Figure 3.7: Crucible furnace and Old Office, [?]

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Ancillary trades

By examination of the two major plans it becomes apparent that there were several of these, so that the glassworks was fairly well self-sufficient, even including a butcher's shop in the 1830s. Blacksmiths, carpenters and joiners all had their own shops, while there must have been all the trades associated with having horses for transport, and people with the necessary skills to run and maintain the engines and boilers providing motive power for certain processes, such as a saw-mill and roller-crushers.

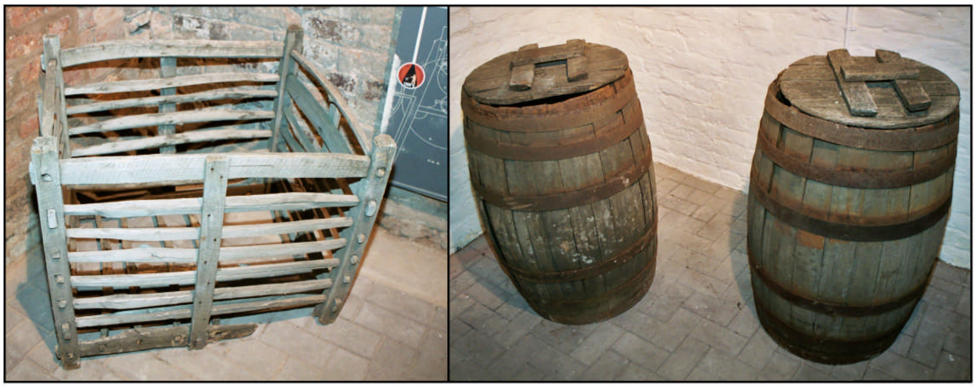

Figure 3.8:Composite of a crate and barrels, all on display at the Red House Cone

The presence in the 1830s of a pole shed and stave yard, combined with Coathupe's reference (Appendix 1, p.98) to making crates from poles leads one to presume that barrels and crates were made on site.

Chemical works

The disposition (other than it seems they were at the western boundary of the site) and detailed layout of these is not known for certain. It is presumed that Brown's plan (Figure 1.6) might show them, where it differs from the 1870 plan. It would appear that the works produced much of its own chemical requirements certainly from the later 1830s under Coathupe until about 1865, when according to Mountain a tall stack associated with the chemical works was demolished as unsafe. We have already seen above that the acid chambers in a smaller {10} were replaced by French Kilns at the latest by 1870, and the schedule gives no indication of any chemical manufacture at that date. (See Appendix 11 for a billhead vignette.)

The only indication of chemical processing not directly involved in the glassmaking process on the 1830s plan is one room identified as "Room for breaking kelp".

The various writers, including Eyres and Mountain give various sources for the primary raw materials. The study by Gilberton and Hawkins of sand in the locality is comprehensive, and concludes that there was significant extraction in the area, but that it was "probably largely the sands of aeolian origin dating from the last glacial stage of the Pleistocene which acted as the main source of the quartz." After further discussion, "Such local supplies, however, cannot have sustained an active industry for long and after a very short period, if not immediately, increasing reliance must have been placed on the importation of better quality sand from further afield." See Table 3.2 below.

Table 3.2 - Sources for raw materials

Item	From	Authority
Sand	Phippard's, Wareham, Dorset Portishead, via Bristol Isle of Wight Easton Failand Ridge	Eyres Mountain Coathupe Coathupe Gilberton & Hawkins
Lime[stone]	Walton, Weston-in-Gordano Wraxall to Clevedon – many kilns on the ridge.	Eyres Thomas
Saltcake	Netham Chemical Works, Bristol	Eyres, Mountain
Coke	Bristol Gas Works	Mountain
Kelp	Possibly Ireland as a return load to Bristol, in view of the considerable trade between them.	Author
Seaweed	Isles of Scilly Wales	Thomas Angerstein

Some idea of the chemistry involved will be found in Appendix 6, and from Coathupe's notebook – Appendix 1, pages 1-21. On page 20 of the notebook there is a reference to Sulphte. Burita. [Much later:this was from the earlier transcription: in the original it is not clearly legible and may read "Barita", but it is not thought that it will change the following.] This has been translated by both Michael Cable and Dr David Watts as 'Barium Sulphate'. The latter was intrigued to find it being referred to by Coathupe, as his initial response was that it was normally used later, particularly in the context of pressed glassware generally. However he subsequently advised that, "The chemistry of Barium and purification of the metal was well worked out by 1835, as indicated in *The Penny Cyclopedia* of that date, Vol. 3, pps.452-454. Its function is to improve toughness, brilliancy and the speeding-up of setting times.[20]

Material preparation

The sand, depending on its source probably would require washing and drying before use. The lime would probably have been ready for use from the limekilns.

Before the works went over to producing its own alkali, etc, the evidence from the 1830s plan indicates that the kelp would be broken up and then calcined in the 'calcining house' to reduce it to ash. [Angerstein, writing in June, 1754, about glass bottle manufacturing in Bristol describes kelp as, "a kind of soda or barilla, burnt from seaweed in Wales. This is quite salty on the tongue, and serves as a flux for the other ingredients."] A 'mill' is shown alongside the 'room for breaking kelp'[21], but it is not known whether this was to further mill down the kelp before burning, or whether it was part of the subsequent process. Taking the evidence from the 1870 schedule it might also have been for breaking down some of the other raw materials. Either way, once all the necessary raw materials were available they would first be measured by weight in the required proportions in to a rotatable wooden drum, and thoroughly mixed to form 'batch'.

