

N.B. This is a very rough, preliminary, draft of the book which was finally published as 'The Glass Bathyscaphe: How Glass Changed the World' by Profile Books, London, 2002. This draft was completed about nine months before the final book. Many arguments are provisional, the footnotes have not been checked, the order is different. But it does contain many bibliographical details and quotations which were excluded from the final published work. It may therefore be useful for those who wish to pursue the matter further or to know the background to certain statements in the published work.

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## GLASS IN ISLAMIC CIVILIZATION

In some ways, one of the most instructive histories of glass is that of its fate in Islamic civilization. After the collapse of the Roman Empire, the centre of glass-making again shifted to the eastern Mediterranean that is the area where glass had first been discovered and developed, namely in Syria, Egypt, Iran and Iraq. For a while this was held by the Sassanian Empire which ruled wide areas of western Asia from AD 224 to 651. The glass, we are told, was 'usually pale green and transparent, or almost colourless with a grey or brownish tint.'<sup>1</sup> Techniques included blowing, casting and pressing, wheel-cutting and stamped and applied decoration and many of the objects were very beautiful and traded long distances; two of them were found in Japanese tombs in the sixth and eighth centuries for example.

In the seventh century the Sassanian Empire was destroyed by the Arabs as part of the spread of Islamic civilization, but we are told that 'it has become clear as a result of recent archaeological excavations in those regions that there was also a flourishing glass industry which continued without interruption into the Islamic period. The Sassanian glasshouses excelled in the cutting of glass on the wheel;...'<sup>2</sup> Hence, since Islam had also absorbed two other great areas of glass-making, the Syro-Palestinian and the Egyptian, the new civilization was heir to many of the most advanced techniques of glass-making.

For about a hundred years after the invasions glass-making declined. According to one account 'until the more settled conditions of around 750 and the choice of Baghdad as the capital, glassmaking seems to have come to a halt.'<sup>3</sup> But gradually glass making re-emerged so that by the ninth century a distinctively Islamic style had been established which was famous for its exquisite craftsmanship. Glass-making was very widespread and 'ranges from simple utilitarian vessels, some with applied or mould-blown ornament, to exquisite luxury items.'<sup>4</sup>

As many have observed, the next half millenium saw in many ways one of the greatest

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<sup>1</sup> Sotheby's Encyclopedia, 40

<sup>2</sup> Tait, Glass, 115

<sup>3</sup> Encyclopedia of Glass, 36

<sup>4</sup> Sotheby's Encyclopedia, 40

developments of glass making in the world. There were technical developments with the re-discovery and refinement of wheel-cutting and cameo glass. Very delicate, thin glass was shaped by grinding away the surface and leaving patterns in relief and lustre-painting, gilding, enamelling and engraving were brought to perfection. We are told that new techniques included a new style of cutting, 'the use of pincers to apply a decorative motif or inscription to the wall of a vessel, and fusing together two layers of glass, as in cameo work.'<sup>5</sup> Very large quantities of bottles, bowls, jugs, gaming pieces, small discs for establishing the weight of coins, lamps (particularly for mosques) and mosaic glass were produced.

Those within the Islamic area 'created a new art of decorated glass, hardly surpassed at any earlier or later time for strength of design and richness of colour.'<sup>6</sup> For example, the style of Islam 'was distinguished by its skillfully cut and engraved products, lustre-painted glass, and spectacular enamelled and gilded glasses which were made in Syria in the thirteenth and fourteenth centuries.'<sup>7</sup> This glass was traded all over Eur-Asia. It has been argued that '... the glass of the Islamic world is as important as that of Rome. Just as Roman glass was widely distributed in the West and the industry established in many of the provinces of the Empire, so the glass produced in the central lands of the Islamic world was traded not only within the Muslim countries but also throughout the Mediterranean area, Scandinavia and Russia, East Africa, the shores of the Indian Ocean and even China. '<sup>8</sup>

