers of so-called production indicators as threads and trails from various stages of the glass-working processes (fig. 2, SF15_351), such as added hands or trail decoration, and strands of glass that were used to test the viscosity of the hot glass itself (Shepherd / Wardle 2009, 39). Even though we are not able to reconstruct the structure of the glass workshop, these fragments could be used as evidence of glass production at the site (Чолакова 2008, 471).

Most glass ateliers from present-day Bulgaria were found in the territory of Moesia Inferior and are generally dated to the Late Roman and Early Byzantine periods. An increase in the number of glass workshops during the Late Roman and Early Byzantine period had also taken place in other Roman provinces (Hartmann / Grünewald 2010, 24). Glass production is often documented in the context of rural settlements, as in the case as of the Early Middle Ages glass workshops. The first glass workshops appeared for the first time in the regions

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5 Novae (Olczak 1998, 44-48), Nicopolis ad Istrum (Shepherd 1999, 337), Iatrus (Gomolka 1979, 164; Gomolka-Fuchs 2007, 299-300), etc.
with Roman presence. A group of production complexes with remains of furnaces were discovered in Novae, the glass workshops probably functioned from the second half of the 2nd until the 6th–7th c. AD; however the production of the first workshop is still not well attested. The traces of the glass production workshop were detected outside the city wall, in the vicus – Ostrite Mogili (Olzck 1978, 176-177; Olzck 1998, 12-13, 87). Another important center of glass production was identified in Oescus, where ruins of six furnaces were found. The possible existence of a local workshop in Iatrus lacks direct evidence, although the groups of certain vessel types could have been produced in a local workshop dated to the 4th–5th centuries (Gomolka 1978, 26-28; Stawiarska 2014, 64). The rich glass collection from Nicopolis ad Istrum presents the glass types dated from the end of the 1st till the 6th century. The finds of glass-working debris (pot or tank metal moils and droplets) were also found (Shepherd 1999, 377-378). The discovery of raw glass and chunk glass fragments may also indicate the local glass working activities at Golemanovo Kale (Drauschke / Greiff 2010, 26). The possible workshops could be located in Sandanski and dated to the 5th century (Stawiarska 2014, 65); Roman workshops were located in Philipopolis, Gabrovskoto gradishte, Gradišteto near Lozarevo (Чолакова 2008, 472), a possible workshop could be located in Odessos (Минчев 1988, 50-51). A glass workshop was found in the context of a Late Roman villa in Bela Voda, dated to the 4th–5th c. AD. Among the finds, there was a large number of fire deformed glass fragments, glass “tears” and sections of threads; however, no furnace or crucibles were found (Stawiarska 2014, 66). A similar situation is identified in a fortress near Dichin, where another local Early Byzantine glass workshop could be located (Чолакова 2008, 474).

2.1. XRF ANALYSIS – METHODS

XRF analysis with an ARL 9400 XP sequential WD-XRF spectrometer was used for the determination of glass chemical composition. All peak intensity data were collected by WinXRF software in vacuum. To validate the analytical procedure, the reference standard (Corning Glass B) was measured.

2.2. RESULTS AND DISCUSSION

The studied samples of final products are sodium-lime-silica with sodium oxide content between 15.8-22.8 %, calcium oxide content 5.3-9.7 %, and silicon dioxide content 62.5-71.1 %. All 40 pieces of product fragments (rims, bases, bodies) were determined as natron type; characterized by low levels of magnesium and potassium oxides (up to 1.5 %; fig. 3).

2.2.1. FRAGMENTS OF GLASS VESSELS

Two fragments were distinct from others – SF14_232 (yellow colour) with 0.08 % MgO and K2O content below the limit of quantitation, and a slightly greenish sample SF14_159 with higher MgO content (0.96 %).

It is evident that natron was used as a flux. The major component to influence the composition of natron glass type is silica. Silica could be added in glass in the form of pure quartz pebbles or by sands containing different impurities (introducing in glass mainly Al2O3, Fe2O3, TiO2). These impurities influence the final glass composition and the differ-
ences between the sand types used reflect the differences between the glass groups described in the literature (Schibille et al. 2016; Freestone, in print), accordingly, there are differences between primary production centres (Freestone, in print). Glass was melted from raw materials (natron and sand) in a small number of primary production centres from where raw glass was distributed to secondary workshops (Freestone, in print).

The content of aluminium oxide is 1.9-3.6 %. Glass with higher aluminium content can be described also as the Na₂O-CaO-Al₂O₃-SiO₂ glass type studied in literature (Lesigyarski et al. 2013, 1608; Kuleff 2002, 102). The exception is the sample with a surprisingly low Al₂O₃ content (the previously mentioned SF14_232 with 0.38 % Al₂O₃ and also with a low level of Fe₂O₃ – 0.09 %). The aluminium oxide content of the majority of samples corresponds well with its level in Roman glass – Al₂O₃ in the range of 2-3 %, and specifically 2-2.5 % in European Roman glass (Lesigyarski et al. 2013, 1611). Samples from Southeastern Bulgaria with a higher content of Al₂O₃ are described by Lesigyarski et al. (2013, 1611). These samples are dated mostly to the 4th–6th centuries. Higher Al₂O₃ amount was found in a few samples coming from Yurta-Stroyno with dark green colour. In addition to high aluminium content, these samples were found to have a high content of manganese (average value of 1.65 %).

