

THE WAY WE WERE: A LOOK BACK AT BREWING FIFTY YEARS AGO

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What do wet milling, high maltose syrup, diaphragm mash filters, high gravity brewing, yeast pitching control, conical bottomed vessels, centrifuges, cross flow filtration, dissolved oxygen metering, beer stabilisation with SHG and PVPP, widgets, hygienic pneumatic valve manifolds, in-line instrumentation, computers and SCADA systems all have in common? Well, fifty years ago we managed to brew beer without them.

Fifty years ago the billion was a mathematic concept and not everyone in academia was a professor. There were shop assistants to serve you and bus conductors to take your fare. You did not have to wear a crash helmet when riding your motor bike and car seat belts were an optional extra. Not too many folk had colour televisions, there were only three TV channels and you had to get up out of your seat to change them. The binmen came around the back of your house to pick up your rubbish and there was no recycling as plastic packaging had yet to become widespread and glass milk, pop and beer bottles were returnable. We used the newspaper to light the open coal fire.

Telephones had dials, you could smoke in pubs and indeed on aeroplanes. Few men had a beard and only sailors had tattoos. AA patrolmen on their motorcycles would salute members when they spotted the badge. Shops closed on Sundays and a happy meal was when your mother did not cook sprouts! Pubs had to close in the afternoon. You took your films to be developed at Boots. Students got maintenance grants and had their tuition fees paid; they also knew how to use a fountain pen. Women did not get equal pay and still don't! Kids played outside all day and parents did not worry. The unemployment rate was below 4% and it would take until 2019 to return to that level.

It was not all rosy; strikes were common, Barbara Castle's 'In place of strife' did not get past the National Union of Mineworkers and Ted Heath had taken over from Harold Wilson as Prime Minister. He saw Britain's future in Europe

and we know what that led to. Inflation would hit 22% and no one mourned the loss of the town's smelly gas works. Concorde had yet to fly to New York; there was no airport security; satellite TV, fax machines, fitbits, ceefax, wind turbines, electric cars, bar codes, videotapes, CDs, personal computers, packet sandwiches, suitcases on wheels, double glazing, vegans, the internet, mobile phones, non alcoholic beer, alcopops, nitro beers, pubcos, genetic engineering, Legionella and the 1989 Beer Orders were all subjects for science fiction writers as was decimal currency and measuring things in metres, diversity, tree hugging, snowflakes and global climate change. Gosh, how on earth did we cope?

This article will look at the technology in use in the early 1970s and using the Institute of Brewing and Distilling archive will show how some of the techniques employed have survived into the twenty first century. So, it is a trip down memory lane for our older members and to younger ones it might explain how we have gotten to the white hot technology of the 2022 brewery.

Industry background

In 1972 the UK beer market was around 59.6mhl, a peak would be reached in 1979 with 68.9mhl but has since fallen back to around 45 mhl. The average original gravity was 1037° or around 4.15% ABV which is much the same as it is today. Of course nobody knew this as it was not a legal requirement to display strength; only the Northern Clubs Federation Brewery displayed the original gravity on its bar fonts.

The market was dominated by the Big Six, Seven if you count Guinness and its emerging Harp Lager interests. The biggest brewer was Bass Charrington at 9mhl, followed by Allied (Ind Coope, Ansells and Tetley) at 8mhl, then Whitbread at 5.5m, Watney Mann at 5m, Scottish and Newcastle with 4m, Courage, Barclay and Simonds with 3m and

Guinness adding a further 2.5m. Whitbread had opened the first new large new brewery development at Luton in 1969, Bass was to follow with Runcorn in 1974 and Courage built Berkshire in 1978 – none of these breweries survive today. Luton closed in 1984, Runcorn in 1991 and Berkshire in 2010, victims of poor industrial relations, company restructuring and rises in fuel making single site huge plants less sustainable. On the positive side Whitbread's later efforts at Samlesbury (1972) and Magor (1979) continue producing today under the Budweiser banner.

About 66% of the nation's beer was sold through licensed premises owned by brewers, clubs sold another 20% with the remainder comprised free trade and off licences. The Big Six brewers also owned just over half of the total of 75,000 pubs; Bass had 9,800, Allied 8,400, Whitbread 7,900, Watney 6,600, Courage had 4,500 and S & N just 1,850. Brewers owned 80% of all pubs. Greenall Whitley, John Smiths and Truman, Hanbury and Buxton were the only other brewers with over 1,000 owned outlets. There were around 100 breweries all the way down to a single brewpub; Ma Pardoe's aka the Old Swan in Netherton in the Black Country. The Three Tuns at Bishops Castle purporting to be one of the nation's oldest did not get a mention. A study by the Monopolies Commission published in 1969 thought that these arrangements might operate against the public interest but nothing was done about it until another study and the Beer Orders some 20 years later.

