

## Innovation and Tradition in Glass Craftsmanship of Graeco-Roman Egypt

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Over the past 20 years, the study of ancient glass has made considerable progress both within the area of production conditions and that of finished objects<sup>1</sup>. It has, in fact, been recognised that production was divided into two stages with, on the one hand, primary workshops that produced the raw material from two components, sand and a flux, principally natron, and on the other, secondary workshops that re-melted the raw glass in order to make objects for a multitude of uses: table ware, storage vases, light fittings, elements for decoration and furnishings, and architectural glass. The production of raw glass and finished objects was to remain the preserve of the eastern part of the Mediterranean throughout the second and first millennia BC. The invention of blown glass in the middle of the first century BC transformed the material from a luxury object into something more commonplace and the technique was spread across the entirety of the Roman Empire. Egypt plays an important role in the history of glass, both as a production centre of the raw material and as home to the development of refined techniques (**Fig. 1**).

### 1. The Hellenistic Period

The remains that we have for the Hellenistic period are scarce in terms of object finds and absent in terms of production structures. What we have essentially for the Early Hellenistic period is evidence of secondary glass workshops in the vicinity of temples, in the Fayoum, in Dionysias, Tebtunis (**Fig. 2**) and Soknopaiou Nesos, and in the Delta at Tanis and Tell Gemayiem. These workshops manufactured inlays of opaque and mosaic glass, which were to be inserted into portable *naos* and furniture. The evidence of their activity is semi-products and limestone moulds used as templates for ceramic moulds in which were formed body parts and hieroglyphs, and also architectural decorative elements<sup>2</sup>. The glassworkers

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\* This contribution is an expanded and revised version of Nenna, M.-D., 2013a. Thanks to Colin Clement for the English translation.

1 Nenna, M.-D., 2007a, 2008a; Stern, E.M., 2008.

2 Arveiller-Dulong, V., Nenna, M.-D., 2011: 350-383; Cervi, A., 2011; Nenna, M.-D., forthcoming 1.

who created such objects were certainly Egyptians and were following a tradition that, in the first millennium BC, goes back to the time of Amasis. They were probably itinerant, accepting commissions from different communities or individuals and we can imagine that they carried rather small amounts of raw glass of a wide palette of colours along with their other tools. The analysis of raw glass and semi-products of the Tebtunis workshop<sup>3</sup> shows a wide range of recipes:

- The majority of the samples are from a soda-lime glass produced with natron as flux (deep blue, turquoise blue, colourless, clear green, yellow, orange)
- A part of the clear blue, orange, red glass and green glass is made with plant ash as a flux.
- A small proportion of the white and violet glass bears a higher percentage of magnesium than the usual natron glass.

From where was this raw glass coming? We have no clue about that, but we might guess that, keeping within the tradition, it was from Egypt, the quality of these opaque glasses being always higher than what we can see in the contemporary core-formed containers. These objects were created by and for a local population, be it Greek or Egyptian, in a religious Egyptian context. We know that this kind of opaque glass, especially red, but also blue was also used in plaques found in early Ptolemaic (until Ptolemy IV) foundation deposits of temples in Alexandria (Sarapieion, Boubastieion) and elsewhere in the country (Canopos, Taposiris Magna, Gumayyama, Tell Gemayiem, Tanis, Coptos, Deir el-Medineh, Cusae)<sup>4</sup>.

This situation changes somehow at the end of the third century and glass begins to be used in the secular sphere. The mosaic technique is employed for casting bowls and we note the development in Alexandria of pictorial style mosaics, which adorn the houses of the rich Alexandrians, a fashion that will spread to other Hellenistic kingdoms (mosaics of Pergamon), and by the end of the second century to the wealthy houses of the Aegean islands (Delos, Samos)<sup>5</sup>. Both crafts use opaque or translucent glass of vivid

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3 Nenna, M.-D., Gratuze, B. 2003.

4 Arveiller-Dulong, V., Nenna, M.-D., 2011: 342-343 ; for the Boubastieion of Alexandria, see Seif el-Din in this volume; for Taposiris Magna, see Hawas, Z., Martinez, K., 2013: 242, fig. 15-16.

5 Guimier-Sorbets, A.-M., Nenna, M.-D., 1995.

colours. Egypt, however, does not seem to become involved in the production of core-formed glass containers and of monochrome translucent glass. A typically Greek product, manufactured in Rhodes, but also probably in Macedonia, core-formed glass containers were exported all over the Mediterranean between the sixth and the first century BC. These luxury products containing perfumed oil made their way into Egypt, to Alexandria<sup>6</sup> but also to remote places in the country such as the villages of the Fayoum oasis. We can count, for example, 25 fragments of such containers in the village of Tebtunis, of which three belong to the early Hellenistic period. At the end of the Hellenistic period, they are attested in Alexandria, but also in Medinet Madi, Tanis, Tell el-Herr, Coptos and in Ain Manawir (Kharga oasis)<sup>7</sup>. Egyptian glassworkers never produced such pieces, but Greeks and Egyptians appreciated this kind of object and had them at home or used them as burial offerings<sup>8</sup>.

For a long time, gilded colourless glass used in inlays and in vessels has been considered as Alexandrian. This assumption is based on the fact that in the famous procession held in honour of Ptolemy I around 280 BC, two *hyalina diachrysa* were presented (Athenaeus, *Deipnosophists* V 199f). Some scholars have identified these pieces as items of tableware, others as decorative pieces<sup>9</sup>.

Certain discoveries, however, in late fourth century BC Macedonian tombs have shed new light on the origin of such a technique in the Greek world<sup>10</sup>. Plaques of monochrome glass covering gold foil have been found decorating funerary beds and a similar combination adorns the shield of Phillip II. Glass tableware decorated with gold foil has also been found in the same contexts. As there is no previous tradition of working glass in such a way in Egypt, it seems reasonable to think that the two *hyalina diachrysa* may have been

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6 See for example, Breccia, E., 1912: nos. 312-315 (three from the same child burial). Other unpublished vases kept in the Graeco-Roman Museum or found in the CEAlex and Polish mission excavations in Alexandria.

