

## GLASS IN CHINA

For most of history China was the technologically most sophisticated of civilizations and so we may wonder what the Chinese made of the extraordinary substance we call glass. From the initial perspective of the West, the career of glass in China over the last three thousand years is puzzling. To anticipate the findings of this chapter, as one author puts it, 'It has always been an extraordinary aspect of glass history that the Chinese, who were supreme in the creative art of the potter, the metalworker, the woodcarver, and the print-maker, have been relatively uninterested in glassmaking... the early history remains entirely conjectural until the reign of K'ang Hsi (1661-1722).'<sup>1</sup> As another writes 'Glass has never been as important in China as in the West. While glass beads and glass-paste inlays were made as early as the fifth century BC, other materials such as ceramics and jade were accorded higher status. Little is known about the history of glass-making before about 1640...'<sup>2</sup> Before investigating the causes of this supposed absence, let us look at the history of glass-making.

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Glass making techniques seem to have reached China by about the sixth century B.C. or a little later. Needham suggested that by the sixth century B.C. glass was quite widely made though other authors place the event a little later.<sup>3</sup> One account states that the 'earliest glass in China seems to have been made in the Warring States Period (481-221 BC), when beads and cast inlays appeared. Many items have been found in the graves of local rulers in north China, in Henan province.'<sup>4</sup> Another author states that 'Glassmaking reached China towards the end of the Zhou period (c.1122-249 BC). "Eye beads" of Western origin have been recovered from tombs of the fourth and third centuries BC.'<sup>5</sup> He continues that 'The art of casting in glass was mastered in the Han period (206 BC - AD 220), when ritual objects such as the **bi** and cicada and objects for personal adornment, including earrings, were moulded in opaque glass in imitation of the jade original. Glass was also used as an inlay for bronze belt hooks and bronze mirrors.'<sup>6</sup>

The next major turning point was the introduction of glass-blowing techniques, about half a millenium after they had been developed in the Middle East. At first blown glass objects were imported. 'When the discovery of glassblowing in the first century BC made mass production possible, Roman glass from Syria began to reach China as early as the third century AD,

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<sup>1</sup> Encyclopedia of Glass, 213

<sup>2</sup> Ed.Liefkes, Glass, 80

<sup>3</sup> Needham, vol.5, 103

<sup>4</sup> Ed.Liefkes, Glass, 80

<sup>5</sup> Tait, Glass, 141

<sup>6</sup> Tait, Glass, 141

Sasanian glass from the late third to fourth century AD and Islamic glass from Persia and Syria up to the fifteenth century. These imports were transported either by sea or overland by the Silk Route...'<sup>7</sup> In about 320 A.D. it is noted that 'In foreign countries [Ko Hung says] people make bowls of glass... by combining five sorts of ash.'<sup>8</sup> According to Chinese legends, we are told, the secrets of glass-making, presumably referring to glass-blowing, were 'brought to the country by travellers from the West' in 435 A.D.<sup>9</sup> The earliest finds of 'native' blowing glass in an archaeological context is in AD 481.<sup>10</sup>

During the following thousand years there was a mixture of some native manufacture and a good deal of importation. We are told that 'China imported Roman glass, glasses were depicted in early Chinese paintings, and small moulded ornaments and votive objects such as Buddha figures were made in the ninth and tenth centuries, but little more is known about Chinese glass-making until the beginning of the Ch'ing period (1644-1912), when the first explicit references to it are found in Chinese literature.<sup>11</sup> Another use for glass in this period was for toys and devices. 'In the Song, glass was added to the stock-in-trade of the artisans who employed themselves in such domains, for we read of a mount of glass with moving figures, and screens of glass behind which movements went on by the use of water-power. By this time also, puppets were involved in the service of horology.'<sup>12</sup> It seems that some native glass-making continued through the medieval period among the people of Yangshen, though it seems to have suffered a serious blow according to a later history when 'ninety percent of the glassmakers of Yanshen died during the droughts in the thirteenth and fourteenth years of the reign of Chongzhen in the Ming Dynasty.'<sup>13</sup>