It was in Syria during the thirteenth and fourteenth centuries that the most glorious glass was produced. In Aleppo and then Damascus glass was produced on a wide scale. 'From the mid-thirteenth century, blue and red colours began to dominate Syrian enamelled ware, and much use was also made of opaque white and gold....Motifs included animals, birds, human figures, arabesque foliage and shields.'<sup>9</sup> We are also told that a Chinese influence appeared through the effects of the Mongol dynasty in Persia and Mesopotamia and a 'new naturalism was observable in the depiction of plant forms, especially vine ornament, and new motifs included cloud-scrolls, lotuses, peony flowers, dragons, phoenixes and tigers'.<sup>10</sup> Among the objects which were decorated there were 'sprinklers, globes, footed bowls, beakers, long-necked bottles, and mosque lamps'.<sup>11</sup> Mosque lamps (really lanterns), for use in schools and mosques were particularly beautiful and important, the nearest equivalent in their symbolism and widespread use to the growth of stained glass in west European Churches. They illustrated the words of the Koran, 'Allah is the Light of the Heavens and the earth. The likeness of His light is as a niche, in which is a lamp. The lamp in a glass, the glass as it were a shining star.(Sura XXIV,V.35)<sup>12</sup> The production of the most beautiful glass in the world continued until about 1400. The decorated glass of Damascus was especially famous and examples of Syrian glass were exported to the Far East and Europe.

What is particularly relevant to our analysis is the use of glass for things other than fine

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<sup>5</sup> Klein and Lloyd, Glass, 59

<sup>6</sup> Honey, Glass, 35

<sup>7</sup> Klein and Lloyd, 39

<sup>8</sup> Tait, Glass, 112

<sup>9</sup> Klein and Lloyd, Glass, 62

<sup>10</sup> Klein and Lloyd, Glass, 63

<sup>11</sup> Klein and Lloyd, Glass, 63

<sup>12</sup> Quoted in Liefkes, Glass, 34

decorative, engraved, items. In particular, we may wonder whether, with their superb technical ability, the Islamic glass-makers developed glass for those uses which were to transform the West, namely for lenses, spectacles, mirrors, glass panes, fine wine glasses.

The best preliminary account I have encountered is by Oliver Watson (in ed. Liefkes). He states that 'glass was largely a consumer item, competing with other materials, especially silver, bronze, and fine ceramics, to provide, if not always luxuries, then the accoutrements of graceful living.'<sup>13</sup> He notes that we know little about the use of glass for more functional purposes, 'for storage and transport of other materials' since such objects were neither preserved, nor attracted the attention of commercial diggers on archaeological sites.<sup>14</sup> But Watson very helpfully divides what was made in the period up to the fifteenth century into four categories of 'common types of glass made'.

The first 'include such scientific and medical things as alembics for distilling, cupping glasses for the bleeding of patients, and a large production of official and accurate glass weights and measures.'<sup>15</sup> One would very much like to know whether lenses were made as part of this category, for examining small objects, whether prisms were made, whether glass mirrors were made etc. That this is the case is suggested, for example, by the fact that Alhazen, (c.965-c.1039) 'studied the reflective properties of curved mirrors, and the magnification of segments of glass spheres was well known to him.'<sup>16</sup>

This is all vital to the argument about the effects of glass on thought. The fact that Arabic thinkers at this precise time revolutionized mathematics, geometry, optics and perspective, chemistry, is surely not a coincidence. All of these needed glass and developed in precisely that place and area where fine glass abounded. This legacy was, of course, passed on to medieval Europe and taken on there.

Another major category is 'glass for perfumes and cosmetics', that is 'sprinklers, small flasks, and boxes, and small dishes for ointments and unguents'.<sup>17</sup> This is interesting and, as far as I know, is far less developed in western glass-making. A third group is the largest, namely 'tableware'. This consists of 'dishes, bowls, bottles and beakers used for serving and consuming food and drink.'<sup>18</sup> One thing one would like to know here is about the development of drinking glasses. Is it true that the ban in Islam on the consumption of wine had an effect? The question is prompted by the importance of wine glass manufacture in Italy on the development of fine glass. If this were precluded, it might be important.

Finally, we are told that 'there was only a small and sporadic industry making window glass, an article not used in the traditional houses of the Middle East, and only occasionally used in mosques and other public buildings'.<sup>19</sup> Creswell in his book on 'Early Muslim Architecture' twice mentions the use of glass windows; in the Dome on the Rock in Jerusalem and in some houses in Samarra which had windows 'which were filled with great coloured disks of glass of

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<sup>13</sup> Ed. Liefkes, *Glass*, 27

<sup>14</sup> Liefkes, 28

<sup>15</sup> Liefkes, 28

<sup>16</sup> Singer, iii, 230

<sup>17</sup> Liefkes, 28

<sup>18</sup> Liefkes, 28

<sup>19</sup> Liefkes, *Glass*, 28

20-50 cm diameter.<sup>20</sup> For a whole book on architecture to mention only two instances of windows, and in one case at least the windows were not flat panes but obviously decorative, to stain the light, supports Watson's point that window glass was little used. Yet Watson does not explain why this was the case. Is it just simply that it is too hot - one needs the circulation of air? As we shall see, the absence of the development of flat glass is very important; much of what is most extraordinary, particularly in northern Europe, arises out of an intersection of climate, Christianity, and glass in the development of stained glass in Churches, and plain glass windows from Roman times onwards.