7 Silvano, Fl., 2012a: pl. 41, no. 860 (Medinet Madi); Nenna, M.-D., 2007c: 278-279, fig. 1 (Tell el-Herr). Other pieces unpublished.

8 The stylistic criteria proposed by Harden, D.B., 1984 are too weak to suppose the production in Alexandria of such vases.

9 For a discussion on this topic, see Stern, E.M., Schlick-Nolte, B., 1994: 97-115; Arveiller-Dulong, V., Nenna, M.-D., 2000: 16-19.

10 Ignatiadou, D., 2014.

imported from Macedonia, objects of such a price that they were displayed as masterpieces during the procession. This fact does not exclude that by the end of the third century sandwich gold glass could have been produced in Egypt. It is true that a good comparison can be made between Egyptian faience and metal bowls and sandwich gold glassware, and that some decor is related to Egyptian religion<sup>11</sup>.

From the end of the second century BC onwards, a substantial increase in the production of monochrome translucent glass drinking ware occurs in Syro-Palestinian workshops<sup>12</sup>. These bowls of various forms (conical, ovoid, hemispherical), ornamented with grooves, or with more complex decorations (vegetal calyx, fluting, rows of beads) are distributed all over the eastern Mediterranean region, as well as in Egypt, in Alexandria and in the *chora*. There is no archaeological evidence of the production of such glassware in Egypt, but textual sources dating back to the 1st century BC, give us a glimpse of the glass industry at this time in Egypt. The common and abundant character of Egyptian glassware, on the same level as the other two characteristic products of Egypt – linen and papyri – is revealed in the *Pro Rabirio Postumo* speech of Cicero dated to 54 BC (XIV, 40). The enigmatic *hyalinê puelos* of Alexander the Great that replaced the gold sarcophagus, stolen by Ptolemy X in 88 BC, may hold information on the type of the primary glass workshops existing at the time. Most of the commentators of this passage of Strabo (*Geography*, XVII, 8) translate these terms as 'alabaster sarcophagus', but why would Strabo, who knew about the glassworkers and their products, have used the term *glass* to designate alabaster? The term *puelos* is used in Greek literature for describing a cavity and from there, a trough, a bath and a sarcophagus; in the papyri, it describes the flattish tubs that were built inside the characteristically Egyptian collective tholos baths. It seems most probable that between 88 BC and 27-20 BC, the date of Strabo's stay in Alexandria, a true glass sarcophagus was made, and one of the ways it could have been made was to use one or more glass slabs to create the tub and the cover. These clues could be synchronous with a change in the architecture and the size of the primary furnaces and a shift to bigger furnaces during the first century BC, perhaps of the type that we have discovered in the Beni Salama excavations. Interestingly, a papyrus (*P. Ryl.* II, 374, 4-5) dated to the first century AD,

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11 Adriani, A., 1967; Nenna, M.-D., 2002b.

12 Nenna, M.-D., 1999; for an updated bibliography, see Nenna, M.-D., 2014.

mentions in its first use (first century BC), the glassworkers of *Schithis* (the difference in the spelling, *Schithis* for *Skitis*, does not seem to be a problem for the papyrologists). We would thus have a textual attestation of a glass industry in Wadi Natrun at the end of the Hellenistic period.

During the same period, we know that Egyptian glassworkers were active in manufacturing mosaic glass, be it vessels or inlays. They improved their way of making inlays (**Fig. 3**) and were able to manufacture bars of glass, displaying very complex motifs such as various theatre masks or representations of Egyptian deities<sup>13</sup>. These bars, cut into slices, were used to decorate caskets and furniture.

## 2. The Early Empire

Until the beginning of the 1990s, the field of research into glass of the Roman era was very much marked by the pioneering work of Edgar in 1905 and of Harden in 1936. Since then, the development of excavations on sites occupied during the Roman period - excavated for themselves and not just to reach the Pharaonic layers - has profoundly changed the order of things. This is true for some regions that were recently considered as *terrae incognitae*, such as the Eastern and Libyan Deserts, while others have still barely received any attention, for example Middle Egypt and even the Delta. Except for a few sites, such as Quseir el-Qadim, Medinet Madi or Elephantine, the majority of glass specialists are still building up their documentation and the material is published in the form of short articles or is not published at all. The *topos* of the Alexandrian triad, flax, papyrus and glass, so vaunted in the literature of the imperial period begins to materialise thanks to the discovery of primary workshops in the sites of Wadi Natrun and the Mariotid that date to the two first centuries AD.

### 2.1 Primary Workshops

When confronted with the remarkable discovery in the early 1990s of 17 tank furnaces, dated to the 6th-7th centuries<sup>14</sup>, on the Bet Eli'ezer site in Israel, it struck me as important given the reputation glass production in Egypt, to try to find such structures in this country. Surface prospection in the region of Alexandria and in Wadi Natrun led to the identification of five primary workshop sites: two in the Mariotid, at Taposiris Magna and

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13 Arveiller-Dulong, V., Nenna, M.-D., 2011: 384-391.

14 Gorin-Rosen, Y., 2000: 52-54.

at Marea-Philoxenite, and three in Wadi Natrun at Beni Salama, Bir Hooker and Zakik<sup>15</sup>.

