

## Bristol glassmakers: Their role in an emergent industry

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### Technological Change

When James I, in 1615, issued his proclamation forbidding the use of wood as fuel for melting glass<sup>1</sup> he was confirming a trend, since already two entrepreneurs had been granted monopoly patents for the development of furnaces fired by pitcoal or seacoal<sup>2</sup>. Environmental considerations apart, the competing demand for wood for shipbuilding, housing, industrial equipment and fuel was causing the price to rise, and an alternative form of energy was necessary if glassmaking was to remain competitive. One commentator wrote of the consumption of oak and beech in the south east by the iron masters and the glassmakers '... fewe yeares more, as pestilent as the former, will leave fewe good trees standing ...'<sup>3</sup>. Nef comments<sup>4</sup> '... had there been no other way of meeting the problem of deforestation, the burst of industrial enterprise which accompanied the later years of Elizabeth's reign, must have died in its infancy ...'

The technological change from wood to coal burning furnaces, remarkable in its conception, posed a number of questions, not all of which at the time of the proclamation had been fully resolved. Their introduction was still at an early stage, even though the further licence granted to Zouch in 1614<sup>5</sup> referred to the fact that £5,000 had been spent on development, and that by then several furnaces were in use. Glassmakers were used to burning wood, and with few exceptions their environment was predominantly that of the forest. It was difficult to force them to disrupt centuries of practice by using an alien fuel.

The solution was the creation of another monopoly. Zouch's company had been reformed just prior to the proclamation. One of the partners was Sir Robert Mansell '... a Welshman with the manners of an admiral and the brain of a financier ...'<sup>6</sup>. By 1623 the monopoly was vested in him alone<sup>7</sup> and remained so until the Commonwealth. The earlier patent had been assisted by a prohibition of all imports of glass, but this was lifted when Mansell received the renewed patents-

... that the making of glasse with seacoale and pitcoale be continued, and that all makeing of glasse with wood for ever hereafter shall cease, and the priviledge for sole makeing thereof with seacoale and pittcoale shalbe renewed to the said Sir Robert Mansell ... but yet without any restraints of the importacon of forraigne glasse ...

The embargo on wood firing caused a major geographical shift in glassmaking. Whereas the industry had been predominantly forest based it now began to move to those areas where coal was readily available. It is claimed that the first coal fired furnace was installed by Mansell at Newnham on Severn<sup>8</sup>, although a similar claim was made by Lord Dudley when he opposed the renewal of the Zouch patent, asserting that on his estate a glass furnace had been fired by coal two years before the Zouch patent had been granted<sup>9</sup>.

### The Advantages of Bristol

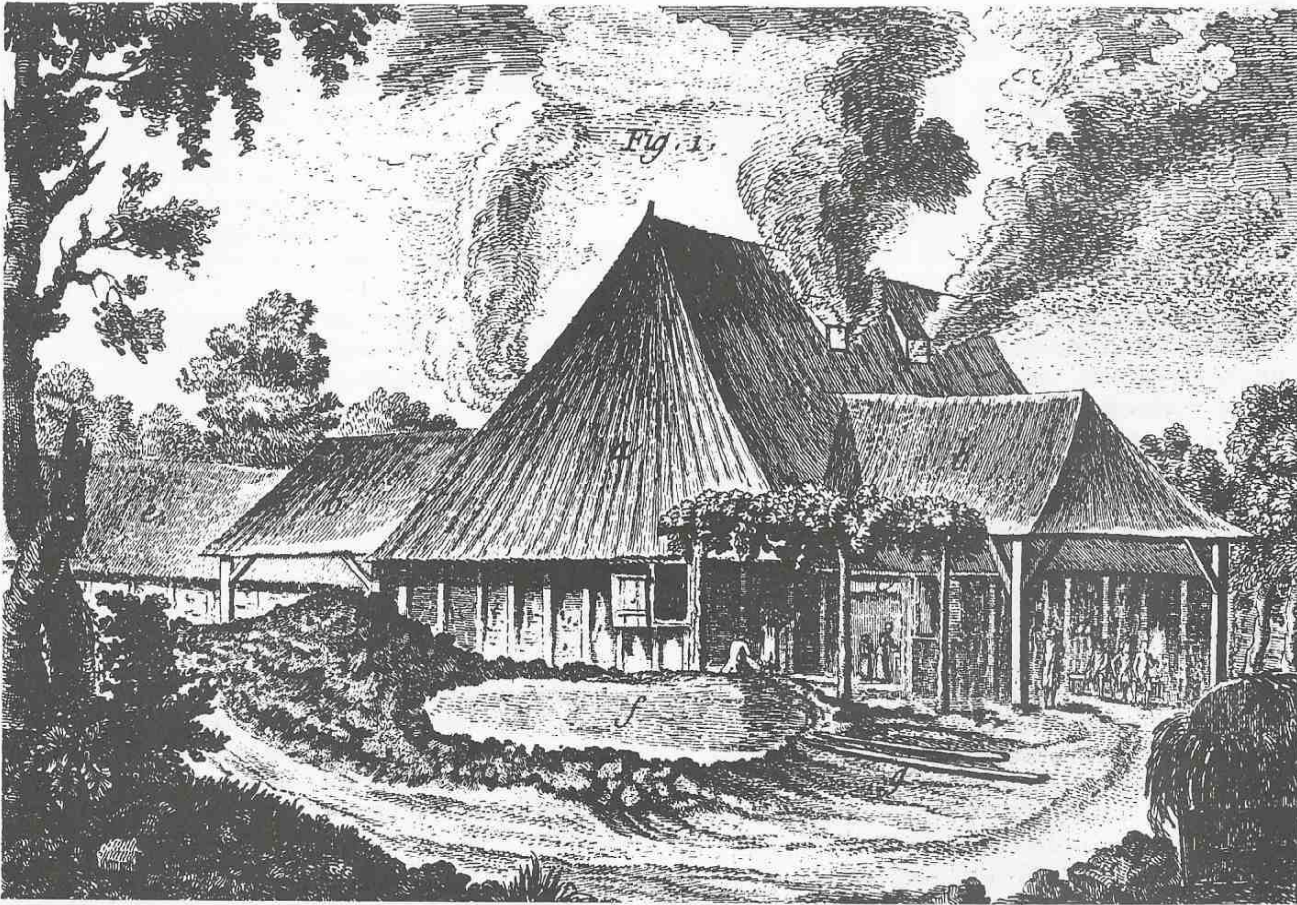
Bristol offered considerable advantages to the glassmakers. By the 17th century it was a flourishing port with a well-established Society of Merchant Venturers, the raw materials for glassmaking were readily available<sup>10</sup> and coal was extensively mined in the area:

In the mining district that extends from Brislington parish, on the outskirts of Bristol, northwards along the eastern side of the Cotswolds, colliery enterprises existed mainly for the purpose of supplying Bristol with fuel ... After 1600 the outcrops all the way from Brislington to Westerleigh were ruthlessly exploited. New pits, too numerous to count, were dug, before the old ones had been filled up ... So intensively was mining enterprise carried on during the first half of the seventeenth century, that commissioners who surveyed Kingswood Chase in 1652 were pessimistic as to the future of the mining industry there. But their fears were groundless. There is abundant evidence of a revival in mining activity after 1660; and in 1675 another group of commissioners found 156 'cole pitts that are wrought and left open' ... There must have been hundreds of others.<sup>11</sup>

What is not known is when and where the first glassmakers started to work at Bristol. Dud Dudley writes of an attempt, during the Commonwealth, to make iron 'with Pit-cole and Sea-cole' in the Forest of Dean and, when it failed because the pots broke, the calling in of 'an Ingenious Glass Maker, Master Edward Dagney an Italian then living in Bristow, who after he had made many Potts, for that purpose went ... into the Forest of Dean, and built ... a new Furnace, and made therein many and sundry Experiments and Tryalls ' for the making of Iron with Pit-cole and Sea-cole, etc. But he failing, and all his Potts being all broken, he did return to Bristow frustrate of his Expectation; but further promising to come again, and make more Experiments ... ! Whether he did is not recorded, but Dud Dudley goes on to refer to the fact that John Williams, the 'Master' of Dagney's glasshouse, became a partner in the iron smelting business for the sum of £300.<sup>12</sup>

Mansell, faced with the need to implement his monopoly, had imported glassmakers instead of products, and Thorpe<sup>13</sup>, suggests that the Dagnia family were brought from Altare, an Italian glassmaking centre close to Genoa. They did not remain at Bristol, however, moving first to Stourbridge before settling at Newcastle<sup>14</sup>. The change from wood to coal fired furnaces brought changes in technique, both to glassmakers and subsequently to the smelters of metals such as iron, lead, copper and zinc, particularly in the Bristol area. The recognition that their industry had similar problems was presumably why the iron smelters ' called on Edward Dagnia for advice.