In the thousand years after the introduction of glass-blowing there seems, in fact, to have been hardly any real development of the glass industry. This is noted by Tait. 'In the decorative arts, the Chinese have excelled in bronze work, ceramics and lacquer and the carving of hardstones, notably jade. They learned to make glass late in comparison with western Asia and Egypt, and the art of blowing glass reached China only some five centuries after its discovery in the Near East.'<sup>14</sup> Thus we are told that 'The vessels produced in China up to the Song period are small and were used as **objects d'art** or as reliquary bottles for burial in Buddhist pagodas. Locally produced lead glass, however, was found to be brittle and it seems that for domestic vessels the Chinese still preferred foreign imports.'<sup>15</sup> In the period of what many consider the greatest flourishing of Chinese ceramics, glass practically disappeared. 'Little is known about glass

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<sup>7</sup> Tait, Glass, 141

<sup>8</sup> Needham, vol.5, 2, 64

<sup>9</sup> Klein & XXX

<sup>10</sup> Tait

<sup>11</sup> Klein and Lloyd, Glass, 65

<sup>12</sup> Ronan, Shorter Science, 4,104; comes from Needham, iv:2, 164.

<sup>13</sup> ?Xerox, 140

<sup>14</sup> Tait, Glass, 141

<sup>15</sup> Tait, Glass, 142

production in China under the Yuan (1280-1368) and the Ming dynasties (1368-1644). The few attributions of known pieces to this period have been much questioned. Perhaps, as in the earlier periods, foreign competition discouraged the development of a native industry... It was not until the Qing dynasty (1644-1912) that the glass industry was revived...'<sup>16</sup>

We do not know how the native glass was made since early accounts are ambiguous. 'As described by Wang Chong, an Eastern Han Dynasty (25-220 AD) philosopher, in his masterpiece **Lun heng (Discourses Weighed in the Balance)**, "The Taoist monks used to make five-coloured artificial jade as shiny as real jade by fusing five-coloured stones...Suihou made beads out of several 'medicines' which were shiny and appealing." When explaining the glassmaking done by the **ibin** craftsmen, the Tang writer Yan Shigu said in his book entitled **Qian Hanshu (Chronicle of the Eastern Han Dynasty)**: "The most popular way for making glass was fusing stones and then treating the molten substance with chemicals."<sup>17</sup> What these stones and medicines were, we do not know, but they probably, the editor thinks, 'included soda-lime compositions.'

Needham summarizes his findings as follows. 'Thus the general impression which is given by the evidence both archaeological and literary is that almost from the middle of the -1st millenium onwards an indigenous Chinese glass industry, the roots of which lay doubtless in ancient Mesopotamia, ran parallel with a considerable trade in imported glass wares of particular kinds and some special raw materials.' Needham, however, admits that as far as Chinese glass manufacture is concerned, the 'art seems sometimes to have been recondite in character, and often distinctly localised, so that here and there it had to be revived from time to time.' (p.111) He notes the influence of the west when telescopes were introduced in the early seventeenth century.<sup>18</sup>

We can summarize the story of glass in China to the middle of the seventeenth century as follows. The idea and probably the making of glass had spread to China from its original source in the Middle East by about the sixth century BC. Glass-blowing techniques had reached China by at least the fifth century AD. Yet little evidence of Chinese glass-making can be found, in either objects or literature, before the seventeenth century. Whatever glass-making activity there was in the early period seems to have faded away so that in the period between 800-1500, when the massive growth in glass production was occurring in Islam and Europe, glass-making was at a low level in China.

### **Veroterie: beads, toys, counters and jewellery.**

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<sup>16</sup> Tait, Glass, 142

<sup>17</sup> ?Xerox, p.137

<sup>18</sup> Needham, 'Optick Artists', 205ff

Glass had been known in China from at least the sixth century BC. It was quite widely used in the early period for beads and imitation jewellery, and even for toys and gadgets, as we have seen. Yet it never developed much further. Why was this? One way of explaining this is to look at its functions and the attitude towards it. Basically it was seen very largely as an inferior substitute for precious and scarce substances, not as a wonderful material in its own right.