It was possible to distinguish at least three groups based on data related to the decolourants used – manganese-decolourised glasses, antimony-decolourised glasses and mixed glasses (fig. 4).

Specific groups are described below:

**Group 1** – samples with zero concentrations of Sb₂O₃ or under the XRF detection limit, and MnO with a maximum value of 1.88 %; there are samples with different colours. Samples with the highest MnO concentrations (over 1.43 %) are dark green. We can conclude that decolourisers were probably used unsuccessfully. The MnO level below 0.5 % could be due to impurities in the raw materials (Jackson...
samples SF15_130, SF15_175, SF15_188, SF15_290. The sample with a really low Al₂O₃, MgO and Fe₂O₃, SF14_232, could be considered as outlier.

**Group 2** – majority of samples with Sb₂O₃ in the range of 0.36-0.76 % and low MnO concentrations (below 0.01 %); mainly colourless and slightly greenish samples. Only one sample contains a higher amount of Sb₂O₃ (1.52 %; sample SF15_001). There are three samples that differ from others by higher MgO, Al₂O₃ and Fe₂O₃ – SF14_159, SF15_001, SF15_281.

**Group 3** – samples containing Sb₂O₃ and MnO; there are colourless and slightly greenish samples in group 3. This type of glass was produced probably through recycling and mixing of two glass types – rich in antimony and rich in manganese (Schibile 2016).

Manganese and antimony were used simultaneously in colourless and slightly coloured glass from a workshop discovered in Oescus (Kuleff 2002, 106). The addition of either only antimony or manganese was described about glass from Varna, Kaliakra and Armira (Kuleff 2002, 106). Most Roman glass contains Fe₂O₃ (in excess of 0.3 %) coming from the sand used (Freestone, in print). The presence of iron in reducing atmosphere leads to a greenish-blue colour of the glass. Adding decolourisers (manganese dioxide MnO₂ or the more powerful antimony trioxide Sb₂O₃) to the glass melt results in inhibition of the greenish-blue colour and the undesirable natural tint is replaced by a yellowish colour or appears almost colourless (Smrček / Voldřich 1994, 288; Freestone, in print). There was one blue sample in our set from Yurta-Stroyno. Blue colour was achieved with CuO (0.41 %) and CoO (0.04 %); higher levels of Fe₂O₃ (0.63 %) and MnO (0.59 %) could influence the final shade. Samples of yellow/brownish colour contain manganese, probably in the form of MnO₂.

These groups were compared with the results dealing with natron glass groups published by Freestone (Freestone, in print). A report by Schibille and co-workers (Schibile et al. 2016; Freestone, in print) has shown that a plot representing the ratios of TiO₂/Al₂O₃ and Al₂O₃/SiO₂ is very useful for distinguishing most of the major groups of natron glass of the first millennium AD (fig. 5).

Glass finds from Yurta-Stroyno seem to have two basic origins – group 1 (Mn decolourised glasses) is probably coming from the Levantine region, and group 2 (Sb decolourised glasses – group Roman Sb) from the Egyptian coastal region (in literature dated to 1st-3rd century AD) (Freestone, in print). As an outlier could be described the aforementioned sample SF14_232 and a more accurate determination will be the subject of further work.

Further assignment to specific groups can be based on alumina content. The provisional limit for distinguishing Roman-Mn and Levantine I group used in Schibille’s work (Schibile et al. 2016) is 2.69 % Al₂O₃. Al₂O₃ content of ≥ 2.69 % is described for samples dated to the fourth century or later and assigned to the Levantine I group. All Yurta-Stroyno samples of group 1 have Al₂O₃ content higher than 2.69 % and so we can conclude that samples can probably be dated to the 4th century or later. Such an assumption can be confirmed by the evaluation of glass found in Bulgaria (Lesigyarski et al. 2013, 1611). However, majority of samples contain a higher MnO content. Manganese was used in the 4th century but it is not typical of 6th-7th century
Levantine I glass from the primary furnaces in Syria-Palestine (Schibile 2016; Freestone, in print). The period from the late 4th to the 5th century probably determines the upper limit of our sample dating.