Excavations from 2003 to 2009 on the Beni Salama site at the eastern entrance to Wadi Natrun revealed a series of huge tank furnaces<sup>16</sup>. These discoveries are exceptional because of their date, their dimensions and the very good state of preservation (**Fig. 4**). They are, in fact, the oldest tank furnaces as yet discovered since they can be dated by associated material from the first to second centuries AD. The different spaces of the furnace, the firing chamber and the rectangular tank, were aligned along a north-west/south-east axis following the prevailing winds, and the tank was mostly buried, probably up to the vaulted roof. The melting tanks were very large (2 m by 6-7 m on the inside), much bigger than all similar discoveries to date, and with impressive walls of up to 1.8 m thick for the long side walls and 2.5 m for the back end wall, all built of big rectangular bricks. They were covered by a flattened barrel vault made of different types of narrow curved bricks. There are only fragmentary remains of the firing chamber but it must have had a square interior in which compartmentalised spaces were for heating and for evacuating the ash. This chamber was most likely open to the tank along its entire width. On one of the sides of the furnace there was a "clean" zone paved with small square bricks that may have been for mixing the raw materials

By looking at certain modern Indian examples<sup>17</sup>, one might try to reconstitute the different stages in the workings of the furnace. Over a very long period, of up to 30 days perhaps, the mix of sand and soda was left lying and then gradually poured into the tank through holes in the vault. It needed to be heated to 1100 degrees. The batch was vitrified by the heat reverberating off the vault and building up within the tank. After the firing, which creates a slab of glass weighing between 15 and 20 tonnes, all or part of the vault and one of the long walls of the tank were dismantled in order to get at the glass. The slab was cut into blocks of a manageable size to be transported to the secondary workshops. The glassmakers would then re-

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15 Nenna, M.-D., Picon, M., Vichy, M. 2000: 99-104; Nenna, M.-D. *et al.* 2005.

16 Publication is underway, for preliminary reports, see Nenna, M.-D. 2007b, 2009, 2010b, the reports of subsequent campaigns are being prepared for publication in *ASAE*; see also Nenna, M.-D., 2007a: 127-130; Nenna 2008a: 61-62; *Orientalia* 77.3, 2008, p. 248-250; Nenna, M.-D., 2010c, Nenna, M.-D., forthcoming 2.

17 Sode, T., Kock, J., 2001.

use the same site, taking advantage of the hardening of the already existing floor and walls, raising these latter and reconstructing the one long wall and the vault of the tank, as well as the firing chamber. Excavations have, in fact, revealed the remains of three superimposed furnaces in the case of the western furnace of Sector 1, and four in the case of the western furnace of Sector 2. The question as to what was used as fuel is central. We have elements that would indicate the use of reeds, a fuel of high heat value and plentiful along the shores of the lake. One can also presume the presence of tamarisk, acacia and palms.

The dimensions of these furnaces are a continuing source of wonder. They imply a technical expertise that research had not yet identified for an era so ancient. Reverberatory furnaces were indeed known in Antiquity, but they are always small in size. The shift to using large dimension furnaces implies a mastery of heat that was previously unknown. The production capacity of the Wadi Natrun workshops would appear to be enormous when compared to that which has been attested until now. They were producing a slab of raw glass that must have approached 15 to 20 tonnes in weight. This technological revolution unfolded at the same moment as another: the invention of blown glass and its spread throughout the provinces of the Empire.

Judging from the rare fragments retrieved on the surface or in digs, we know that at least three categories of glass were produced in these workshops: blue green glass, colourless glass decoloured by the use of manganese and colourless glass decoloured by the use of antimony. These types of glass, it would seem, were destined entirely for Egyptian secondary workshops and, contrary to what we know about Syro-Palestinian glass, were not part of an important export market to the northern Mediterranean and the western provinces<sup>18</sup>. The workshops of Wadi Natrun, whose activities ended at the latest in the beginning of the third century, represent an important step in our understanding of the production and trade of ancient glass. They demonstrate that Egyptian glassmakers participated fully in the great development of glass craftsmanship from the Augustan period.

Other primary glass workshops, working with plant ash, in the Wadi Natrun itself<sup>19</sup> and elsewhere, produced a blue-green impure glass used to make

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18 See nonetheless Cabart, H., *Velde, Br.*, 2009.

19 Picon, M., Thirion-Merle, V., *Vichy, M.* 2008.

utilitarian wares such as unguentaria and kohl containers, which are a hallmark of the second-third centuries Egyptian contexts, very sparsely distributed outside Egypt. We must not also rule out that opaque glass was still produced to manufacture mosaic vessels.

## 2.2 *Glass for Everyday Use*

Given that Egyptian early Roman secondary workshops are still unknown to us through a lack of archaeological discoveries, we must turn to consumption sites in order to draw up an inventory of Egyptian products and to understand their peculiarities. As far as the first two centuries and the beginning of the 3rd century are concerned, the useable evidence that we have today comes essentially from, on the one hand, sites of the Fayyum<sup>20</sup> and, on the other, from sites in the Eastern Desert. One should also point out the recent publications of archaeological material from Tel el-Herr, Buto and Marina el-Alamein<sup>21</sup>. The state of conservation and the nature of the contexts of the Fayyum sites mean that it is not really possible to tighten the chronology through internal criteria of the sites. This is also true for the material from the excavations of Quseir el-Qadim<sup>22</sup> and Elephantine<sup>23</sup>, which have been comprehensively published. In contrast, however, it is possible to define phases of a quarter- or a half-century<sup>24</sup> in the forts and quarry sites of the Eastern Desert as well as in Berenike<sup>25</sup>. One important gap must be pointed out: the first three quarters of the 1st century, the moment when blown glass develops, for which we have very few closed or well-dated contexts. We should also note that Egypt holds no evidence equivalent to that provided by the tombs with glassware found in the cemeteries of early imperial Italy and the western provinces. Nonetheless, if one takes the example of glassware from the end of the 1st and the first half of the 2nd century, one can see that Egypt adopted, on the one hand, types that were widespread throughout the entire empire, such as faceted goblets and cast colourless glass bowls and plates, and, on the other, stood distinct from other provinces of the empire (**Fig. 5**) through the adoption of a model of

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20 Karanis: Harden, D.B., 1936; Tebtynis: Nenna, M.-D., 2000; Medinet Madi: Silvano, Fl., 2005, 2009, 2012a.