When speculating on the curious history of glass in China, one author writes that 'The reasons for this rarity are complicated, but one of the central factors is the traditional Chinese attitude toward glass as a material.' It is suggested that the Chinese 'felt that its principal quality was the ease with which it could be made to mimic other substances. Opaque pale blue glass, for example, made a good copy of the mineral turquoise, was easier to work into small items of personal adornment than the stone and was considerably less costly. By contrast, the Western and Near Eastern traditions of glass-making have sought, through a vast range of techniques, to emphasize the interplay of glass with light and sometimes to produce objects of great delicacy and beauty. The effect of this rather limited Chinese attitude was that in the pre-Qin period glass was viewed not so much as something precious but as a rather low-status material.'<sup>19</sup> Or, as another describes this fundamental difference. 'In China glass seems never to have elicited the same response as in the Roman Empire, the Islamic world and Europe. This lack of aesthetic appreciation resulted in a very particular approach and treatment: the Chinese makers used glass in order to simulate other materials, such as hardstones, or as a vehicle for pictorial presentation. Until the seventeenth century, when glass production was organised on a larger scale, vessels and objects were unpretentious, little attempt being made to exploit decorative techniques.'<sup>20</sup> Although we are forced to use the word 'glass' for comparative purposes, the substance did not carry the whole load of meanings which we attribute to it. It was just one rather inferior material, less interesting than clay, bamboo, paper and many others.

### **Verrerie: glass vessels, vases, other useful ware.**

The second potential use of glass is for containers and vessels of various kinds. Mark Elvin asks, 'As regards constituting containers, what, if anything, can glass do that high-glaze porcelain cannot equal or surpass?' He notes that perhaps it cannot contain certain very corrosive acids, it may not be as easy to measure things in a porcelain container since one cannot put measures on the outside etc., and 'the creation of complex shapes is also probably not so easy in porcelain', yet 'Porcelain, though, is not far off being glass'.<sup>21</sup> The point had been made forcefully some centuries before.

Du Halde in the early eighteenth century made a comparison of porcelain and glass and thereby

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<sup>19</sup> Sotheby's Encyclopedia, 106

<sup>20</sup> Tait, Glass, 141

<sup>21</sup> Personal communication.

gave an important insight into one of the main reasons for the absence of glass in China. 'They are almost as curious in **China**, with respect to Glasses and Crystals that come from **Europe**, as the **Europeans** are with regard to China-ware; and yet this has never induc'd the **Chinese** to cross the Seas in quest of it, because they find their own Ware more useful; for it will bear hot Liquor, and you may hold a Dish of boiling Tea without burning yourself, when you take it after their way, which you could not do even with a Silver Dish of the same Thickness and Figure; besides China-ware has its Lustre as well as Glass, and if it is less transparent it is likewise less brittle.' He then goes on to show that porcelain, like glass, can be cut with a diamond to make patterns, or to sew bits together.<sup>22</sup> Thus Du Halde stated the obvious fact that one is not likely to need glass for hot drinks when one has china ware. A tea-drinking nation is unlikely to develop the same kind of wonderful wine glasses as the heirs to Roman glass.

The role of ordinary pottery, as well as porcelain, is important. China is, along with Japan, one of the great potting nations and pottery has many advantages. It is much cheaper, replaceable, holds hot liquids better, keeps things cool better for storage, sweating on the outside when filled with water and so keeping liquids from heating, as in India.<sup>23</sup> Thus, except in a cold climate or with beautiful sparkling wine, it is generally much more useful. Even the northern Europeans used other things than glass to drink out of, for example pewter. As it was recognized almost a century ago, in China the 'case has been the converse of that of the Romans; the latter had no fine pottery, and therefore employed glass as the material for vessels of an ornamental kind, for table services and the like. The Chinese, on the contrary, having from an early period had excellent porcelain, have been careless about the manufacture of glass.'<sup>24</sup>