As for his assessment of technological change as a whole, Watson gives a sober view. He notes the thriving glass industries taken over in the areas conquered by Islam. He notes that 'new methods of manufacture were gradually introduced - for example, the use of a pintil to hold a glass after its removal from the blowing iron - and shapes slowly changed', yet he believes that there was 'no revolution in technology or taste'.<sup>21</sup> All the same 'Until the development of wine glass in the Venetian glasshouses in the fifteenth century, the Islamic glass-makers led the world in the sophistication and quality of their products.'<sup>22</sup>

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The rapid collapse of the glass industries within Islam is a mystery. The decline in glass in the fifteenth century is clear, yet 'its exact cause, whether plague, deportation of workers, or foreign competition, has yet to be determined.'<sup>23</sup> The simple explanation, of course, is that they were wiped out by Mongol invaders and clearly this had a good deal to do with it. The first wave of destruction occurred in the twelfth and thirteenth centuries and encompassed the northern half of Islam and parts of Russia. We are told that the flourishing Persian industry 'was all but destroyed when, at the beginning of the thirteenth century, Genghis Khan succeeded in conquering Mongolia...conquered Persia, in 1231, and then Mesopotamia, sacking Baghdad in 1258.'<sup>24</sup> Simultaneously Mongol invasions had destroyed the flourishing glass industry in Kievan Russia. 'Enamelled jewellery in vivid colours and comparatively free styles, similar to Byzantine products elsewhere, was being made, and enamel and glass-making workshops dating from around the eleventh century have been excavated at Kiev.'<sup>25</sup> Glass was used for a wide variety of purposes.'In Kievan Russia glass was used for windows, tableware and jewellery ...'<sup>26</sup> Then 'In the early twelfth century the Mongolian conquest of Kievan Russia dealt a crushing blow to the glass industry. The main centres were destroyed and the craftsmen either went to live under the Tartars or dispersed into the villages and countryside. Glass-making continued in a small way in western and south-western Russia, but did not re-emerge in any

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<sup>20</sup> Cresswell, Muslim, 22, 287.

<sup>21</sup> Liefkes, Glass, 28

<sup>22</sup> Liefkes, Glass, 29

<sup>23</sup> Sheila S.Blair and Jonathan M.Bloom, The Art and Architecture of Islam, 1250-1800 (Yale, 1994), 108

<sup>24</sup> Klein and Lloyd, 61

<sup>25</sup> Klein and Lloyd, Glass, 53

<sup>26</sup> Klein & Lloyd, 39

substantial form until the seventeenth century.<sup>127</sup>

The second wave of destruction occurred in the fourteenth century. According to one account, the 'deportation of the glass-makers of Damascus by Timur in 1400 supposedly put an end to the production of gilt and enamelled glass in western Asia...the golden age of Islamic glass-making had ended.'<sup>28</sup> According to another, 'Mosque lamps and other glass produce ceased to be made at Damascus after Timur (Tamerlaine) captured the city in 1400. The glass industry gradually declined as many of its skilled craftsmen left for Samarkand, Timur's capital. After this date, little glass of any quality was produced in the Near East...'<sup>29</sup>

The most thoughtful account of the decline is again by Oliver Watson. He notes that 'At some point in the fifteenth century, the Islamic glass industry had simply died out. Venetian imports continued to supply some luxury items, but it appears that in general much less glass was used.'<sup>30</sup> Why was this? Watson appears to be uncertain. He points out that 'The disappearance of the Islamic glass industry has never been satisfactorily explained'.<sup>31</sup> He points toward the theories of others. Some people 'see its cause in the destruction of Syrian cities in the early fifteenth century by the Central Asian warlord and emperor, Timur (Tamerlane).' Then again others 'blame the undercutting of the local market by Venetian glass-makers.'<sup>32</sup> Watson does not appear satisfied with either explanation. He is well aware, for example, of the difficulty of believing that it was just a matter of Mongolian invasions. As Tait points out, 'the decline of the industry was not, however, entirely due to this calamity [i.e. Timur's conquest of Syria] since mosque lamps made in the second half of the fourteenth century show a marked deterioration in quality.'<sup>33</sup>