21 Nenna, M.-D., 2007c and 2007d; Kucharczyk, R., 2005.

22 Meyer, C., 1992; Peacock, D., 2011.

23 Rodziewicz, M., 2005: 25-28, 81-96 (tableware), 34-35, 115-122 (beads), see nonetheless Keller 2008.

24 Brun, J.-P., 2003a, 2003b, 2011; Bailey, D., 2007.

25 Kucharczyk, R., 2012.

tall, colourless, cylindrical goblet with a cut rim, a bowl with four deep depressions and a very thick recessed bottom. This type was distributed throughout Egypt from Marina el-Alamein to Tel el-Herr and from Tel el-Balamun to Aswan, and turns up in both the Eastern and the Libyan Deserts. There are other examples of strictly Egyptian types that were spread across the entire country, but which had a longer life span: the little *balsamarium* with bulbous neck tightening in at the base and ovoid body, and kohl containers. For the former, the variety of mouth, of decoration (engraved or applied) and of matter means that their evolution can be followed from the middle or the end of the first century until the fourth. The latter, of impure blue-green glass and made on a mandrel are dated from the second and third centuries. They always have a very thick bottom and limited capacity. Three forms of body stand out: low conical body, tall conical body narrowing where the neck begins and conical body that grows gradually out of the neck.

In terms of function, in a site such as Tebtunis, for the period spanning the end of the first and the second century, glassware is spread between 42% of toilet bottles (oil and kohl), 23% of closed vases of medium size (oil-containers, flasks and jugs), 21% of goblets and 8% of bowls and plates. Luxury vessels (engraved, painted, mould-blown) constitute 6% of the whole.

### 3. The Late Roman Period

#### 3.1 Primary and Secondary Workshops

In the 3rd century, the Wadi Natrun sites were no longer active, nor probably those of the Mariotid, but other primary glass workshops must have been active, as we have good proof of Egyptian luxury wares, colourless engraved and painted glass, being traded towards the western part of the part of the Mediterranean and beyond the borders of the Empire (see *infra*).

In *Historia Augusta* (*Aur.* XLV,1) the triad of linen, papyrus and glass is once again present. The emperor Aurelian, ruling from 270 to 275, is said to have offered to the city of Rome the income from the taxes on exported Egyptian products such as glass, papyri, linen and tow. We should also mention two papyri: one (*P.Got.* 7) discovered in Panopolis dated to 253 AD mentions that two glassworkers from Coptos are employed in the glazing of several monuments of the city, three baths, the gymnasium, the praetorium, the

kosmaterion; the other dated to 287 mentions one Aurelios Loukas, alias Potamon, glassworker in Lykopolis (*P.Sijp* 17.) In the early fourth century, the existence of a glassworkers' guild in Oxyrhynchus is well attested by papyri dated to 315 (*P.Oxy.* 64.4441), 317 (price of the glass: *P.Oxy* 54.3742) and 326 (glazing of monuments: *P.Oxy* 44.3265). In the late fourth century, we have an attestation of a glassworker in Hermopolis (*P.Ross. Georg.* 5, 60)<sup>26</sup>. These textual sources provide evidence of glass manufacture in Middle Egypt, as well as the recently identified glass tank furnace in Antinoupolis, as yet undated<sup>27</sup>.

We also know that by the mid-fourth century, a new composition of glass characterised by a high iron, manganese and titanium (HIMT) content competed on the markets with Levantine glass and was distributed to the western part of the Mediterranean, the north-western European provinces, the Aegean and Black sea regions. For several reasons, archaeological and chemical, there seems to be today a consensus as to the fact that HIMT glass was manufactured on the northern shore of Sinai between Pelusium and Ostrakine. We have no textual sources indicating such an activity, but the presence of dumps from primary glass workshops discovered in the 1970s during the Israeli survey of all the sites along the seashore and Lake Burullus are sufficient proof<sup>28</sup>.

It is not possible to explain why this new glass appeared in the mid-fourth century. As Foster and Jackson have pointed out<sup>29</sup>, there is no evidence for a reduction of glass production in the Near Eastern region, as there was population growth and economic prosperity in Syria-Palestine in the 4th century and the glass industry in the region was flourishing. The regular occurrence of Levantine vessel glass on the same sites as HIMT vessel glass, though in smaller quantities, clearly shows that this glass was coming from Syria-Palestine, and was being distributed to the same markets. Moreover, raw glass chunks of Levantine origin are also attested in secondary glass workshops in Western contexts, and sometimes in the same ones as HIMT glass<sup>30</sup>. One reason why HIMT glass is more dominant than Levantine glass

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26 For more details, see Nenna, M.-D., 2005 and Melaerts, H., 2007.

27 Silvano, Fl., forthcoming.

28 Nenna, M.-D., 2014.

29 Foster, H., Jackson, C.M., 2009: 195-196.

30 Foy, D., *et al.* 2003: 67, 70, 72.

may be because of the cost. As Foster and Jackson<sup>31</sup> have shown, Levantine 1 and Colourless 1 compositional groups vessel glass show no traces of recycling and they appear to be higher quality glassware than the objects produced in HIMT 2 and Colourless 3 compositional groups. This could well be because the quality of the technology of HIMT glass was lower than that of Levantine glass, much more variable and also less expensive than Levantine 1 glass. Egyptian glassworkers did not hesitate to introduce recycled glass into the primary batch to aid the fusion of the sand and the flux, without concerning themselves about the consistency of the colour, and this practice seems to have increased over time. Another reason for this lower quality could have been also the lack of easy to use fuel such as hard wood, and as in the Wadi Natrun, and in Mariotid, the obligation to use reeds.