The 17th century was crucial to the glass industry, as it was to many other English industries. Mansell's monopoly,



*Exterior of an 18th century glasshouse before the introduction of the brick cone. D Diderot and J d'Alembert, Encyclopedie, 1772*

which continued until 1642, established the base from which the glass industry in the second half of the century was able to expand. Helped by the commercial policies of successive governments, in particular by the Navigation Acts which gave English merchants a monopoly in English sea-going colonial trade, and the 1654 treaty with Portugal, which transferred Portuguese trade from Dutch to English merchants, the port of Bristol experienced a rapid expansion in trade, estimated as having increased tenfold between 1614 and 1687.<sup>15</sup> By 1696 there were 90 glasshouses at work in England, of which nine were in and about Bristol.<sup>16</sup>

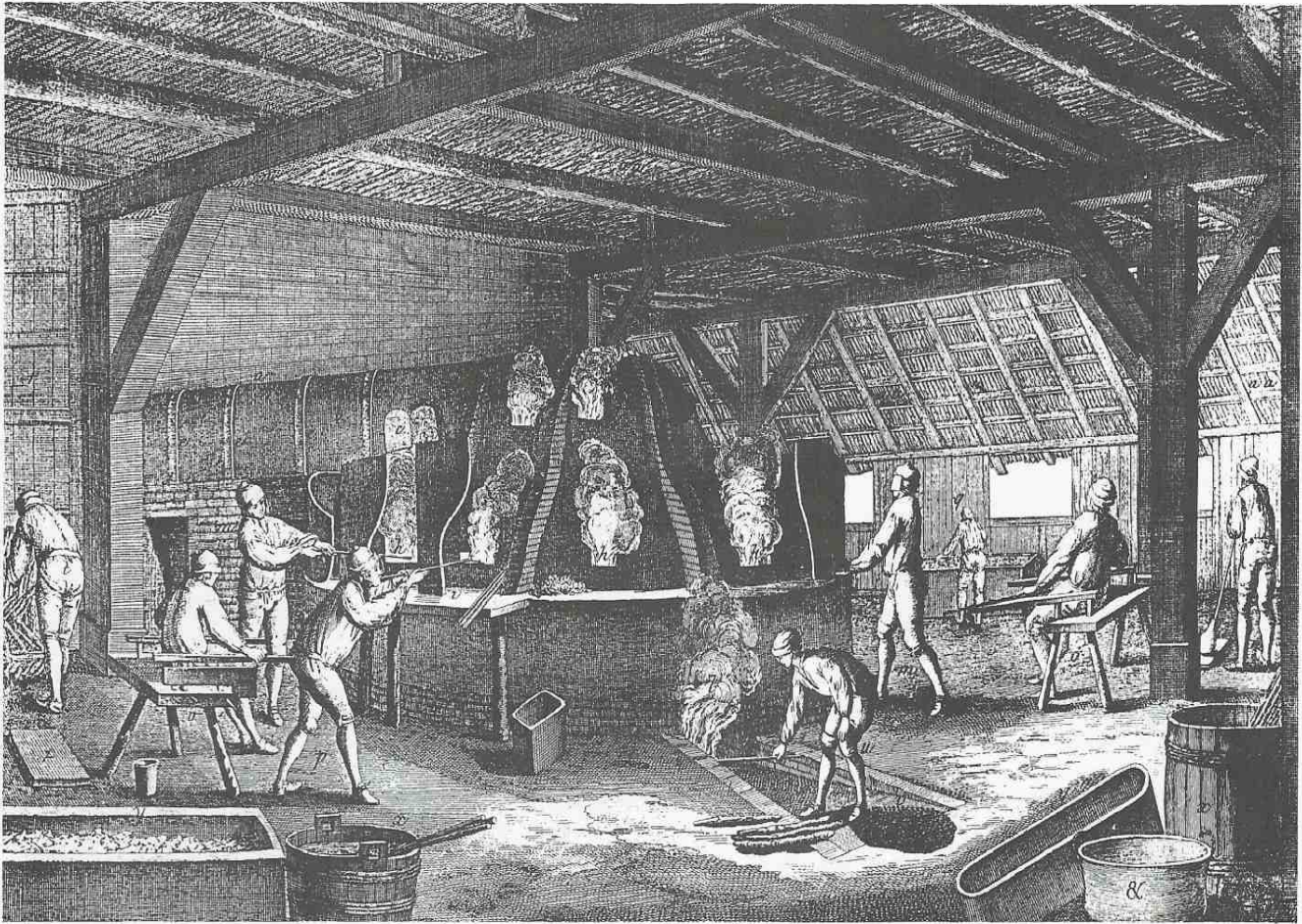
### A Setback

Toward the end of the century expansion was to suffer a setback. With the accession of William of Orange the Netherlands and the English formed an alliance against France, and the subsequent war was an expensive business. The cost fell mainly upon industry, and in 1695 glassmakers found themselves saddled with a range of taxes covering all types of glassware. Quart bottles were charged with a duty of 12d (5p) a dozen and pint bottles with 6d (2.5p). Flint glass, which covered glassware for domestic purposes and small bottles for medicines, was charged at 20% ad valorem, and window glass at 10%. Coal delivered by water was taxed at 5s (25p) per chaldron. Exports were free of duty; imports bore the same rates as home sales.<sup>17</sup>

The glassmakers were incensed, particularly with the tax

on coal, which enabled those who had their coal delivered overland to undercut those who had deliveries by water. Sitting, as it were, on their fuel supplies Bristol glassmakers were in an advantageous position, and they do not figure among the early petitioners. The removal of the coal tax a year later eliminated an area of inequity. The glass tax hit bottle makers the hardest, which was not surprising since the duty they paid represented a 60% increase in price and costwise wooden casks became an attractive alternative form of packaging. Furthermore, buyers were not prepared to pay more than 24s (£1.20) a dozen for quart bottles, which meant that the real selling price fell from 20s (£1.00) a dozen to 12s (60p); The situation in the west country was worsened by a glut in cider production which caused a Mr Baldwyn, on behalf of glassmakers in Gloucester and Newnham, to comment, '... People choose to lose the Sale of their Cyder, or sell it in Cask for little, rather than run the Hazard of putting it into Bottles at so dear a Price . . .' Fifteen months later he confirmed that his cider customers '... do now put the same into Cask, instead of Bottles . . .'

It was on the 31 December 1696 that Bristol glassmakers reported that '... Manufacture thereof is much lessened; so that fires in most Glasshouses hereabouts have been put out for want of Employ, whereby many of the Petitioners are reduced to great Poverty . . .'. A year later, John Cole who had built a glasshouse at Crews Hole some six months prior to the tax reported '... That the great Duties upon Glass has been and is a full stop to that beneficial Manufacture; which has produced but small Advantage to the



*Interior of an 18th century glasshouse with a wood-burning furnace. D Diderot and J d'Alembert, Encyclopedie, 1772*

Crown, but hath occasioned the Improverishment of many of the Petitioners, and brought them to live on the Charity of their respective Parishes. . .'. At the same time other glassmakers from Bristol, led by William Clark, were more muted in their complaint. 'That the high Duties on Glass-wares have not only reduced the Consumption of Glass so as to render the Petitioners incapable to carry on their Trade, but it will also endanger the Loss of that Manufacture to England . . .'

Five months later a glassblower, Henry Dixon, gave a more factual account when he reported that out of the six bottle houses in Bristol only three were working, and they were on short time. What they made was for export, and therefore of no advantage to the Crown. Two of the four white houses (in this context, the flint glasshouses) only were working, and they also were on short time. James Jones, another glassblower, was more poignant. ' . . . this Tax hath ruined both him and his Family; for, before the Duty he could earn constant Wages of 30s (£1.50) a Week; and now if he can get a Day's Work, he can earn but 6d (2.5p); and, for want of that Employment, he begged his way up to Town, leaving his Wife and Four small Children behind him, to seek Redress . . .' Certainly the revenue from the tax was far below what had been expected and after a short period with duties at half the rate the tax was annulled on 1 August 1699.<sup>18</sup>

It is possible, as Henry Dixon implied, that Bristol glassmakers, because of a thriving export trade, were spared the worst effects of the tax which seems to have ended glass-

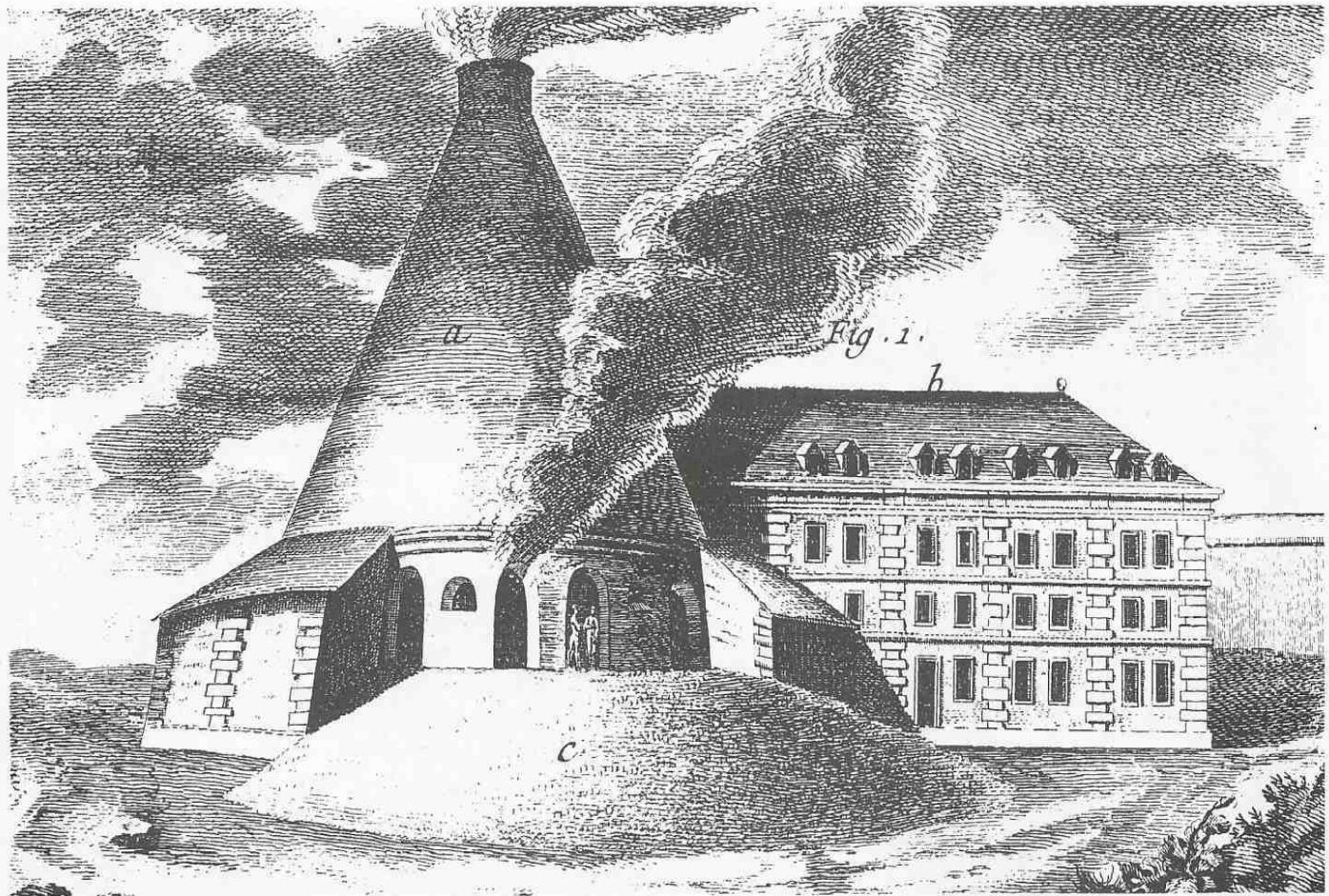
making at Newnham and left only one glasshouse working at Gloucester.