### **Vitrail or vitrage: window glass.**

A second point made by Mark Elvin is that 'oiled paper windows were probably cheaper than glass ones. So pane-making technology probably lacked any strong impulse.' This is part of a much wider set of differences which are beginning to become obvious. In relation to Chinese architecture Needham writes that '... no part of the weight of the roof or structural beams was taken in China by the walls - delicate woodwork and lattice', and in a note 'Its interstitial spaces were, and still are, covered with thin paper. Glass was never used until late times. In this, Europe led the way from the +1st century onwards.'<sup>25</sup>

Williams in **The Middle Kingdom**, originally published in the middle of the nineteenth century, notes a number of features of Chinese architecture which could be important in explaining the total absence of glass windows. There are almost no large and lavish buildings

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<sup>22</sup> (p.?? I am not sure where it comes from seems to overlap with next text).The overlapping passage is to be found in Du Halde vol. ?, p. 352 - though wording just a tiny bit different).

<sup>23</sup> This point was made to me by Professor Chris Bayly.

<sup>24</sup> Enc. Brit., 'Glass'

<sup>25</sup> Needham, vol.4.3, 103.

built by either religious or secular rulers. 'The architecture of the Chinese suggests, in its general outline and the peculiar concave roof, a canvas tent as its primary **motive**... From the palace to the hovel, in temples and in private dwellings, this type everywhere stands confessed, and almost nothing like a dome or cupola, a spire or a turret, is anywhere found. Few instances occur of an attempt to develop even this simple model into a grand or imposing building. While the Mogul princes in India reared costly mausolea and palaces to perpetuate their memory and the splendour of their reigns, the monarchs of China, with equal or greater resources at command, seldom indulged in this princely pastime...' He speculates on the possible reasons for this, and quotes Fergusson to the effect that "'the Chinese never had either a dominant priesthood or a hereditary nobility. The absence of the former class is important, because it is to sacred art that architecture has owed its highest inspiration, and sacred art is never so strongly developed as under the influence of a powerful and splendid hierarchy. In the same manner the want of a hereditary nobility is equally unfavourable to domestic architecture of a durable description.'"<sup>26</sup>

Williams then describes the normal housing. 'Dwelling-houses are generally of one story, having neither cellars nor basements, and lighted by lattices opening into a court... The common building materials are bricks, adobie or matting for the walls, stone for the foundation, brick tiling for the roof, and wood only for the inner work; stone and wooden houses are not unknown, but are so rare as to attract attention. The high prices of timber and the very partial use of window-glass have both tended to modify and restrict the construction of dwellings.'<sup>27</sup> Williams continues for a number of pages to give a detailed account of housing styles and makes a number of further comments on the way in which light is let in without the use of glass. In the inner courts of larger houses, for example, 'Even in a bright day the room is dim, and the absence of carpets and fireplaces, and of windows to afford a prospect abroad, renders it cheerless to a foreigner accustomed to his own glazed and loftier houses.'<sup>28</sup> We are told that the 'rear rooms are lighted by skylights when other modes are unavailable, and along the southern sea-coasts the thin laminae of a species of oyster (**Placuna**) cut into small squares supply the place of window-glass. Commerce is gradually bringing this material [i.e. glass] into greater use all over the land, though the fear of thieves still limits it. Corean paper is the chief substitute for glass in the north.'<sup>29</sup> He describes how the 'houses of the poor are dark, dirty, low, and narrow tenements... and the doorway the only opening, on which a swinging mat conceals the interior.'<sup>30</sup>

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<sup>26</sup> Williams, Middle Kingdom, 726-727

<sup>27</sup> Williams, Middle, 727-8.

<sup>28</sup> Williams, Middle, 732

<sup>29</sup> Williams, Middle Kingdom, 732

<sup>30</sup> Williams, Middle, 733

This conforms with Fortune's account at about the same time. 'The Chinese cottages generally are wretched buildings of mud and stone, with damp earthen floors, scarcely fit for cattle to sleep in, and remind one of what Scottish cottages were a few years ago... bad fittings, loose, creaking doors, paper windows, dirty and torn; ducks, geese, fowls, dogs, and pigs in the house and at the doors...'<sup>31</sup> Hommel in the late nineteenth century concludes that it is 'evident that the making of window glass is a late accomplishment brought from abroad. In the interior even to this day glass is not used for windows. Instead paper, silk or sea-shells are used. By far the commonest is the use of paper.' In order to protect the paper it is pasted to 'a kind of lattice-work, dividing the space into various small panes.' Near the sea, the lattice-work is not uncommonly covered with 'translucent sea-shells cut into rectangles'.<sup>32</sup>