To date, no remains of secondary glass kilns and workshops have been found in excavations<sup>32</sup> and it is the study of the glass material unearthed which can help us to define the Egyptian Late Roman facies.

### 3.2 *Everyday Glass Ware*

For the period covering the mid-third century to the beginning of the fifth century, we have a series of good closed contexts in Karanis and in residential sites of the oases of Khargeh and Dakhleh. There is much data from deposits in the houses of Karanis inside ceramic jars, wooden crates, basketwork and wall cupboards where glass pieces lie next to ceramic vases<sup>33</sup>. This is also true of Kellis, where a basket held no less than 32 pieces of glass dated to between 280 and 360<sup>34</sup>. At Dush, in a room of the fortified storehouse<sup>35</sup>, a hoard of luxury glass was discovered that included mosaic glass, inlay glass, colourless moulded glass, mould-blown glass, engraved and incised glass. This hoard was found associated with more commonplace ware, such as small bowls and plates, *amphoriskoi* and lamps. Funeral contexts unearthed in older excavations, as for example the very particular closed deposit of Tomb 211 at

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31 Foster, H., Jackson, C.M., 2009 and 2010.

32 The kilns supposed to be glass kilns discovered in Kom el-Dikka site in Alexandria (Majcherek, Grz., 2006) are today considered as alien to glass manufacture (verbal information R. Kucharzcyk).

33 Harden, D.B. 1936, p. 34-37; Wainwright, G.A., 1915.

34 Marchini, C., 1999, I have since resumed a study of the material from the houses and the churches.

35 Nenna, M.-D., 2003a; Nenna, M.-D., 2013a, p. 313, fig. 5.

Bagawat<sup>36</sup>, where no less than 68 pieces of glass were used to decorate the cupola of the funerary chapel, are also very enlightening as to the remarkable flourishing of luxury glassware in fourth century Egypt (**Fig. 6**). Information on glass in Middle Egypt can be found in the recent publications of the glassware from Amarna<sup>37</sup> and from Antinoupolis<sup>38</sup>. In Alexandria, the excavations of the Polish Mission in Kom el Dikka have yielded good series of Late Roman glassware in the sector of the auditoria<sup>39</sup>, as well as in the dump of the baths, which accumulated quickly starting from the late fourth century, growing into a small mound in the fifth and sixth centuries<sup>40</sup>.

In houses of the fourth century, if we take the examples of Kellis (Ismet el-Kharab), dated between 280 and 360 AD, glass vessels, all techniques of manufacture taken into account, are spread between 81% drinking and table ware, 10% toilet bottles and 8% light fitments. Luxury tableware (mosaic glass, painted glass, mould-blown glass) represent between 15 and 20% of the whole. The free blown common tableware is distributed between small footed bowls (53%), goblets (21%), flasks and jugs (6%), the other categories (shallow cups, plates, bowls) are under 5%. In the houses of Dush, which were occupied until the beginning of the 5<sup>th</sup> century, the percentages are generally the same, but the light fitments (**Fig. 7**) increase to 20%, at the expense of tableware (around 70%).

#### 4. The Particularity of Egyptian Glassmakers

##### 4.1. Mosaic Glass

The skill of Egyptian glassmakers was well known in antiquity and they were part of a long tradition that reached back to the New Kingdom. The glassmakers of the second and first millennia BC were specialised in the craft of inlaying and it was in Egypt towards the end of the fifth century BC that mosaic glass was invented<sup>41</sup>. This consists of combining prefabricated polychrome elements. It is natural to think that the move to the creation of mosaic glass vases happened at the beginning of the Hellenistic period in Egypt. They then remained a luxury object for a long time and such vases were produced in very

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36 Hill, M., Nenna, M.-D., 2003; Nenna, M.-D., 2010a.

37 Faiers, J., 2013.

38 Silvano, Fl. 2012b.

39 Kucharczyk, R., 2007.

40 Kucharczyk, R., 2010 and 2011a.

41 Nenna, M.-D., 2000 and 2006.

large numbers in Roman workshops of the Augustan era. More than 15 000 fragments are recorded in the Gorga collection<sup>42</sup> as against 300 pieces known from the Hellenistic period. In this case, we are most certainly dealing with a transfer of Egyptian labour to the capital of the empire. The taste for these multi-coloured pieces died out in the west in the 40s AD, but in Egypt the tradition was not abandoned and there was a resurgence of this technique in the fourth century, amply attested by discoveries in the oases of the Libyan Desert. These sometimes presented floral, geometric and faux-marble motifs or else were inspired by Nilotic vegetation and animal life (**Fig. 8**). Such decoration might make up the entirety of the vase or else was inserted into the internal or external walls of shallow bowls that were either colourless or of such a deep violet that they appeared black<sup>43</sup>. Mosaic glass demonstrates clearly how Egyptian tradition adapted itself to new tastes, created an export market and managed to evolve new forms, decoration and techniques<sup>44</sup>.

#### 4.2 *Painted Glass*

The situation is different for painted glass, in that we have little information regarding the development of this technique in the first millennium BC. Between the 30s and 70s AD, a small series of bowls (roughly 80 pieces recorded) with enamelled decoration, both vegetal and figurative, was spread throughout the empire. Whether the site of their manufacture was in Italy or Egypt remains under discussion<sup>45</sup>. However, from the end of the first century other forms (tall conical goblets, goblets with depressions, shallow bowl) and other decorations start to appear that can be attributed to Egyptian workshops and would have been developed either from a borrowed technique or by adapting an already known technique<sup>46</sup>. These

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42 Petrianni, A., 2003.

43 Nenna, M.-D., 2002b: 155-157 and Silvano, Fl., 2005: 20-121 for a new example of a shallow cup at Medinet Madi and Silvano 2008, for elements of mural decor of a funerary chapel at Antinopolis dated to 4th-5th centuries, pending the publication of some 30 mosaic vases from the houses and churches of Kellis and an important ensemble from Ain et-Turba.