The petitioner John Cole does not appear to have survived. He was a glassmaker who, in 1694, with John Baker, Nicholas Wornall, a yeoman; Daniel Ballard, a gentleman; William Lansdowne, and a cooper from Bristol named Jonathan Horneblow, took, from a John Langley of Hales:

' . . All those Two Acres of Woodland lying and being in Abbots Hill neare a place there called Strawberry lane with in the Tytheing of Blacksworth in the Parish of St Phillip and Jacob in the said County of Gloucester Bounded on the South and west sides with the River of Avon and a little mead called the Ham, on the north parte with the other parte of Abbott's Hill aforesaid and on the East side with a Grove or Coppice then of one John Templeman which said premises . . . are parcell of the said Manor of Blacksworth in the County of Gloucester . . . for Fourscore and Nineteen Years. . .

The indenture adds that they ' . . Did att their or some or one of their owne proper Costs and Charges Erect and Build in and upon the same premises one Glasshouse and other Messuages, Tenements or other Structures and Buildings . . .'<sup>19</sup>

In 1709 the lease was renegotiated between Nathaniel Day, a Bristol Alderman, who had taken over the Manor of Blacksworth from John Langley, and John Baker and William Lansdowne, the remaining partners, both now listed as Bristol merchants. The lease refers to ' . . the Glasshouse and all the other houses structures and



Exterior of an 18th century English cone type glasshouse. D Diderot and J d'Alembert, *Encyclopedie*, 1772

buildings now standing . . . Part of one of which said Houses is now or late was in the possession of Nehemiah Orford who useth the same as a Smith shopp one other of them is now or late was in the holding of John Cole and another is in the possession of John Platt and also all those Gardens, Orchards, Outlets, Courts, Backsides, Warehouses, Storehouses and other Buildings to the said Glasshouse belonging and now used and enjoyed by the said John Baker and William Lansdowne their Tennants or assigned . . .'. The lease refers to 'the Liberty of Coleing in and upon the said premises', which points to one reason for building the glasshouse on this site, another being easy access to the port of Bristol by means of the Avon.<sup>20</sup>

In 1727, 1731 and the following year there are further leases between John Baker alone, and John Baker and William Lansdowne, and Sir Abraham Elton, who now owned the Manor of Blacksworth.<sup>21</sup> There is no mention of the glasshouse, although the property is referred as being 'near unto a place called Screwshole'. By the close of the century the Manor became the property of the Bristol merchant Thomas Jones and he, in 1794, drew up an indenture with his brother James which includes the reference, '. . . which said premises were late and for many years in the possession and occupation of William King glassmaker . . .'<sup>22</sup> William King had run the glasshouse, then known as Crews Hole, for a number of years before he died in 1777, and it was later run by James Jones who, until he died in 1795, had interests in other Bristol glasshouses.<sup>22</sup>

It looks very much as though the initial Crews Hole glasshouse was replaced, either on the same or an adjoining site. But the reason for suggesting that there may have been two separate glasshouses at Crews Hole needs a further examination of the change from wood to coal firing.

#### Advances in Technology

The change to coal fired furnaces was accomplished in a short space of time, due to the vigour with which Mansell enforced his monopoly. Once they had acquired the technique of locating the fire on a grating above the flue so that the draught could assist combustion and thus generate higher temperatures, the glassmakers were in possession of a far more efficient means of making glass.

The question was, however, how best to provide the draught, and such records as exist are not explicit on this point. What happened eventually, almost a century after the change in fuel, was the development of the brick-built cone. It was, in effect, the construction of a glass melting furnace within a chimney. The combination of controlling both the entry of air through the flues and its exit via the chimney increased the efficiency of the furnace, and gave English glassmakers a considerable advantage over their competitors.

On the Millerd map of Bristol c1710, the sites of six glasshouses are shown all of which, with the exception of one on Redcliff Backs, have brick cones. The map does not include

the Crews Hole site and in view of the date it was built, 1694, it is likely to have been a wooden structure.<sup>23</sup> It is unlikely that the brick cones were erected in the city much before the 18th century since Seyer<sup>24</sup> from Rob Ricart & alii quotes, 'This year 1698 (or perhaps 1699) a pile of brick building was erected on the Broad-kay, the first brick building in this city'.

But the increased temperatures achieved by the improved method of combustion brought in its train a number of problems which the glassmakers had to solve empirically. One was the effect of higher temperatures on the refractory clay pots in which the glass was melted. Here the Bristol glassmakers were at an advantage since they were able to ship clay down the Severn from Stourbridge, a source that had not only encouraged glassmakers to settle there, but also provided supplies for many other glassmaking areas, for which Bristol appears to have acted as an entrepot.<sup>25</sup> Despite the technical advances the furnaces were still direct fired in that the flames played on the pots. Since these were generally bucket shaped the fumes and impurities from combustion could contaminate the glass. This led to the development of covered pots, where the glass was gathered from the side and not from the open top, for the manufacture of glasses sensitive to the waste glass and particles. This was particularly so in the manufacture of flint glass where transparency and clarity were the aims, and it became a matter of major importance when lead crystal glass was introduced.<sup>26</sup>

An early objection to the use of coal as fuel was the obnoxious nature of its fumes and the advantage of the cone was that its updraught kept the working area clear by discharging these to the outside. The effect upon the general public was not a matter that the glassmakers seem to have considered, although they were frequently under attack for creating a nuisance. One visitor to Bristol spoke thus:

The public nuisance of their glass-houses is likewise another instance of their intolerable obstinacy: the city, from the continual smoke arising from them, being constantly darkened and in dirt, while the inhabitants are almost suffocated with noxious effluvia.<sup>27</sup>

The second half of the 17th century saw two events which, taken with the change to coal fired furnaces, were to give England a technological advantage over the rest of the glass-making world. In 1662, Christopher Merrett, a founder member of the newly-incorporated Royal Society, published *The Art of Glass*, based on a work of the same name by an Italian monk and scientist, Antonio Neri. Turner<sup>28</sup> points out that the original work was in itself 'the first systematic account of the preparation and treatment of the glassmaking raw materials together with directions for the melting of a wide variety of glasses', and that with his own commentary Merrett 'added valuable observations of his own and threw light on the construction of glassmaking furnaces and tools used in England'.

It is generally agreed that the publication of this work influenced George Ravenscroft who, in 1674, was commissioned by the Worshipful Company of Glass Sellers to

produce a glass that could match the quality of the Venetian glasses they then imported. George Ravenscroft was not the first English glassmaker to attempt to match the clarity of the Venetian *cristallo*, but he succeeded by introducing lead oxide to the glass. The new formula produced a glass of great clarity, with a longer working range when gathered from the furnace and physical characteristics that favoured cutting and engraving. It also hit the market during the Restoration, when new ideas were welcomed and the economy was buoyant. Within a short space of time its manufacture had spread to most centres. Thorpe<sup>29</sup> suggests that Bristol started to make lead glass c1691, but advances no evidence to support this view. He may well be right since Houghton listed three flint glass houses in 1696. However, of the two glassmakers Thorpe names John Perrott was a manufacturer of window glass and probably bottles, but not flint glass. He adds that the country glass-makers were:

. . . under great disadvantages. They were outside the closed ring of the London industry and were not obliged to pass an essay of metal or observe an exacting standard of design. In the founding and working of lead crystal they had to start from scratch. In 1685 they tried to rush the London market with a cheap lead crystal of inferior quality and were promptly squashed by the Company. Thereafter they fell back on the trade of their own areas and it was half a century before their work - at Bristol and Newcastle - was good enough to compete with London . . .

### Confidence in the Trade

By 1720 there were at least twelve glasshouses in Bristol and the following notice reflects the importance of Bristol as a glassmaking centre:

Whereas several eminent merchants and tradesmen in the City of London and Bristol have mutually engaged to enter into a copartnership for making of glass bottles and glass<sup>30</sup>

Apart from the trade with the Americas and the West Indies, where the Colonists needed glass of all types as well as bottles filled with various drinks, there was a growing demand close at hand. By 1727 the Avon was navigable to Bath, which was rapidly becoming a fashionable watering place for high society, thus creating a demand for window glass for new buildings, bottles for medicinal and other liquids and glasses from which those liquids could be drunk. Furthermore, in 1703, the Methuen treaty carried the alliance with Portugal a step further by creating in effect a monopoly of trade for British merchants. The bottle makers in particular benefited from the stimulation of trade with a country famous for its wines. All this, together with the proposal to extend the canal route to London, made an exciting prospect for the Bristol merchants.

Since the Millerd map shows that glasshouse cones were in existence in Bristol early in the 18th century it can be assumed that the additional glasshouses were built in this way. Powell<sup>31</sup> describes the Avon Street cone, built in 1720 and earlier known as the Hoopers glasshouse, in this way:

Upon a large circular foundation of perhaps six feet in thickness below ground, arches were built, and from about

fifteen feet above floor level the whole structure was only nine inches thick. The diameter inside was about fifty feet on the ground, and the height about 90 feet. From the foundations upwards the building was made to lean towards the centre.

It was more than two hundred years before this cone was pulled down, but others built at about the same time did not always fare so well. Sir Abraham Elton's glasshouse, shown on the Millerd map on the east side of the Avon on the lane called Coldharbour, fell down in 1736, as had another of unspecified ownership some eleven years earlier, with regrettably the loss of several lives.<sup>32</sup> Those who developed the cone could hardly have imposed on bricklayers a more difficult design on which to exercise their newly-acquired skills.

The signs were that the glassmakers, with their improved control over combustion, better refractory materials and covered pots, were gradually getting to terms with the new source of energy. During the 17th century the royal prerogative in granting monopolies had come to an end, and the basis of contemporary patent law had been set down. Mansell's patent, admittedly an exception to the provisions of the statute, was the first to deal specifically with furnaces, and it was followed by several others during the course of the century.