All we have is the fact. 'What is indisputable is that fine quality glass ceased to be made anywhere in the Islamic world for some centuries to come.'<sup>34</sup> Watson summarizes the history of glass in the later Islamic civilizations. 'In the sixteenth century ... Court patronage stimulated the development of architecture and the arts, but the glass industry was not to share in this prosperity. If Timur settled the glassmakers of Damascus in Samarqand, there has survived no single trace of their work. The glasshouses of Syria and Egypt may have continued to supply local needs, but produced no fine ware. By the end of the fifteenth century, the glass wares of Murano was already supplying the imperial court at Istanbul.'<sup>35</sup>

This is a rather extraordinary story. In the period between about 700 and 1400 the leading glass area in the world was within the area of Islamic civilization. It was also the leading area for medicine, chemistry, mathematics and optics (physics). Then, just at the point where European glass was transforming science and vision, glass more or less disappeared from Islam. Surely

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<sup>27</sup> Klein and Lloyd, *Glass*, 53; cf. also **Decorative Arts**, 682, 'the Mongol invasions killed the industry'.

<sup>28</sup> Sotheby's *Encyclopedia*, 45

<sup>29</sup> Klein and Lloyd, *Glass*, 65

<sup>30</sup> Liefkes, *Glass*, 30

<sup>31</sup> Liefkes, 30

<sup>32</sup> Liefkes, *Glass*, 33

<sup>33</sup> Tait, *Glass*, 135

<sup>34</sup> Liefkes, *Glass*, 33

<sup>35</sup> Tait, *Glass*, 136

these are not just coincidences, but some kind of elective affinity, at the least, is involved. But what may have made the European development from about 1200 onwards so much more powerful, in the end, is that the thinking tools of glass - particularly lenses and prisms, spectacles, mirrors, were emphasized in a way that, at present at least does not seem to be the case in Islamic glass-making. There the use of mirrors was essential, and perhaps prisms. But lenses (and spectacles), and flat planes of glass (as used in Renaissance painting), and very fine mirrors as developed in Venice, are absent. Is this the crucial difference?

The story after 1400 is quite briefly told. A little glass was produced in Turkey under the Ottomans, but glass techniques had to be re-introduced from Venice in the later eighteenth century.<sup>36</sup> There is evidence of a little glass made in Turkey from the sixteenth century and Iran from the seventeenth, but 'it appears not have been fine glass'.<sup>37</sup> The decline is shown by the fact that in Iran in the seventeenth century a French traveller described how an impoverished Italian had re-introduced glass yet '...most of the glass is full of flaws ... and is greyish'.<sup>38</sup> There are other small instances of a minor glass manufacture, but in general 'almost no glass can with any degree of certainty be attributed to Middle Eastern manufacture between the fourteenth and the nineteenth century'.<sup>39</sup> Under European influence, there were again attempts to revive glass-making in the nineteenth century, most successfully in Iran.<sup>40</sup>

We may conclude as follows. After the collapse of Rome, and before the rise of western glass from the thirteenth century, glass-making had its home in the Middle East. Just as Islam preserved and expanded the heritage of Greek science, so it preserved and expanded the heritage of early Persian and Roman glass manufacturing. Both were taken to a high level and then passed back into Europe. The two combined in Europe to open men's eyes both literally and philosophically in a way which had almost happened in Islam. It is tempting to speculate what would have happened if the Mongols had not smashed first the glass-making of the north, and then of the south. If, after 1400, Venice had vied with a vigorous Islamic glass-industry which began to make fine mirrors and lenses, our world might now be rather different.

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<sup>36</sup> Sotheby's Encyclopedia, 45

<sup>37</sup> Liefkes, Glass, 33

<sup>38</sup> Liefkes, Glass, 33

<sup>39</sup> Liefkes, Glass, 33; presumably the author means 1400 onwards, ie. the fifteenth century.

<sup>40</sup> Liefkes, Glass, 33