44 Nenna, M.-D. 2006.

45 For a bowl with Nilotic decoration, see Nenna, M.-D., 2008b with a list of vases from this period, to which can be added Silvano, Fl., 2012a: 61, no. 863 (Medinet Madi).

46 For a summary of discoveries, see Nenna, M.-D., 2003b: 360-361, to which can be added Peacock, D., 2011: 60-62, nos 27-32, three unpublished fragments discovered at Tebtynis, one of which in a context from the beginning of 2nd century AD and fragments found in Petra, O'Hea, M., 2009. For recent analysis of pigments, see Greiff, S., Schuster, J., 2008 and Wypyski, M., 2009, revealing the unexpected presence of lapis lazuli in the blues.

vases with enamelled decoration are primarily attested in Egypt, and outside the borders of the empire at Begram, in Sudanese Nubia, in the oases of the Fezzan and beyond the Germanic *limes*. Thereafter, it appears that Egypt made a speciality of painted glass, something that was barely developed in other regions of the empire. Evidence of this can be seen in the exports dated to the third century found once again on the edges of the empire at Sedeinga and at Meroe, and even on the shores of the Black Sea. Certain of these blend cold-painted and gilded decoration<sup>47</sup>. For the fourth century, it is objects found locally in the sites of the Libyan Desert that attest to the continuation of these techniques. Indeed, one finds objects manufactured using previously known techniques, such as enamelled glass (the gladiator jug of Kellis<sup>48</sup>) and the combination of gilding and cold painting (astrological tablet from Dush [Fig. 9]<sup>49</sup>). New approaches were also developed with reverse-painted decoration, whereby the inked drawing and the pigments were applied behind the visible wall and covered the entire surface<sup>50</sup>. The most surely dated examples from Kellis are the fragments of panels found in one of the churches. These are from the fourth century. Other panel fragments manufactured with the same cold technique have been discovered at Dush<sup>51</sup> and at Tebtynis<sup>52</sup>, but we also know of reverse cold-painted fragments from Medinet Madi<sup>53</sup> and in Western museums<sup>54</sup>. In certain cases, the reverse-painted decoration can be fired, as shown by fragments gathered in Egypt<sup>55</sup> with Nilotic images, like one fragment with an otter that appeared on the art market in the 2000s<sup>56</sup>.

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47 For a summary of discoveries, see Nenna, M.-D., 2003b: 361-364 to which can be added Silvano, Fl., 2012a: 62, no. 864 (Medinet Madi); Shatberashvili, V., 2009, for two exceptional jugs, one showing Bellerophon astride Pegasus fighting the Chimera and Bellerophon with Philonoe, the other showing a Dionysiac procession with the characters placed beneath arches, both from the same workshop as the famous Daphne ewer.

48 See Hope, C., Whitehouse, H., 2004.

49 Since the publication of this piece in Nenna, M.-D., 2003b, the fragment discovered by Cailliaud has been rediscovered by Ph. Mainterot (Mainterot, Ph., 2011: 266-267, pl. XIII).

50 The reverse painting technique is already known from the second century AD on a series of pyxis lids, though only the figures are painted and not the entire area bearing the representation, see for example Whitehouse, D., 2001: 264, no. 859.

51 Nenna, M.-D., 2003b: 364.

52 Torino Museum, excavations from the 1930s, inv. S 19221a.

53 Silvano, Fl., 2012a: 59-60, pl. D, 1 et 4.

54 Whitehouse, D., 2001: no. 858 (Judgement of Paris plate); n° 860-862; Clairmont, Chr., 1977: 22, no. 66 (Benaki collection, accumulated in Egypt).

55 Whitehouse, D., 2001: no. 863.

56 Nenna, M.-D., 2013a: fig. 7b.

### 4.3. Engraved Glass

One could continue the demonstration with engraved glass, in which Egyptian workshops also most certainly played an important role and produced items destined for export from the end of the first century AD<sup>57</sup>. A certain number of groups have been defined according to technical criteria, for example the *contour grooves group* from the end of the second to beginning of the third century as characterised by M. Stern<sup>58</sup> or the Karanis group (Fig. 10a). Subsequently, new pieces belonging to the contour grooves group have been discovered that confirm an Egyptian origin<sup>59</sup>. The group of vases with greetings in double line letters, that was originally composed of tall cylindrical goblets discovered in Egypt, the Sudan and in oases of the Libyan Desert and dated to the third-fourth centuries by D. Harden<sup>60</sup>, has grown with the addition of new examples of goblets<sup>61</sup> and new forms: hemispherical bowls with cut lip<sup>62</sup>, jugs<sup>63</sup>, and a flat-bottomed, cut lip cylindrical goblet recently discovered in Petra and attributed with reason to an Egyptian workshop<sup>64</sup>.

### 4.4. Mould-blown Glass

Other techniques would seem to have barely taken root in Egypt, such as mould-blown glass, which at least during its initial flowering in the 1st century is rarely to be found. In the Late Roman period though, double-head toilet-bottles manufactured in HIMT glass<sup>65</sup>, as well as goblets and shallow bowls with honeycomb decoration are commonly found in Egypt<sup>66</sup>, but the

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57 For a synthesis see Nenna, M.-D., 2003c. See also for more recent discoveries, Silvano, Fl., 2012a: 55-56, nos. 809-825

58 Stern, E.M., 2001: no. 56.

59 Nenna, M.-D., 2003c: 361-362, 375, Nenna, M.-D., 2007a: 141, footnote 2 and fig. 8; Brun, J.-P., 2011: 218, nos. 43-54; Peacock, D., 2011: 65-66, n° 69. Subsequently, a fragment from the centre of a shallow bowl with medallion showing a bust in profile has been unearthed at the Dios/Jovis station on the Coptos-Berenice route (verbal communication H. Cuvigny).