### Innovation in Bristol

It was in 1720 that a Bristol glassmaker, Benjamin Perrott, was granted a patent<sup>33</sup> in which it was cited that:

. . . he hath been bred up and followed the trade and mystery of a glassmaker for the space of fifty yeares last past, that the usual way and method of making and melting the mettle for all manner of glass and glass wares hath from the practice thereof to this day been in clay potts, which potts frequently breaking by many accidents, and the mettle therein running out to wast is the only reason the price of glass wares is so high, and that he hath with much difficulty expence, and trouble invented '**A Furnace for makeing, melting and preparing the said mettle for the making all sorts of glass wares**', whereby the inconveniency so as aforesaid happening to the said potts will be effectively prevented, and our subjects, by means of his contrivance and invencon, will be sufficiently supplied with all manner of glass wares much cheaper . . .

What the invention comprised is a matter for speculation since the early patents were not accompanied by drawings, but the description emphasises the problem that glassmakers rated highest on their list.

The Perrotts were glassmakers who had moved from Belbroughton in Worcestershire to Bristol late in the 17th century. Court<sup>34</sup> suggests that Benjamin Perrott, together with his son of the same name, were party to one of the earliest restrictive agreements when, in conjunction with a group of Stourbridge glass manufacturers, they undertook to limit the manufacture of broad glass. The terms of the agreement were that the Perrotts on their side undertook not to manufacture broad glass for a period of eleven years, outside of London, whilst the Stourbridge manufacturers agreed to deliver to the Perrotts one hundred and sixty cases of good merchantable broad glass annually. The

cases were to be delivered to Wribbenthal or Bewdley on the Severn on specified dates. If the price of glass should encourage other glassmakers to enter the trade and continue manufacturing for more than a year within forty miles of Bristol or Stourbridge, the agreement would terminate. In the event of termination, or if the deliveries of glass should lapse, the Stourbridge manufacturers would supply sufficient workmen to restart broad glass manufacture for the Perrotts. The wages per week are set down: master workman, 30s (£1.50); blower, 15s (75p); gatherer, 10s (50p).

At this time there were two competing ways of making window glass. The broad glass method was to gather glass on a blowing iron and then, by alternately blowing and swinging the gather pendulum fashion, elongating it into a cylindrical shape. This, after the waste glass at the ends had been removed, was laid on a flat surface cut lengthwise and flattened. Crown glass was made by blowing the gather of glass into a large sphere, transferring this from the blowing iron to a solid iron known as a pontil at a point diametrically opposite the blowing iron, which was then cracked off. By rotating the pontil at high speed the centrifugal force spread the glass into a disc. This was then cracked off the pontil. The finished glass in each process was known as a table, and these were packed into cases and sold to glaziers who cut them into the sizes they needed. Crown glass, because it had not been in contact with a surface during the flattening process had fewer blemishes and was therefore a better product, but because it was circular with a distorted centre where it had been attached to the pontil, rather than rectangular, it had to be cut into smaller sizes. Crown glass, because of its superior quality fetched a higher price and the information given by Neve<sup>35</sup>, writing some twenty years later, suggests that the differential was then three to four times.

The agreement confirms the regional character of the glass trade. Newcastle sold its window glass to London, sending it by coastal shipping with the coal, whereas Stourbridge shipped theirs down the Severn to Bristol. Neve writes, 'This sort of glass which is made in Staffordshire I could never yet learn any certain Account of: for 'tis a sort of Glass but seldom used in these parts of the Kingdom'. And on Bristol glass he adds, '. . . by reason they have not the Conveniency to send it by Sea, (as they have from Newcastle by Coal-Ships), it is very rare to have any of it in London tho' it be as cheap, and better than Newcastle Glass'. From Houghton's survey there were 5 crown glass manufacturers and 18 window glass manufacturers in England in 1696, and we can assume the latter made broad glass, although this is not specifically stated. All the crown glassmakers were in the London area, but six of the window glassmakers worked in Newcastle, seven in Stourbridge, two at Chelwood near Bristol, and one each at Bristol, Liverpool and Shropshire. It was to be almost a century before the Severn-Thames connection opened up the trade to London, and more than that before the Bristol-London link via the Avon was to come into use.

Court suggests that the agreement did not run its eleven years, and there is evidence that in time it failed in its aim of maintaining prices. Nine years after it was signed the following notice appeared:

Whereas the price of Broad Glass or Window Glass in and about Stourbridge . . . for many years past has been 26s (£1.30) the case. Now all Glaziers and others are desired to take notice that from this time the said Broad Glass or Window Glass will be sold by any of the Broadglass makers thereabouts at 22s (£1.10) the case, either broad or cut.

The price had dropped, but the broad glass makers appear to have acted together in the matter. Five years later, another notice, this time on behalf of the glasshouse owned by the Henzeys, who were part to the agreement, announced that the price would be reduced from 18s (90p) a case to 16s (80p).<sup>36</sup> The agreement was due to finish in 1714, and it seems that with falling prices there had been no question of renewal. In any case, by this time Benjamin Perrott was making crown glass and no doubt engrossed in his experiments with furnaces. Perhaps a clue to the problems of broad glassmaking lies in the notices in 1723<sup>37</sup> that Samuel Tizack and Benjamin Batchelor, each of whom were party to the agreement some twenty years earlier, were insolvent debtors.

Benjamin Perrott signed the agreement with his son Benjamin, but he had a second son, Humphrey, who also became a glassmaker. Benjamin junior was a master craftsman by 1699 and began taking apprentices that year. He appears to have worked with his father at the glasshouse in Red Lane, but when he died in the 1750s the glasshouse was taken over by the Taylor family.

### In Father's Footsteps

Humphrey Perrott, twelve years younger than his brother, seems to have taken over where his father left off. Between 1711, when he became a master craftsman, and 1715, when he indentured his first apprentice, he took over or built a glasshouse in Temple Street. In 1734 he filed a patent<sup>38</sup> which closely followed that of his father, indeed his patent may well offer a clue as to what Benjamin Perrott was trying to achieve when he referred to the waste of glass through the frequent breakage of pots.

The patent referred to the fact that Humphrey Perrott had for some years:

. . . been endeavouring to make finer metal than heretofore, as well as to render it cheaper to our subjects, which at length he has accomplished by inventing 'A Furnace to contain double bottom potts, or any others, for the better melting, preparing and preserving all sorts of glass wares, which furnace is contrived in a new manner with artificial draughts to it, whereby to force the heat of fire the sooner to perform its office, as well as a furnace with artificial draughts for the better warming and flashing of crown glass by feeding it with fewell at teasing holes, which will much reduce the expence of coal; and hath also found out a new method for the more effectual preserving all sorts of window glass, when nealing in the kiln. by leaving off drossers and using in their stead mathematical racks, made of iron, clay, or stone, or anything else that will endure the fire, all which will be of general use and benefit to the publick'.

Unfortunately, by the time the patent was granted Humphrey Perrott had been declared bankrupt<sup>39</sup>, and a Captain William Stretton of St Michael's Hill, Bristol, had been assigned to run the estate.<sup>40</sup> Humphrey Perrott seems to

have been in financial difficulties for some years, since in 1726 he and his partner George Whitmore were due to repay a bond of £205 to Stretton, and in 1729 Perrott alone a bond for £80 to Elizabeth Oakes. Humphrey seems to have been responsible for clearing the stock for which, week by week, he had to render an account to Captain Stretton setting out the receipts, expenditure and balance, including the payments to six employees, which varied from 1s 2d (5.8p) to 1s 10d (9.2p) a day.

In the valuation of Humphrey Perrotts estate<sup>41</sup> two glasshouses are referred to, both valued at £700. One is given as:

Sir John Hawkins Barn and Garden with the glasshouse thereon erected and other Buildings being a lease from ye Church of St Mary Redcliff

and the other:

The land whereon ye old Glasshouse stands . . .

The valuation includes an item 'book debts £2,000' which clearly was one reason for his financial instability. He was also carrying stocks of crown glass valued at £660, bottles at £106, and over £300 worth of raw materials for glass-making. His stock of pots and pot making materials, possibly connected in part with his experiments, amounted to more than £400. These items amount to almost half of the total valuation of £7,378.

It is interesting to see that Humphrey Perrott combined the manufacture of crown glass with bottle making. In Houghton's survey three of the broad glass manufacturers combined their work in this way, but none of the crown glass manufacturers. Possibly one reason why Benjamin Perrott was willing to sign the agreement was that he could fall back on bottle making. The glasshouse does not appear to have been put up for sale until 1744<sup>42</sup>, which raises the question as to whether Humphrey Perrott continued in a limited way on the strength of his patent, which was due to expire in 1748. Hughes<sup>43</sup> suggests that before this happened several of his furnaces were operating in Bristol, London, Newcastle and Stourbridge.

From the collection of bills<sup>44</sup> Humphrey Perrott followed the pattern of Bristol crown glass and bottle trade by selling in the west country and the midlands as well as exporting to the Americas. London crown glass seems to have sold at a premium, however, since Neve quotes it as 8d and 9d (3.3p and 3.8p) a foot in 1727 as against Perrotts at 6d (2.5p) a foot in 1730.