Lager represented only 7% of the market, the rest being top fermented ales. In 2020, around 75% is lager despite the efforts of over 2500 tiny cask beer brewers. 73% of beer was on draught (18% dark mild, 31% standard bitter, 17% best bitter and stouts and 7% lager), 24% in returnable bottles with the remainder being non-returnable and mainly in cans. Some 90% of the beer was sold in the on-trade, today slightly over half of our consumption is bought in the off-trade. Exports were just short of 700,000hL and over a third of that went to Belgium. Today's export figure is 10 times higher with Belgium, Ireland and the USA being popular destinations. Imports totalled 2.8 million hectolitres most of that coming from Ireland and Denmark; that figure has increased to over 9 million hectolitres mainly from France, Italy and the Netherlands as well as all of Britain's Guinness now coming from Ireland.

Regional brewers launched their own lager brands but the big boys did deals with overseas brewers to preserve that continental cachet. Carling Black Label from Canada was first brewed in Sheffield in 1953; Guinness launched Harp in 1960, Whitbread imported Heineken from 1961 and brewed a weaker version of it from 1968; in the same year Watney linked up with Carlsberg.

There were of course wholly owned and joint ventures abroad with both Allied and Watneys acquiring breweries in the Netherlands and Belgium respectively and brewing beer over there. Allied with a 20% share of the Dutch market was second only to Heineken and in Belgium Watneys became the country's third largest brewer with the 90% share in Brasseries Jules Delbruyere and Vandenheuvel. Allied was part of the Skol International consortium which was brewing the beer in 16 countries. Whitbread had a 50% share in a South African Brewery with Heineken and had plans to build a series of plants. Bass Charrington brewed Toby beer for local consumption at Brasseries de la Manche in France and had acquired the Lamot plant at Mechelin in Belgium in 1970. Courage was active at the Blue Nile Brewery in Khartoum and at Melbourne in Australia through British Tobacco. Guinness had built its first brewery outside the British Isles in Nigeria in 1962. Even tiny Youngs in London had a deal with Piedboeuf at Jupille in Belgium (a forerunner of Interbrew) which turned over production at one of its breweries entirely to the brewing of Youngs Pale Ale

. At home Brits drank 103L of beer per head, 2.6L of cider, 3.7L of wine and 900mL of spirits so as far as total alcohol was concerned; that comprised 71% beer, 2% cider, 10% wine and 17% spirits heading up to a total of 5.4L per head of 100% alcohol. In 2020 total litres of alcohol per head is around eight with beer having dropped to a 35% share, cider increased to 9%, spirits 21% and wine has trebled to 33%. The price of a pint was around 2 shillings. I remember a pint of M & B Brew XI was 2/10½ on 14 February 1971 and that became 15p on decimal day, an inflationary rise of over 4%! To put that figure into context, the author's annual salary was £1,450!

Watneys was reputed to be the first brewer to sell beer in keg during the 1930s although they did not call it that. The keg accolade was first used by Flowers in Stratford-on-Avon in 1957. Bouyed up by the potential of national television advertising, all the big boys had launched keg products. Watneys Red Barrel was about to morph into Watney's Red and join a Mao Tse Tung lookalike in the Red Revolution. Bass Charrington's Worthington E was 'the taste that satisfies'; Courage Tavern was 'what your right arm's for' while Ind Coope's Double Diamond 'worked wonders'. Whitbread Tankard was apparently 'like bitter oughta be'. S & N's Youngers Tartan continued to make a play on words implying enhanced longevity. Keg beer's greater reliability and increased fizz was not attractive to some and the Campaign for Real Ale would be founded in 1971. It is reckoned that around 18% of total beer sales were in keg in 1970 but that figure was higher in Scotland where lager was popular. Just under half of the market was satisfied by cask conditioned beers, it is now just 6%.

Inside the brewery

The modern brewer would recognise the brewery of fifty years ago. It was often said the only thing a brewer needed to know when going to another plant was the location of the Excise Office – now the Excise Book has long gone but more about that later. There would be a lot more wood about, copper coppers and copper mains with brass fittings but not much stainless steel beyond fermenting squares. Older wooden, iron or aluminium vessels may have been resin or polypropylene lined but 300 barrels would have been a big one although Guinness had 26M an enclosed 12,000hL square stainless steel giant described as a double length tun which was built on site by APV in 1959. It remains Guinness' only entry in its own book of records! It measured 19.2 x 8.7m so the depth was 24 feet (7.3m). Eddie Bourke remembers children, who were allowed to tour the brewery in those days, climbing some wooden steps and getting a CO₂ bang from the open manway!

There would be a lot of operators about, all of them would have been men with the ladies confined to the bottling hall but a few like the redoubtable Dora on the empty cask bank at Cape Hill, a job she had started during the war. All the brewers would be male with Guinness favouring those with experience in Guard's regiments. Barrels per man year is a useful KPI for brewery performance. Comparisons are difficult these days as so many brewers have contracted out peripheral duties to reduce the apparent head count but suffice it to say that when Bass closed its No2 Brewery in Burton on Trent in 1982 with its 60 union sets that 98 jobs were displaced and that was just to get the beer into racking vessel.