60 Harden, D.B., 1967-1968.

61 Dush and Ain et-Turba: Nenna, M.-D., 2003c: 366, fig. 15-17; Medinet Madi: Silvano, Fl., 2012a: no. 170, pl. XV.

62 Nenna 2003c: 366, fig. 18: examples from Dush and Ain et-Turba.

63 Stern, E.M., 2001: 137-138, 160-161, no. 58 (Wolf collection).

64 Keller, D., 2006: 118, 211-212, pl. 12a-c.

65 Kucharczyk, R., 2004 (Alexandria); *ead.* 2010b: 117, fig. 1.7 (Marina el-Alamein); Foy, D., 2010a, p. 264 for a preliminary list of the pieces discovered in Egypt.

66 To pieces coming from Karanis, Hermonthis and Egypt (Harden, D.B., 1936, nos 333-334 and 472, *id.* 1940: 118; Clairmont, Chr., 1977: 23, no. 69, pl. IV), add unpublished pieces coming from Isment el-Kharab (Marchini, C. 1999: fig. 1d), Alexandria (excavations of CEAlex) ; Dush, Ain et-Turba and Coptos.

wide distribution of these forms of vessel, always in thin glass and with in-depth decoration, in the western provinces as well as in the Aegean and the Levant is probably the result of a multiplicity of workshops<sup>67</sup>. On the contrary, a special kind of rather thick shallow bowl and carinated plates with a decoration in relief combining concentric circles and dots in squares on the bottom and fluting on the body, could well have been a speciality of Egyptian workshops, and more precisely of Alexandrian workshops as is shown by recent discoveries in Kom el Dikka<sup>68</sup>. These vases were traded all over Egypt (**Fig. 10b**)<sup>69</sup>, as well as abroad<sup>70</sup>. To this Alexandrian group, the following should also belong:

- shallow bowls with intersecting circles and dots on the bottom and fluting on the body (**Fig. 10b**)<sup>71</sup>,
- shallow bowls decorated with hexagons in which is a raised dot<sup>72</sup> or a deep blue or violet inlay<sup>73</sup>,
- shallow bowls with hexagons and circles with rosette, of which the heart is marked by the inlay of a blue glass drop<sup>74</sup> or a section of mosaic glass canes<sup>75</sup>.

These are all characterized by a rather thick glass and a decoration in relief. They were mainly unearthed in Egypt, but some have travelled as far as southern France and Great Britain.

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67 Arveiller-Dulong, V., Nenna, M.-D., 2005: 357, nos. 991-993.

68 Kucharczyk, R., 2010a: 60-63, fig. 4.

69 Karanis: Harden, D.B., 1936: 93, no. 216, pl. XIII and 305, no. 999, pl. XXII; Elephantine, *ibid.*: 93, fig. 1f.; Bagawat: Nenna, M.-D., 2010a: 202, no. 4; unpublished example at Isment el-Kharab (inv. A6/93.920). See also of Egyptian provenance: Clairmont, Chr., 1977: no. 70, pl. VI; Petrie Museum, inv. no. UC22650. For a slightly different motif with stars in circles, each framed by four crosses, see Clairmont, Chr., 1977: no. 233, pl. XV.

70 Oliver, A., 2002: examples of Kourion and Carthage. See also of unknown provenance: Stern, E.M., 2001, no.156, Whitehouse, D., 2001, no. 635

71 Arveiller-Dulong, V., Nenna, M.-D., 2011: 416, no. Add. 4 from Elephantine; unpublished examples in Dush (inv. no. IFAO 3093) and in Isment el-Kharab (inv. no. A5/91.244). See also from Egypt, Petrie Museum, inv. no. UC22191.

72 Petrie Museum, inv. no. 22643 (Egypt). Unpublished example in Isment el-Kharab, inv. no. A5/92.43 and in Dush (inv. no. DV79.42).

73 Karanis: Harden, D.B., 1936: 93, no. 217; Egypt: Clairmont, Chr., 1977: n°35; Arles: Foy, D., 2010b: no. 828; unpublished examples in Dush (inv. no. IFAO 3245b)

74 Unpublished examples in Dush (inv. no. .86.262.1) and in Isment el-Kharab (inv. no. A6/93.455).

75 Clairmont, Chr., 1977: n°13; Cool, H.E.M., Henderson, J., 1993 (Dorchester); Whitehouse, D., 2001: no. 636-637; Arveiller-Dulong, V., Nenna, M.-D., 2005: 433, no. 1203.

#### 4.5 Applied Decoration

Applied decoration, be it threads applied on the rim or on the body or blobs applied on the body, is so common in Egypt and elsewhere that it cannot be taken as evidence defining a workshop. But more complex decorations also occur. If the vases with snake-shaped decoration that were such a success for the workshops of the Levant and of Cologne in the third century<sup>76</sup> are scarcely attested in Egypt<sup>77</sup>, Egypt seems to have made a speciality in the Late Roman period of medallions in the shape of a lion's head and actor's mask<sup>78</sup>. They are most of the time preserved without the vessel to which they were attached, but they indicated a taste for imitation of metal vessels that can be traced back to the early Roman Empire.

Today, as a result of new discoveries and analyses, one can present a more nuanced image than the standard pan-Alexandrianism of the first half of the twentieth century and the counter reaction of the second. Egypt certainly participated in the great development of the glass industry from the Augustan era, as is evident from the primary furnaces of Wadi Natrun and the Mariotid. It is, however, impossible to say at this point whether it was Egyptian glassmakers who provided the impetus for the technological innovation that saw a shift from crucible furnaces to tank furnaces of small and then very large size, permitting the treatment of huge quantities of raw material. Egypt adopted the technique of blowing glass that was invented in the middle of the 1st century BC in the Levant, and then created her own repertory of shapes, while still preserving and developing a traditional technique like mosaic glass. The country eventually specialised in different categories of luxury blown glass, such as painted or engraved glass, partly aimed at the export market. Egypt thus developed its own multiple engraving methods and painting techniques unused elsewhere. While we may be beginning to know the repertory of both common glassware as well as luxury products of the 4th century, the initial development of blown glassware in the 1st century is still not clear.