In another respect Humphrey Perrott followed his father's example. In 1723 he was party to an agreement to restrict the production of crown glass, together with Richard Warren, proprietor of a glasshouse in St Thomas Street and John Baker who ran a glasshouse at Barton Regis.<sup>45</sup> The terms of the agreement were comprehensive. After complaining that the 'Trade Art or profession of making Crown glass hath been and is subject and liable to many disadvantages and inconveniencys' it is stated that the agreement aims at removing and preventing these, 'for the Mutual ease profit and advantages as well of the said partys to these presents'.

fig 1

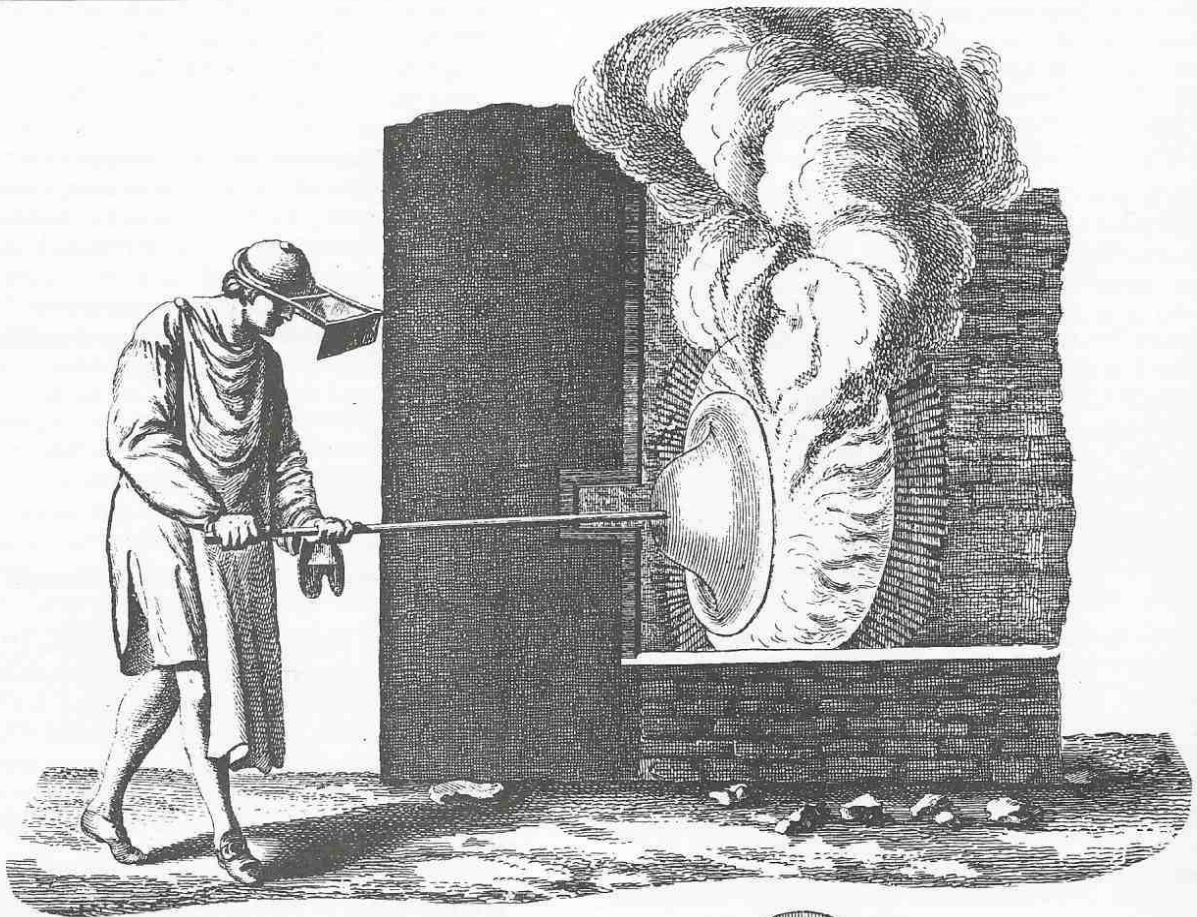
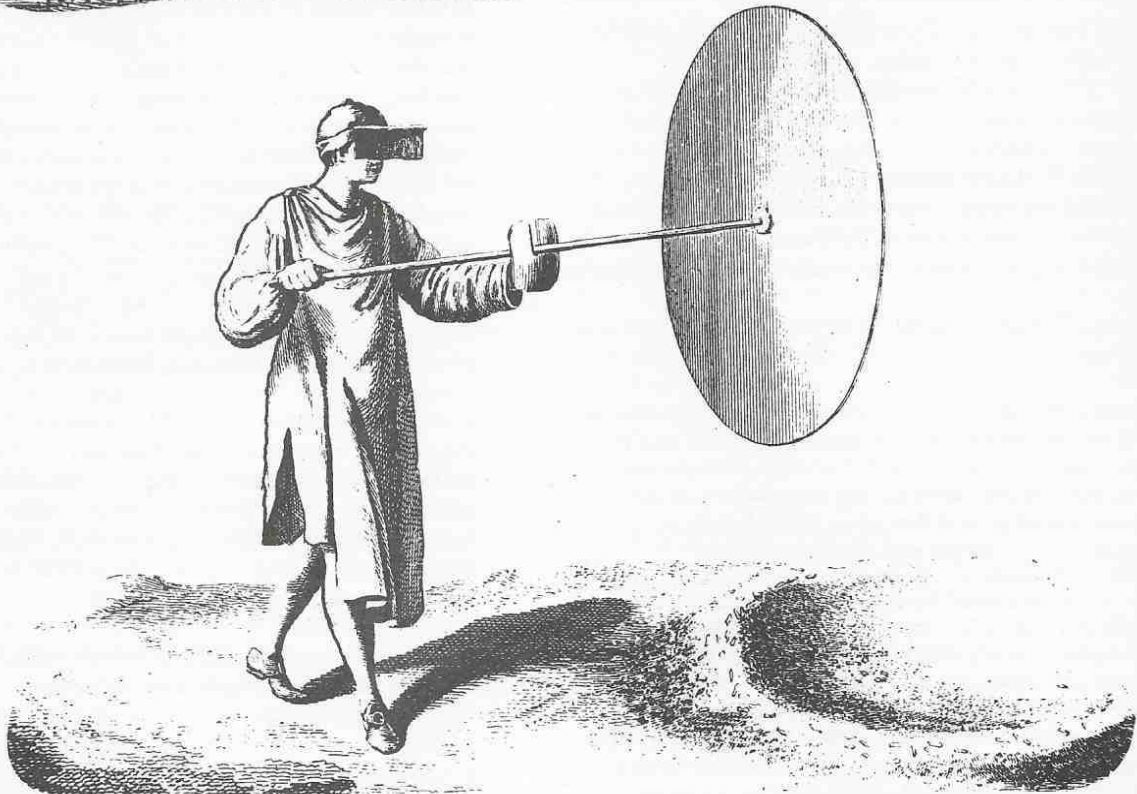


fig 2



*Crown glass manufacturing. The glass is reheated after the sphere has been opened up (fig 1). It is then 'flashed' by rotating at high speed (fig 2). Encyclopédie 1772.*



The nub of the argument was that each party should make crown glass in one glasshouse only and with one furnace containing no more than four pots, for a total period not exceeding twenty four weeks in a year. Any one of them making crown glass for a longer period than this, or with more furnaces or pots than stipulated, was to pay £20 for each additional week to each of the other parties to the agreement. No one party to the agreement should make crown glass within the year until all stocks had been sold by any two of the partners, and reduced to sixty cases of glass 'good merchantable and fitt to be packed' in the third. If the demand on any one glass house should be greater than the stocks that it held the others were to sell to that glasshouse, at a specified discount, an amount not exceeding one third of their combined stocks. There was also a clause restricting the movement of workmen in that they were not to employ anyone from one of the partners glasshouses without the agreement of that partner. Finally no new glasshouse was to be built without pulling down the old one, or converting it to some other use. The agreement was to last for seven years.

The document from which these particulars are taken is unsigned, and it is doubtful whether it was ever implemented. The main impediment to its success was that only two of the Bristol crown glassmakers were party to the agreement, and there were the crown glasshouses belonging to Sir Abraham Elton and Edmund Mountjoy, both in Cheese Lane, and brother Benjamin's glasshouse in Red Lane. The agreement would have had little chance of success without their cooperation. If, as Humphrey Perrott, Richard Warren and John Baker felt, the supply of crown glass had outstripped demand, market forces were soon to correct the imbalance with the bankruptcy of Humphrey Perrott. It is, as Buckley comments<sup>46</sup>, 'melancholy to record the fate of an ingenious but commercially unsuccessful glass-maker' to which can be added, who was sadly reduced to packing glassware on his own premises for 25 (10p) a day.

### The Top End of the Trade

The success of the Bristol glass industry was based on the sales of glass bottles and window glass. Of the thirteen glasshouses at work in the first quarter of the 18th century ten made one or other, or both of these products, whereas three only were flint glasshouses. In the second half of the 18th century the flint glassmakers came into their own, and from their endeavours grew the conception of what today is understood as Bristol glass, even though there are few pieces today that can with authenticity be credited to them.

By now the flint glassmakers of Bristol had established themselves in the manufacture of lead glass, the quality of which was improving through the use of better quality raw materials and improved processes. Opaque glass, 'as white as milk', was not a new glass when it began to achieve popularity in England in the mid 18th century. indeed, opaque glass threads, both white and coloured, as a decorative feature in the stems of drinking glasses was a technique well known in Europe, but in the 1740s English glassmakers adapted it to lead glass with great success<sup>47</sup>. Soon it began to be used for domestic articles, and became

a serious competitor to porcelain. Thorpe<sup>48</sup> quotes Frances Thynne, Countess of Hertford:

They have made a great improvement in Southwark upon the manufacture of glass, and brought it so nearly to resemble old white china, that when it is placed upon a cabinet at a convenient distance it would not easily be distinguished by an indifferent judge. They make jars, beakers, flower-pots, sauce boats, salt-cellars and milk pots of it, which look extremely pretty.

This type of glass was much enhanced by decoration painted on the surface, which took the form of birds, flowers, Chinese and other motifs. Among the best of the decorators was Michael Edkins, so much so that Charleston<sup>49</sup> writes: 'Almost every type of painting on English opaque-white glass seems to have been attributed to Edkins at one time or another'. Not a great deal is known of Michael Edkins early life other than that he probably started his career as a delftware painter at a pottery adjacent to the Redcliff Backs flint glasshouse, for whose various owners he worked as an independent craftsman from the early 1760s to the mid 1780s, and for the glass decorating company, Lazarus Jacobs, for a similar period. In the mid 1760s he also decorated for the short lived Williams, Dunbar glasshouse at Chepstow. Opaque white glass was in the early stage of development in England when the excise tax was introduced in 1745 and it was not included until 1778, when the tax of 9s 4d (47p) per cwt, on flint glass was doubled, and that effectively killed off the trade.