This would then be 'fritted', that is partly fused together, by heating in an oven called a 'calcar' ('caulker' on the Nailsea drawings/schedule). By taking the batch to a temperature somewhat below 800º C, this would tend to reduce the production of gasses in, help to burn off any impurities before introduction to, and reduce the energy required in, the main furnace. [Coathupe refers to a calcar (p.94).] To make it more manageable it may well have been subsequently milled to give a more uniformly sized product. With the addition of an appropriate amount of clean cullet the resultant mix would then be added to a pot for melting. Whether the terminology, as opposed to the process, had been changed by 1870 is not known, but in 1870 there is a reference to a 'Sand caulker" {12}: this may have functioned as a drying oven, the sand having been washed first, as it is next to the 'Mixing Room' {13}. An alternative might be that by then 'sand' was a colloquial term for the mixed ingredients.

Cullet is not a 'raw' material, but it is a significant aid to the process of making glass, and therefore should be considered. This seems an appropriate place and I am grateful to Mr Mike Noble, factory manager at United Glass Limited, Alloa, for drawing it to my attention. He asked if there was any indication of the source(s) of the cullet used, as this is a question that has interested him. Obviously nowadays the ubiquitous 'bottle-bank' is an obvious source, as well as in-house waste, but he has wondered if in the past there were people who collected scrap glass (c.f. scrap merchants for scrap metal) or even if there were works whose principal product was cullet, rather than finished goods. The current study has not provided answers, and a close reading of Coathupe's notes does not provide any clarification. Cullet is obviously important because it is referred to a significant number of times. On p.24 he gives 336 lbs. of cullet to 448 lbs. Sand for the "S.S. Standard Mixture" and the same weights, using dry I.o.W. sand, for a 'carbonate' mixture on p.25. He confirms this ratio on p.40, as well as giving additional quantities of cullet used. On p.41 he quantifies cullet in the forms of 'Skimmings' [the scum/contaminated glass floating on the surface of the molten glass in the pot and skimmed off], 'Moils' [the glass remaining on the end of the blowing iron], and 'Pontys' [the glass remaining on the pontil rod after it had been detached from the finished item], as weights per

20 Angus-Butterworth, p.36-7

21 It seems more likely to have actually been kelp in its natural form at Nailsea, as there was a suggestion in 2001 (GT 1/01)of a possible drainage channel from the building, possibly indicating washing before processing.

found. On p.42 he gives the values of cullet as 5 shillings per cwt. if "Thin, picked and washed", and as 3 shillings per cwt. for "Ladlings and skimmings". This does not make it clear whether this is the value for selling or buying, but it is felt that the condition infers that it is being bought in at that price. On p.89 he states, "Wt of Cullet used **:** Wt. of cullet retd. from the Cutting Room as 1 **:** .0332, when we supply not so much cullet as we use." A further series of 'Cullet' ratios follow on p.90. One of these, "Total of Cullet used **:** Total of Sand used as 1 :1.08." appears to be at variance with the 3 **:** 4 ratio quoted above, unless it is including cullet used for glazing etc. The reference to "Brazling Cullet" on p.37 of Coathupe, as transcribed, drew the following comment from Michael Cable, "It could therefore mean the heinous practice of calcining cullet." [Pers. comm., with useful comments on cullet via David Crossley.] [The late access to the original of the notebook now gives an alternative reading of "Crazling"; the initial letter is rather ornamented, and not entirely clear. This is not helpful.]

By 1870 there were two rooms reserved for coloured cullet, {35} and {43}.

The presence of an 'Engine Room' {46} in 1870, with, for example a saw mill {45}, two clay mills, {40} and {50}, and a 'Limestone & Salt cake Mill' {39} in proximity indicates that a degree of mechanisation had been installed: when is not known.

Pot making

This was one of the most important trades in the works, as the pots, or crucibles, played an integral part in the glass-making process. The clay came from Stourbridge, being highly suitable for the purpose, as molten glass is very corrosive. Transport was relatively easy by boat down the Severn. Coathupe covers 'Pots' from p.60 to p.73 in his notebook: being reproduced as Appendix 1, much of the detail may be read there.

The pots were made on site, straight-sided, 'flower-pot' shaped (rather than closed), by the method, dating back to the Neolithic only on a much larger scale, of building up coils to give the required form and dimensions. Considerable manipulation of the clay was necessary to ensure a homogenous texture, clear of any air bubbles, and it would be 'tempered' by the addition of a certain amount of finely ground clay from used pots. This was in the ratio of 7:1 (Coathupe, p.60). Several would be worked on at once, to encourage stability by partial drying once a new ring had been added, but the top edge would be kept damp by sacking to ensure a good bond to the next ring when the turn of that pot came round to have a further ring added. "If very carefully dried, they may be used in from 5 to 6 months." (*Ibid.*, p.61.)

It is understood that once the pots were sufficiently air-dried they would be transferred to a pot-arch for drying out at a higher temperature and would be brought up to furnace temperature before being 'set' in the furnace itself.

It can be seen that while not requiring a large labour force it would have been virtually a continuous production process. While referring to the closed pots in use there, the Red House Cone booklet states that, "Each pot took about two months to build."

It does, however, give some idea of the time that would be involved to finish up with a pot with an external diameter at the top of 56 inches (132 cms), an overall height of virtually 41¼ inches, an external bottom diameter of 40 inches and a wall thickness of 1¾ inches. (Coathupe, p.61).

For whatever reason, it appears that no crucible fragments were found or, if found not retained, from any of the archaeological investigations. There is a reference to crucible fragments in the 1983 report (File 'A'), but none were found during a comprehensive search of the finds stored at the Museum at Weston-super-Mare. [The profile of the pot has been established by use of