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76 Follmann-Schulz, A.-B., 2004.

77 For some fragments, see Harden, D.B., 1936: nos. 490 and 492; Silvano, Fl., 2009: 120.

78 See Kucharczyk, R., 2011b for a complete study dedicated to these pieces.

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- AIHV = Association Internationale pour l'Histoire du Verre
- ASAE = Annales du Service des Antiquités de l'Égypte
- BSAA = Bulletin de la Société Archéologique d'Alexandrie
- IFAO = Institut Français d'Archéologie Orientale
- JGS = Journal of Glass Studies
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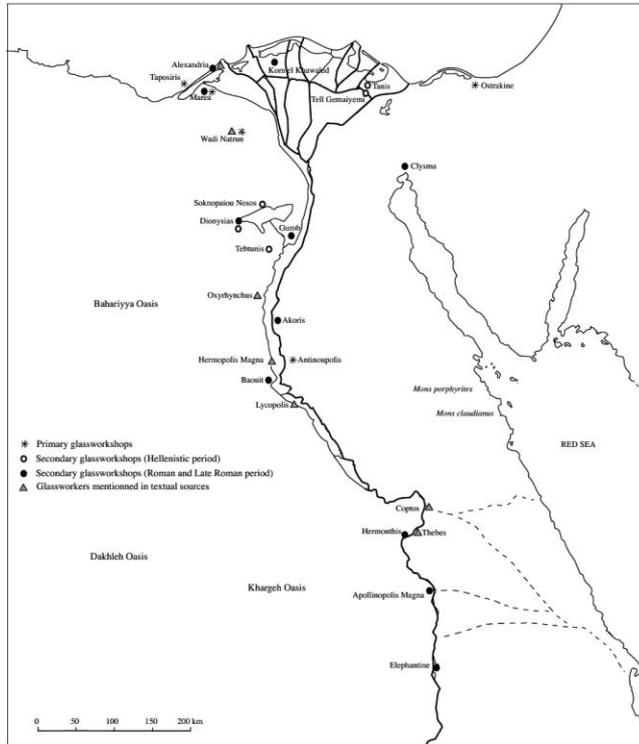


Fig. 1



Fig. 2



Fig. 3



Fig. 4



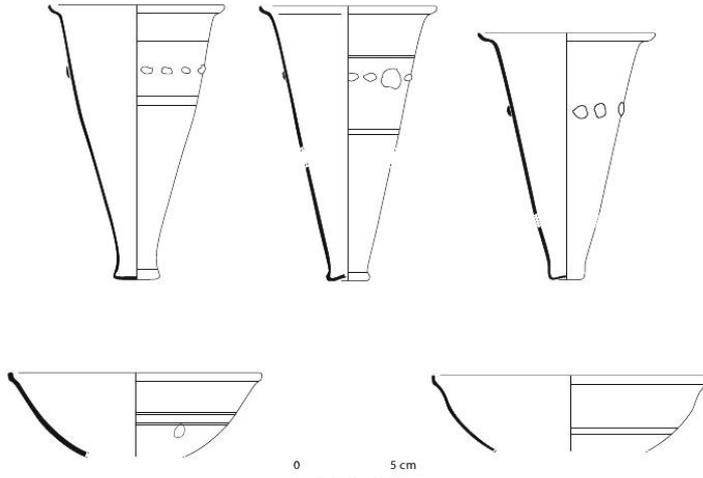


Fig. 7

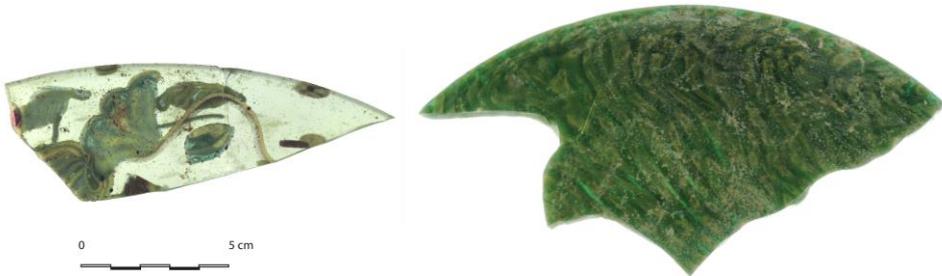


Fig. 8

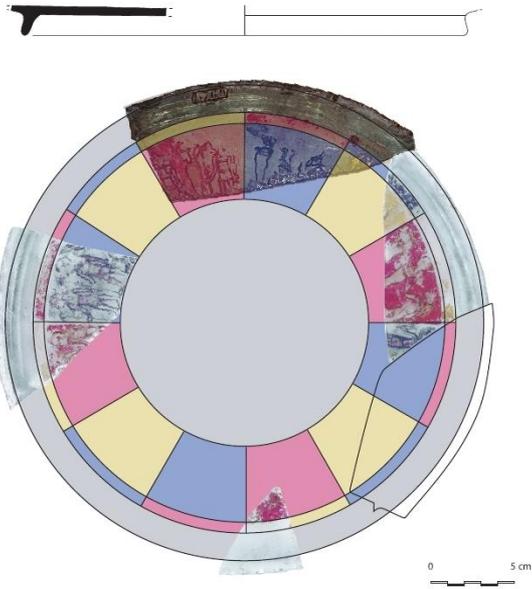


Fig. 9