Coloured glass, as an alternative to the transparent glass that had dominated the market, began to become popular at about the same time as opaque white glass. Various colours were produced, but the one that is almost universally known today is 'Bristol blue'. There was nothing unique about the development of coloured glasses, nor was their manufacture confined to Bristol, but the fact that one colour in particular became associated with the city invites enquiry as to why this was so. Why not 'Bristol red', for example, a colour that had medieval associations through the Flemish dyers that settled in the city?<sup>50</sup>

Blue glass can be obtained by adding a small amount of cobalt oxide to the batch of raw materials. In 18th century England this was done by preparing smalt, a fusion of cobalt oxide, potash and silica, which was subsequently ground. It is the generally accepted view that of the supplies then available to glassmakers none gave as good and as consistent a colour as the cobalt oxide purchased from Silesia, the imports of which were in the hands of a Plymouth merchant and porcelain manufacturer, William Cookworthy. It had been the intention of Cookworthy to set up a works manufacturing porcelain and glazes at Bristol in the 1740s, but nothing came of that and it was not until 1770 that he transferred his Plymouth porcelain factory. It had been his aim to import china clay from Virginia, but for various reasons these negotiations broke down. In one of his letters to the Governor of that colony he comments on the effect of using cobalt in glassmaking:<sup>51</sup>

For if this semimetal is melted in Violent fire along with a composition made of Equal parts of a fix'd Alkali, and powder of white flints, or Clean white sand, this Composition will be

converted into a Black Blue Glass which when reduc'd to a fine powder will be true smalt. . . About 20 Grain of the cobaltine semi-metal is sufficient to tinge 1 oz of Glass.

There is the view that Cookworthy imposed no restriction on the purchase of the product he imported and that, therefore, the term 'Bristol blue' arises not from the place of manufacture, but from the fact that Bristol was where the smalt was bought. In order 'first to substantiate or refute the widely held opinion that Bristol blue glass has distinctive constituents and, therefore, colour, and secondly to find some definite criteria with which to attribute blue glass with greater certainty' the Oxford Laboratory for Archaeology, on behalf of the Bristol City Art Gallery, undertook an analysis of various examples of blue glass of the late 18th. early 19th century.<sup>52</sup> Samples fell into three categories, four known to be from Bristol, thirteen attributed to Bristol, and nine attributed to other sources. The samples in the first two categories, with one exception had lead oxide contents ranging between 6.7% and 9.3% whereas, with the exception of a sample from Brierley Hill, the remainder were below the minimum percentage, and in most cases well below. The report comments, 'The remarkably high lead content of all the documented pieces of Bristol glass and the correspondingly small proportion of calcium serves to emphasise the 'luxury' quality of this decorative flint glass'. To which is added, 'Cobalt appears to be the colouring agent used in all the samples of blue glass analysed, but it has not been possible to establish the variations or sources of this cobalt.'

### Innovation in Decline

Despite the excise tax glassmaking in England continued to expand and by the mid 1770s output was some 70% greater than when the tax was imposed. What the glassmakers did not realise was that they were on the edge of a depression that was to continue through the whole of the next decade. Bristol glassmakers had shared in the general improvement in trade, but the causes of the slump were to affect them more than their competitors in other parts of the country. For their exports Bristol glassmakers looked toward America and the West Indies and the embargo on British goods on the part of some colonies, followed by the war of independence, led to a considerable loss of trade, from which the glass industry in Bristol never fully recovered. By the end of the first decade of the 19th century crown glass making had finished in Bristol and two of the bottle houses had shut down.

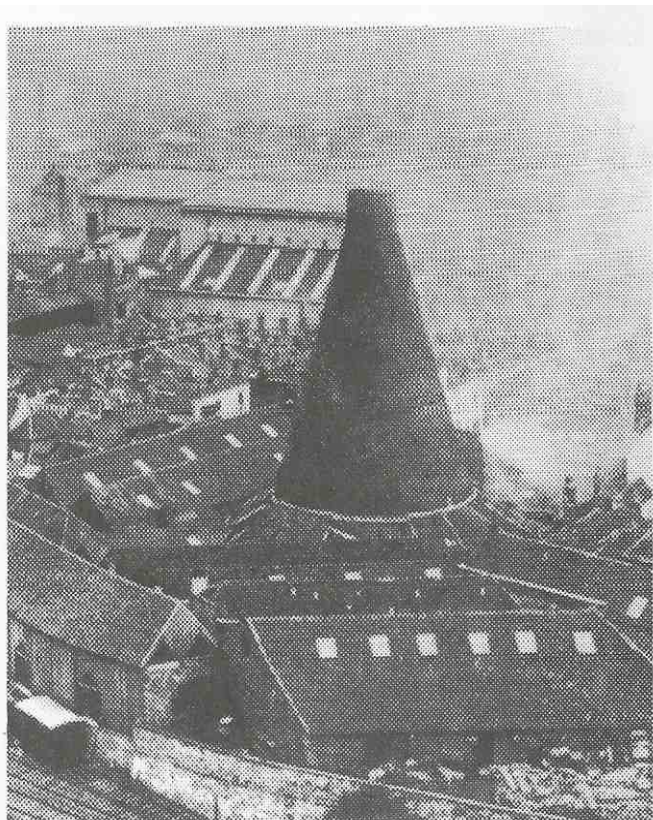
Gradually the glassmakers were moving away. In 1765 Henry William Stiegel had built a glasshouse in Pennsylvania and many of his workmen, it was said, had come from Bristol. Thomas Cains, who built his own glasshouse at South Boston, was apprenticed at the Redcliff Backs glasshouse.<sup>53</sup> Not all the glassmakers went as far as this. In 1793 John Robert Lucas severed his connection with the Limekiln Lane glasshouse in order to follow his interests at Stanton Wick, and then Nailsea, and the Canningtons with family connections in the Cheese Lane, St Thomas Street and Temple Street glasshouses emigrated to the north. The irony of the situation is seen from an advertisement in *Felix Farley's Bristol Journal* on 18 March 1826:

Wanted, a few good bottle-makers, one blower and a pot maker.  
Apply William Geddes, Bottle Works, Glasgow.

There was an exception to the trend. In 1778 a new flint glasshouse opened in Portwall Lane, but even so, by the turn of the century the three older flint glasshouses had closed, two having been absorbed by the newcomer, with the result that there were now only four glasshouses working in Bristol. The Portwall Lane glasshouse, after a shaky start, began to make money and proved to be very profitable, particularly during the first two decades of the century.<sup>54</sup>

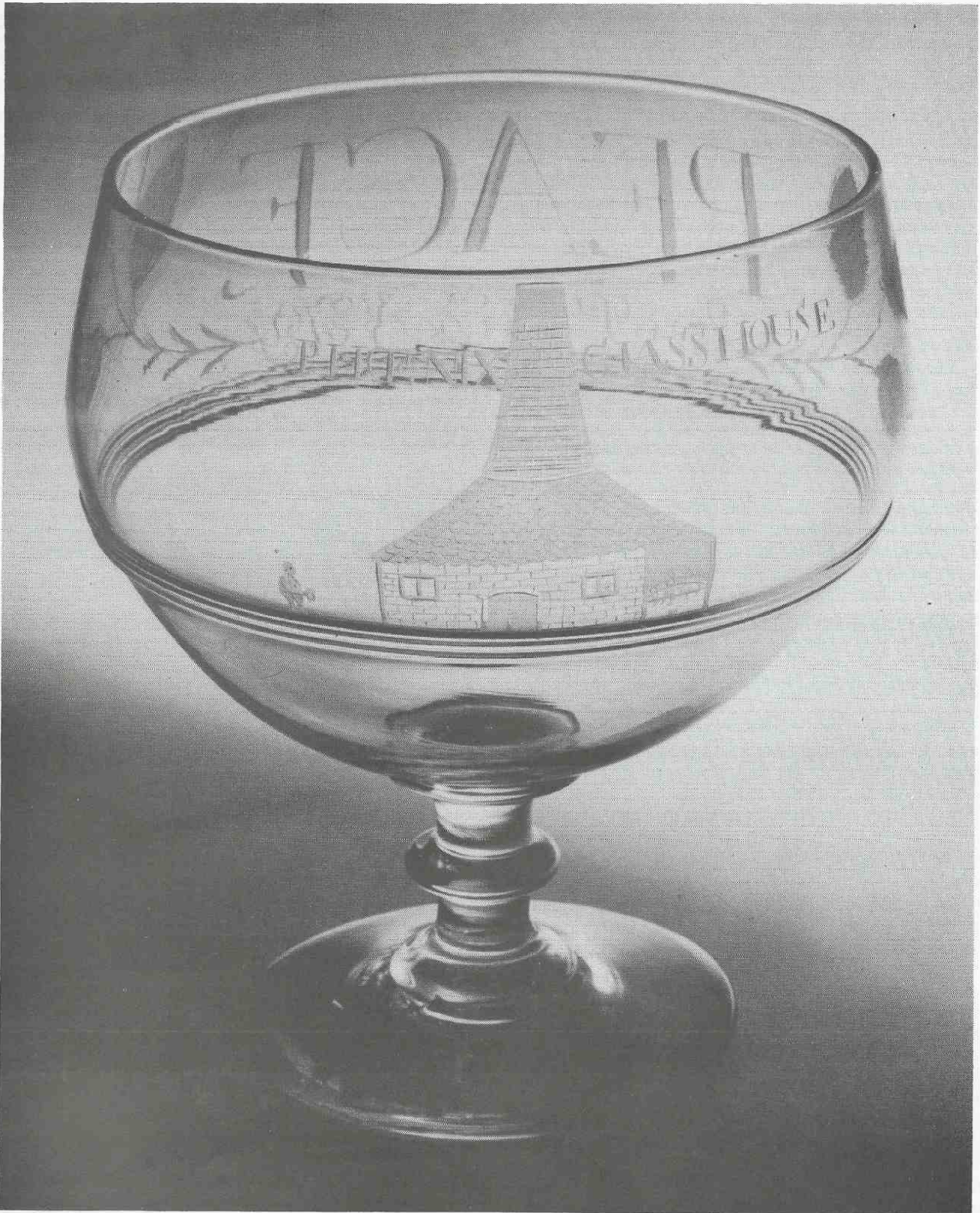
Since the Perrott patents improvements in furnaces had come from outside Bristol, but now the manager of the Portwall Lane glasshouse, John Donaldson, revived the Bristol interest in the subject. Donaldson's concern was with the cost of melting glass, and in 1802 he filed a patent<sup>55</sup> claiming that he had invented a

Method of Making all Kinds of Glass by a very Considerable Improvement in the Construction of the Furnace, and the Flues connected with it, which occasions a Greater Flow of Air through the Furnace, and thereby produced such Intense Heat as to Fuse the Materials in less than One Half of the Usual Time, with a Saving of full One Third Part of the Coal generally Consumed, and Rendering the Glass of a Better Quality.