All of the above might be termed the uses of glass as tools of living - drinking, storage, decoration of the body, decoration and improvement of the house. What is crucial to our argument is the way in which the absence of the development of glass technology in these spheres, so that China was largely a country with a very rudimentary glass technology until at least the 1670's and the reign of the K'ang Shi Emperor, influenced the development of tools of thought made with glass. Here it becomes complicated and the clear distinction between mirrors and lenses does not quite work.

### **Mirrors, burning glasses and lenses.**

A third point made by Mark Elvin is as follows. 'The Chinese passion for mirrors was, so far as I know, for those made of highly polished bronze, usually with interesting designs on the back. In ancient and medieval times such mirrors were often attributed magical properties. Some could, it was alleged, reflect not the outward body but the inner viscera.... here again there may have been a lack of technical impulse to develop 'silvered' glass mirrors.'<sup>33</sup>

Needham argues that to a certain extent the absence of glass mirrors does not seem to have been inhibiting. He starts by giving an overview of Chinese optics. Experiments were made with plane, concave, and convex mirrors (made of metal one presumes) (pp.83-5) Very early on, bronze mirrors were also used as 'burning mirrors' to ignite tinder using the sun. (p.87) The use of these burning mirrors goes back to at least the sixth century BC - but did not involve glass. These and other mirrors of metal led to literary allusions and various social uses (p.90). Thus 'smooth and plane (or precisely curved) mirrors of bright finish and high reflectivity' were made of various metals and were crucial in optical experiments. (p.91) Ronan summarizes his findings thus: 'In China, concave burning mirrors were put to practical use, and in the Han really large metal mirrors were common but, as in the West, glass mirrors were unknown; they were to be a nineteenth century invention.'(171) Needham then discusses at some length

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<sup>31</sup> Fortune, Wanderings, 79-80

<sup>32</sup> Hommel, China, 305

<sup>33</sup> All these are from an e-mail of 8th Jan 1999.

(pp.94-7) the development of 'magic mirrors', in which characters on the back could be seen reflected in certain lights, and explains how they work.<sup>34</sup>

Needham argues that glass was sometimes used for burning-glasses and writes that 'we may be justified in concluding that in the +1st century, and probably as far back as the -3rd century, biconvex lenses of glass could be artificially made.' (p.113) In about +940 a text mentions the possibility of four kinds of lenses, for making objects larger and smaller and making an object upright and inverted (p.117) Then there is a section on the early development of the 'Camera Obscura' from at least the eleventh century, about the same time as its use in Arabia.(p.197) Finally, Needham considers the 'shadow-play and zoetrope', use of light to throw images (pp.122-5) There is no use of glass here. Nor, as we shall see in chapter XXX were spectacles of glass developed in China.

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In China, glass technologies, the making of coloured and plain glass, probably glass blowing, the use of lead and barium, the grinding of lenses and understanding of lenses were all known before 800 AD. Yet there was little interest in glass from then on until the brief burst of enthusiasm under the impetus of the Jesuits between about 1670 and 1760, which again faded away for a century or so. Thus over much of the period between about 800 and 1650, the precise period of the rush of glass technology first in Islam and then in western Europe, coinciding as it did with the flowering of Arabic optics, astronomy and mathematics between about 800 and 1400, and European optics, astronomy, mathematics and the whole of what we call the Renaissance (perspective etc.), glass was more or less absent in China.

The reasons for this fading away seem quite clear. There was little use for windows and hence for flat glass; little use for drinking glasses; metal mirrors were quite satisfactory for most purposes. So glass faded out. The greatest civilization on earth did not follow what we consider to be the obvious (western) route towards the widespread use of glass. When the two ends of Eurasia clashed from the sixteenth century, one of the great differences lay in the virtual absence of glass in China and its ubiquity in western Europe.

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<sup>34</sup> See also Temple, Genius, pp. XXX