The majority of glass finds from Southeastern Bulgaria characterised by Lesigyarski et al. (2013, 1614) originate from the Palestine coast. Through a comparison of the glass from Yurta-Stroyno with other finds from the northern Bulgarian archaeological site Dichin (dated to the Late Roman / Early Byzantine period; Rehren / Cholakova 2010) we found considerable differences. Dichin glasses are classified (Rehren / Cholakova 2010) into or close to the HIMT (High Iron, Manganese and Titania; origin from Northern Egypt) glasses. Several samples were described as glasses of HIT group (without elevated manganese level). Dichin samples of HIMT and HIT groups (Rehren / Cholakova 2014, 86) have more than 1.4 % Fe$_2$O$_3$ in comparison with Yurta-Stroyno glass samples with an average value 0.4 ± 0.1 % (outliers were not included in this value) and more than 0.4 % TiO$_2$ compared to a maximum value 0.1 % for Yurta-Stroyno glasses.

2.2.2. Glass-working indicators

All samples of production indicators have blue-green or green colour. Samples can be divided into two groups – natron glass of Levantine origin and, surprisingly, plant ash glass with K$_2$O and MgO above 2 % (samples SF15_362 and SF15_351_3s).

Indicators of natron type glass can be classified according the content of decolourisers to two sub-groups. Glasses in the first one have almost no antimony and a lower content of manganese (around 0.5 %). The second group represents the sample containing Sb$_2$O$_3$ (0.27 %) and MnO (0.38 %) – our group 3 (according to the distribution of the samples above).

Halophytic plants were probably used as a flux, as samples of glass-working debris contained a higher level of MgO and K$_2$O. The Sb$_2$O$_3$ content is around 0.2 % and the content of MnO is rather low (to 0.44 %) in these samples. However, the use of plant ash for glass making is linked with the 8th–9th century (Freestone, in print). The sample of similar com-

![Fig. 5. Comparison of glasses from Yurta-Stroyno (blue square – group 1, Mn-decolourised glasses; blue rhombus – group 2, Sb-decolourised glasses; blue triangle – group 3, mixed glasses). Origin plot with major natron glass groups taken from Freestone, in print. Dashed line indicates an approximate boundary between Egyptian (above, left) and Levantine (below, right) compositions.](image-url)
position (plant ash type glass) is described by Lesygiarksi et al. (2013, 1611) and dated to the 2nd – 4th c. AD (greenish bowl; found in Sozopol). Authors explain this to be due to the use of higher amount of limestone containing dolomite (bringing Mg). However, it does not explain the higher content of potassium and in glass indicators from Yurta-Stroyno higher phosphorus content was found. The addition of ash is surprising, but it seems possible. The use of soda plant ash in glass production before 8th century is discussed by Ceglia (Ceglia et al. 2015).

**CONCLUSION**

The higher fragmentation of the glass collection makes the identification of different glass objects and reconstruction of vessel shapes difficult. However, we were able to compare the glass from Yurta-Stroyno with glass finds from contemporaneous sites across Bulgaria and other selected sites. The shapes cover a broad spectrum, but most represented are beakers and bowls of various sizes. The limitation of the glass shapes and preferences of table ware shapes as beakers and bowls is characteristic for the Late Roman period, when the production was focused on several of the most used shapes (Stern 2015, 90-91; Чолакова 2009, 266; Olczak 1995, 76). The main goal of the chemical analyses was to propose a general chronological interpretation of the glass collection. The manufacturing specifics and provenience will be the topic of future research. The glass from Yurta-Stroyno could be divided into two main chronological groups, which were distinguished by their elemental composition and morpho-typological analysis. The majority of the fragments could be associated with the glass composition typical for the Roman period (1st–3rd c. AD), the group of the Late Roman / Early Byzantine glass is also indispensable. Several glass-working indicators surprisingly contain plant ash glass with K₂O and MgO above 2 %. According to an established paradigm, the halophyte ashes started to be used only in the Early Islamic Period. Opinions on this subject have become less categorical over the past years. Sodium glass was clearly the dominant group during the Roman period, but the presence of other types of glass needs to be noted. Between the 2nd and the 6th centuries AD, the plant ash glass occurs in the area of Iran and Iraq, where it must have been fused from raw material (Henderson 2013, 88; Stawiarska 2014, 17).

In the case of Yurta-Stroyno, we can assume that the origin of the raw glass fragments could be connected with the Near East – the Levantine coast area (Jackson / Foster 2015, 48-49). The fact of trade and political contacts between Asia Minor and Balkan areas during the Roman period supports the eastern origin of raw glass or even workers in the local workshops. Glass in the form of cakes, slabs and rods must have been traded widely in Europe and the Near East, the large-scale trade with raw glass has been confirmed by the discovery of many different ship wrecks dated from the Bronze Age to Early Medieval period (Stawiarska 2014, 38). Traces of glass production waste – cullet – are another argument in support of the existence of a local workshop. From Season 2015 there are a number of so-called discarded fragments, such as threads and trails from various stages in glass-working processes. Several fragments were identified as moils – parts of the small cylinder left after the vessel had been detached from blowing iron (Shepherd / Wardle 2009, 39). Even though we are not able to reconstruct the structure of the glass workshop, these frag-

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6 However, contamination from the furnace can not be excluded, either.
Bibliography


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