*The Prewett Street glasshouse, the truncated base of which now forms the restaurant of the Dragonara Hotel. Compare the diameter of the base with that of the Portwall Lane (Phoenix) glasshouse, engraved on the 'Peace and Plenty' glass, which may well have been constructed on the principles of the Donaldson patent.*

*Photograph by courtesy of Mardon, Son & Hall Ltd.*



*'Peace and Plenty' goblet, made at the Phoenix glasshouse, Portwall Lane, c1814.*

*City of Bristol Museum and  
Art Gallery N5055*

The patent, although it still had no diagram, described the method by which the claim was to be implemented. The furnace was to be enclosed in a separate structure, thus isolating it from extraneous draughts.

I do advise and prefer a conical figure, of considerable elevation, for the external building, having its orifice or chimney at the top, and its base of such a diameter as that its internal face may be less than one foot distant from the nearest projecting part of the curvature of the furnace.

This may account for the variation from the normal cone shaped building adopted by the Portwall Lane glasshouse, where the elevation indicates a cone with a much smaller base diameter than was customary. External air would enter only through the ash pit and the grate and circulate between the furnace and its enclosure, the chimney creating the draught. Donaldson adds:

... in order that the workmen may have convenient access to the working flues, and that the heat ... may be moderated for working, I form certain openings in the said building, which are to be closed in a fit and proper manner by iron doors, or otherwise, whenever the extreme heat is required, but which are opened by taking the same down at the time of working ...

In other words, the external structure was sealed off when a high temperature was needed for melting glass and opened up and cooled when the glassmakers were at work. It was this attempt to find a way of superheating the furnace that enabled Donaldson to advance his claim that this method gave considerable economic advantage over the then current method of melting glass. Hughes<sup>56</sup> suggests that apart from using the furnace at Portwall Lane others were installed at Stourbridge, Waterford and Cork.

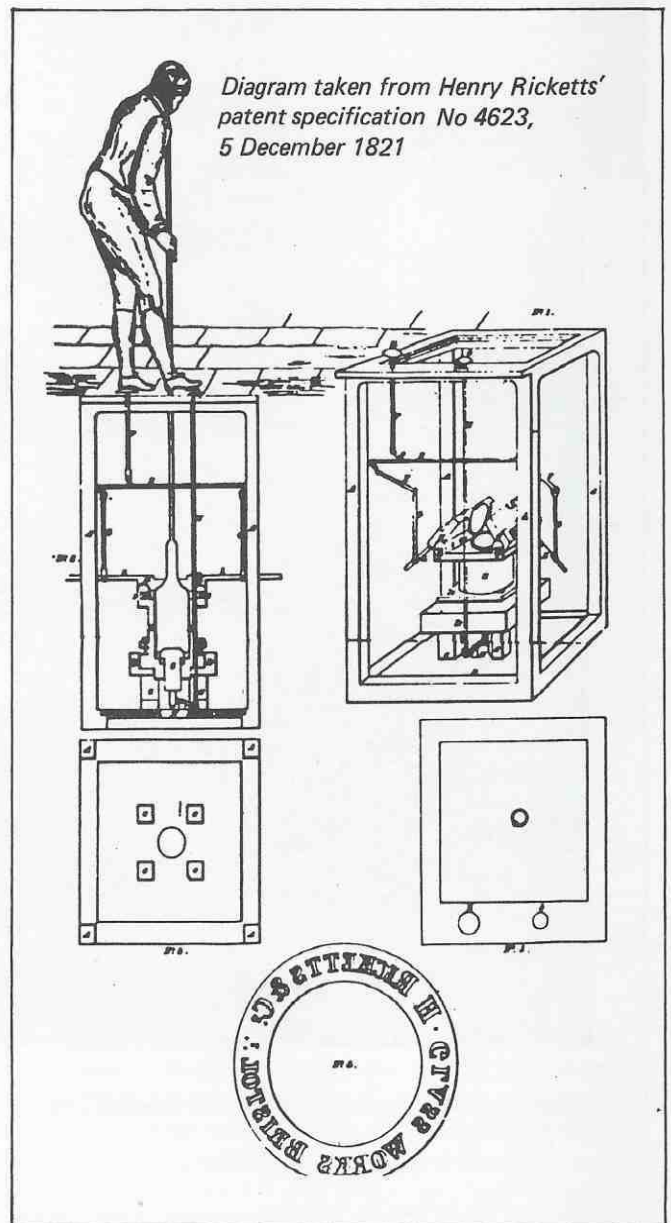
Henry Ricketts was the last of the Bristol glassmakers to file a patent. Son of the founder of the Portwall Lane glasshouse he had taken over the management of the concern after the merger with the Redcliff Backs flint glasshouse in 1802. In 1811 their interests moved into bottle manufacture by taking over one of the Cheese Lane glasshouses. By the beginning of the 19th century there was a growing need for bottles with more accurately determined capacities. When the English dark green bottles first came into use in the early part of the 17th century they were fashioned entirely by hand but, by the early part of the next century, the straight sided bottle began to replace the bulbous shape, and to obtain regularity in shape moulds began to be used. These were simple in construction and formed only the body of the bottle. The glassmaker gathered the glass on the end of his blowing iron and after having marvered it, lowered the parison he had formed into the mould and blew until the glass took the shape of the mould.<sup>57</sup> The shape was then withdrawn and a pontil attached to the base, allowing the blowing iron to be cracked off. This left a jagged top which was finished by wrapping a separate gather of glass around it. In this process the shoulder and neck of the bottle were formed outside the constraint of the mould and were therefore subject to irregularity.

It was this that Henry Ricketts set out to rectify.<sup>58</sup>

... By this my sole Invention, the circumference and diameter of bottles are formed nearly cylindrical, and their height determined

so as to contain given quantities or proportions of a wine or beer gallon measure, with a great degree of regularity or conformity to each other, and all the bottles so made by me after this method present a superior neatness of appearance and regularity of shape for convenient and safe stowage, which cannot by other means be so well attained.

This he achieved by taking the existing type of mould and adding to it a two part shoulder mould which could be closed when the bottle was being blown, thus restricting the shoulder to a given shape, and opened to allow the bottle to be withdrawn and finished. Ricketts also incorporated a removable base plate whereby, ' according to the thickness or thinness of the said ring is the body of the mould shortened or increased, and the various sizes of bottles produced. . .' Information such as the makers name and the capacity engraved on the base plate was permanently embossed on the bottle. For stability all bottles have to - have a concave base and the 'push up' as it is termed, previously a separate operation, was now incorporated in the process. Describing the patent one commentator suggested:



Such a mould ought to be prescribed by legislative enactment, with an excise stamp to define the capacity of every bottle, and thereby put an end to the interminable frauds committed in the measure of wine and all other liquors sold by the bottle.<sup>59</sup>

The Ricketts mould had a great influence on bottle manufacture and design and the principles the patent established, with subsequent refinements, carried its name well into the 20th century.

By the time Henry Ricketts took out his patent Bristol was no longer an important area of glassmaking. In 1833, the Commissioners of Inquiry into the Excise Tax recommended the tax on glass be dropped.<sup>60</sup> In their report the number of glasshouses in England was given as 106, with a further 10 in Scotland and a similar number in Ireland. The regional distribution in England was as Table 1.

Area	Number of Glasshouses	Excise tax paid	% age of payment
North East	41	£304 180	44.7
West Yorkshire	10	25 799	3.8
Lancashire	19	131 676	19.4
West Midlands	27	149 548	22.0
London	3	15 122	2.2
Bristol	6	53 759	7.9
	106	680 084	100.00

The Bristol area included the two Nailsea glasshouses, which were very profitable at the time. If their contribution to the tax is deducted the Bristol percentage falls to 2.1, marginally below London.

By the time the report was published the Limekiln Lane glasshouse had closed, leaving the flint glasshouse in Portwall Lane, which continued until 1851, and two bottle glasshouses in Cheese Lane/Avon Street, which amalgamated in 1853 and continued producing until the post first world war depression caused the company to close in 1923. The proprietors had had one final attempt to keep level with technical development when the Siemens furnace was installed in the 1860s, the first bottle glasshouse to do so. 'Just before 1860', wrote Powell<sup>61</sup>, 'gas-regenerating furnaces were introduced by Siemens to take the place of the old coal fires. Much economy of fuel was effected, as well as greater regularity in working . . .'. He adds, that the company had to 'pass through a long and costly experience of experiments before success was attained'. The earlier Bristol glassmakers would have subscribed to sentiments such as these.

The company seems to have surmounted the introduction of semi-automatic bottle blowing machinery toward the end

of the 19th century, but a recession at a time when capital was needed to install the fully automatic machinery that was being introduced into the United Kingdom combined to end Bristol's interest in the glass industry.

### Acknowledgements

I am most grateful to Lady Elton for calling my attention to the Crews Hole glasshouse documents and to the staff at the Somerset Record Office for making them available; to Dr J H Bettey for directing me to the papers relating to Humphrey Perrott and to the staff at the Wiltshire Record Office for providing these, and to Brian Moody for having read through the paper and for his much welcomed advice.

### References

- BGAS - Bristol and Gloucestershire Archaeology Society
- GT - Glass Technology
- JGS - Journal of Glass Studies
- JSGT - Journal of the Society of Glass Technology
- SRO - Somerset Record Office
- WRO - Wiltshire Record Office

- 1 *Royal Proclamation No 42, 23 May 1615*, State Papers Domestic, James 1.
- 2 *Patent Roll, 28 July 1610*, 8 James 1, License to Sir William Slingsby. i  
*Patent Roll, 25 March 1611*, 9 James I, License to Sir Edward Zouch.  
Slingsby's patent covered a range of objectives in addition to glassmaking, for example, metallurgy, brickmaking, hop drying and baking, whereas the Zouch patent dealt specifically with glassmaking.
- 3 Norden J (1607), *The Surveyors Dialogue*, p 214 (quoted in Nef — see note 4).
- 4 Nef J U (1932), *The Rise of the British Coal Industry*, London vi, p 195.
- 5 *Patent Roll 4 March 1614*, II, James I.  
This monopoly covered all types of glassware whereas, although not specifically stated, it is considered that the previous monopoly was only for window glass. In addition, all imports of foreign glass were forbidden.
- 6 Thorpe, W A (1961), *English glass*, p 115.  
Sir Robert Mansell was born at Margam in 1573, saw service against the Spanish Armada at the age of 15 and became a Vice-Admiral by 1603. He became interested in business affairs and joined the Zouch partnership in 1615,
- 7 *Patent No 24, 22 Ma y 1623*.
- 8 Rudder S (1779), *History of Gloucestershire*, p 572.
- 9 Dudley D (1665), Edited by J N Bagnell, West Bromwich 1854.  
Quoted by Godfrey E S (1975) *The Development of English Glassmaking 1560- 1640* p 63. Dr Godfrey gives an excellent account of the political and commercial issues affesting the change from wood to coal fired furnaces and the controversies that surrounded the award of the monopolies.

- 10 The ash from wood fired furnaces was used as a flux in glass-making. With coal fired furnaces an alternative source of alkali was needed. Bristol was already a major centre of soap making and the needs of the two industries were similar. The soap makers made their plant ash from barilla or kelp, which they then boiled with lime. This resulted in a caustic liquor, used for treating the fat, and a precipitate of calcium carbonate, known as soapers ash, which could be used as a flux by the glassmakers. See letter from W E S Turner, quoted in Powell A C (1926), *Glassmaking in Bristol* BGAS v 47 p 242. Sand was readily available locally, and in some cases could be dug on the site. When purer quality sands were required for clear glass they were shipped in by boat, as did Perrott, for example, from the Isle of Wight. See WRO MS 1178/619.
- 11 Nef J U *op cit*, vi pp 72-73.
- 12 Dudley D, *op cit*, pp 16-17.
- 13 Thorpe, W A, *op cit*, p 124.
- 14 Guttery D R (1956), *From Broad Glass to Cut Crystal*, London p 78.
- 15 Hill C (1972), *The Century of Revolution 1603-1714*, London.
- 16 Houghton J, *A Collection for Improvement of Husbandry and Trade*, No 198, 15 May 1696. In his comments Houghton writes, 'Hence it may be noted that the Places where Glass is made in England and Wales are only in the 2 chief Cities, viz in London, where there are 24 Glass-Houses, and Bristol, with 9 . . .' Stourbridge was listed as having 17, and Newcastle upon Tyne 11. Houghton lists the glasshouses 'in and about Bristol' as: Bottles 5; Bottles and Window Glass 1; Flint, Green and Ordinary 3. In this context the term **flint** would apply to lead glass, **ordinary** to transparent soda-lime glass, both used mainly for domestic purposes, and **green** to glass with a higher iron oxide content used possibly for medicinal, scientific and industrial glassware, which was usually made in these glasshouses.
- 17 *6-7 William & Mary, 20 March 1695.*  
'In 1695 also the Newcastle chaldron was fixed by statute at 53 cwt and it was common usage to trade at one Newcastle chaldron to two London chaldron'. See Net J U, *op cit*, v 2 App C, pp 367-378.
- 18 *House of Commons Journals*, v 11; v 12.
- 19 SRO MS 48DD/RG, 25 August 1694.
- 20 *Ibid*, 5 July 1709.
- 21 *Ibid*, 5 November 1727; 12 November 1731; 25 March 1732.
- 22 *Ibid*, 30 June 1794.
- 23 No date can be given for the introduction of glass cones. Westropp M S D (1920), *Irish Glass*, pp 37-38 credits Captain Roche with building one in Dublin in 1696 and the *London Gazette* 3 August 1691 reports 'At Nottingham Town, a large Glass-House, with all Conveniences thereunto belonging, of good new Brick Building will be Lent or Sold in April next'. This may or may not refer to a glasshouse cone. It John Cole's building was of the brick cone type then it predates the Dublin, but not the Nottingham glasshouse.
- 24 Sayer (1832), *Memoirs of Bristol*, v2, p 546.
- 25 Plot R (1686), *The Natural History of Staffordshire*.
- 26 For a survey of the development of glass furnaces up to and including the brick cone see: Charleston R J (1978), *Glass Furnaces Through the Ages*, JGS v 20, pp 9-33 and Crossley D W (1983), *The Development of English Glass Furnaces in the 16th and 17th Centuries*, JGS v25, pp 147-153.
- 27 Sullivan, R J (1780), *Observations made During a Tour through Parts of England, Scotland and Wales*, London p92.
- 28 Turner W E S (1962), *A Notable British 17th Century Contribution to the Literature of Glassmaking*, GT v 3, pp 201-213.
- 29 Thorpe W A, *op cit*, p161.
- 30 *Daily Post*, 8 June 1720.
- 31 Powell, *op cit*, p 211.
- 32 *General Advertiser*, 8 June 1736; *Norris's Taunton Journal*, 10 December 1725.
- 33 *Patent No 426*, 26 March 1720.
- 34 Court W H B (1938), *The Rise of the Midland Industries, 1600-1838*. London pp 124-126.
- 35 Nave R (1726), *The City and County Purchaser and Builders Dictionary*, London; section *Glass* no pagination.
- 36 *London Gazette*, 10 January 1712; 12 January 1717.
- 37 *Ibid*, 13 August 1723; 24 August 1723.
- 38 *Patent No 545, 15 February 1723.*  
A **teasing hole** is where the coal is fed to the furnace. **Flashing** is the term applied to the process of spinning the bubble of glass so that it forms a flat sheet. **Nealing**, now known as annealing, is the process of controlled cooling in order to prevent objectionable stresses developing in glass. When the glass had been flashed it was taken to a kiln or **lehr**, to be annealed. Each finished piece of glass, or **table**, was stacked on its edge in the kiln by leaning the first against the rear wall and the remainder following suit. In order to limit damage in the event of tables slipping **dressers** were inserted. They were iron frames, inserted at intervals, to keep the groups of tables apart.
- 39 *London Gazette*, 26 May 1730.
- 40 WRO MS1178/618/2.
- 41 *Ibid*, MS 1178/619.  
There are two valuations, one which refers only to the property which is assessed at £3 632.9.0. (£3 632.45), and another which includes glasshouse stocks and household goods amounting in all to £7 378.6.2. (£7 378.31 ), of which the property is £3 168.
- 42 *Bristol Oracle*, 8 September 1744.  
'To be sold the dwelling house, glasshouses etc. Late of Humphrey Perrott, a bankrupt, situate in Temple Street, Bristol.'
- 43 Hughes G B ( 1956.), *English, Scottish and Irish Table Glass*, London p 63.
- 44 WHO MS 1178/618/1.

45 *Ibid*, MS 1178/617.

It was John Baker who, with John Cole, built the Crews Hole glasshouse. As Crews Hole was in the Hundred of Barton Regis it would appear that Perrett aimed at an agreement with the Crews Hole glasshouse where, by 1723, John Baker was the sole owner. In the valuation of Humphrey Perrott's estate there are references to 'The land and ground in Barton Regis . . .' and 'The Land whereon the Old Glass House Stands. . .' This raises the interesting question as to whether the 'old glasshouse' was in Temple Street, as might reasonably be supposed, or had Humphrey Perrott taken over the Crews Hole glasshouse from John Baker after the abortive attempt to restrict production?

46 Buckley (1926), *The Early Glasshouses of Bristol*, JSJT v 9, p 42.

47 See the '*Oliver Cromwell' Privateer Glass* (c1757) Probably made at Bristol City of Bristol Museum and Art Gallery N7834.

48 Thorpe W A, *op cit*, p 202.

49 Charleston R J (1954), *Michael Edkins and the Problem of English Enamelled Glass*, JSJT v 38, pp 3T to 16T.

50 Roper I M (1909-12), *Bristol Red* Clifton Antiquarian Club, v 3, p 65.  
Roper gives several interesting examples of the use of the term, such as John Skelton's reference to 'Her Kyrteel Bristow red' in his early 16th century poem, The Tunning of Elynour Rummung, but the expression does not have the alliterative appeal of 'Bristol blue'.

51 Sellick A D (1978), *Cookworthy* Plymouth, from which the extract from the letter to the Governor of Virginia has been taken. See also Penderill-Church J (1972) *William Cookworthy 1705-80* Truro.

52 Banks M, Elphinstone N, Hall E T (1963), *Bristol Blue Glass* Archaeometry vs 6-8, pp 26-30. See also Hughes G B *op cit*, pp 351-359.

53 Wilson K M (1968), *English Influence on Early 19th Century American Glass*, 8th International Congress on Glass, London pp 85-89.



54 Alford B W E (1968), *The Flint and Bottle Glass Industry in the Early 19th Century; a Case Study of a Bristol Firm*, Business History v 10, pp 12-21.

Weeden C (1982), *The Ricketts Family and the Phoenix Glasshouse, Bristol*, The Glass Circle, v 4, pp 84-101.

55 *Patent No 2589*, 19 March 1802.

56 Hughes G B, *op cit*, p 66; p 366; p 368.

57 To **marver** is to roll the gather of glass on a flat metal or stone surface in order to form a basic shape, and to cool and thus stabilize the outer surface of the glass. The shape thus formed is known as the **parison**.

58 *Patent No 4623*, 5 December 1821.

For an excellent account of the development of this patent see: Jones O (1983), *The Contribution of the Ricketts Mold to the Manufacture of the English Wine Bottle*, JGS v 25, pp 167-177.

59 Ure A (1839), *A Dictionary of Arts, Manufactures and Mines*, London v1, p 161.

60 *Thirteenth Report of the Commissioners of Inquiry into the Excise Establishment: Glass*, London 1835. For a commentary on the regional distribution of the glass industry see: Brown C M (1980), *The Glass Industry in the 1830s*, GT v 21, pp 184-189.

61 Powell A C, *op cit*, p 249.