Stokers firing the coppers had largely disappeared but there was a lot of manual work to be done. Hop pockets were taller than you were weighing 168lb (76kg). Malt came in half quarter (76kg) sacks. There were mash tuns to dig out, sometimes having to lift the grains over the edge and not simply push it down a hole. Hop backs were cleared by hand and both these tasks were hard and hot work, rewarded by an on-the-job beer allowance system. Another bucket of beer appeared whenever the crew went on to overtime. Wooden hogsheads (245L of beer) weighed around 300kg and thus demanded a certain size of operator and three men in the delivery vehicle cab, a situation which persisted long after the demise of wood and then the hogshead. If the young shift brewer alone on patrol through the ale stores during the night shift heard the gurgle of a leaking hogshead, it just had to stay there!

FVs were cleaned by hand. A paste of wheat flour and water had been applied above the wort level to facilitate the clear-

ing of the worst of the fermentation head and then a man would enter the vessel, squeegee the yeast away and then use a Scotchbrite pad to scour it clean. A spray of chlorinated isocyanurate or else the more expensive amphoteric Tego 51B would sterilise the surface.

The Health and Safety at Work Act was a couple of years away. Draeger tubes and Ringrose CO₂ detectors were in use or a lighted candle would suffice and the gas was usually removed by playing a hose pipe in for a while or trying to suck it out with a long flexible tube attached to a fan. There would have been a harness and perhaps breathing apparatus hidden away somewhere nearby. Sadly there were fatalities, often in confined spaces, from boiling liquid or fork lift trucks.

Raw materials

Malt has not changed much nor has the method of making it. Drums and boxes were getting larger though limited by the power needed to blow air through a deeper bed. The Wanderhaufen system was in action at Pauls and Bairds, here rather than the conditions changing in a single box, system involved a very long box fitted with a sophisticated turner which moved the piece along towards the kiln experiencing different conditions on the way.

Barley varieties only started to churn more frequently after plant breeders were allowed to obtain royalties after 1964. With a twelve year development period, these new barleys did not appear until the mid 1970s. We largely used Proctor and Maris Otter with hot water extracts around 300L°/kg (dry). Field yields have also improved from 3t/ha to over eight, and today some samples of fat corned Cooper weigh in at 320L°/kg.

Hot water extract was not stated in Lo/kg back then; it was reported in brewers pounds per quarter. Malt was weighed in 336lb quarters (152kg) which could be subdivided into eight bushels of 42lb. Just to be perverse and perhaps account for the malting loss and change in moisture between malt and barley, the latter was weighed in quarters of 448 lbs and bushels of 56lb! A brewers pound compares the weight of a barrel (36 gallons or 163L) of wort against the weight of a barrel of water. Thus a barrel of wort at 1040° would weigh 374.4lb or 14.4 brewers pounds. The use of degrees Fahrenheit for temperature was also widespread with brewers mashing at 149°F (65°C) and collecting at 60°F (15.6°C).

Many brewers were able to exert some control on the supply chain by owning their own malting plants. Britain's last was Molson Coors which inherited the 60m high Shobnall tower malting from Bass and sold it on to Soufflet in 2015.



Figure 1. The Victorian tower brewhouse, Wadworth in Devizes dates from 1885 (pictured in 2002).

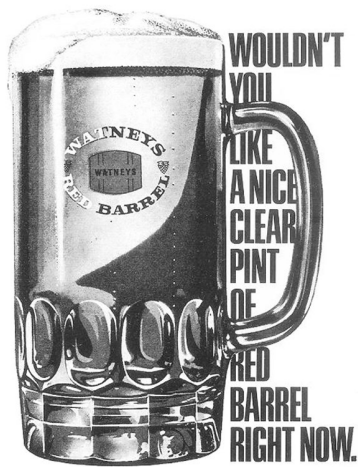


Figure 2. The future according to the Big Six.



Figure 3. The malt screens in Bass' No2 Brewery, Burton (NBHT).

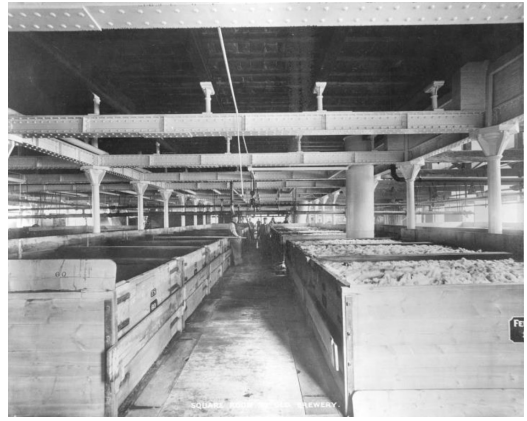


Figure 4. Collection squares at Bass' Old Brewery on High Street, Burton (NBHT).



Figure 5. Filling a wooden barrel at Bass (NBHT).

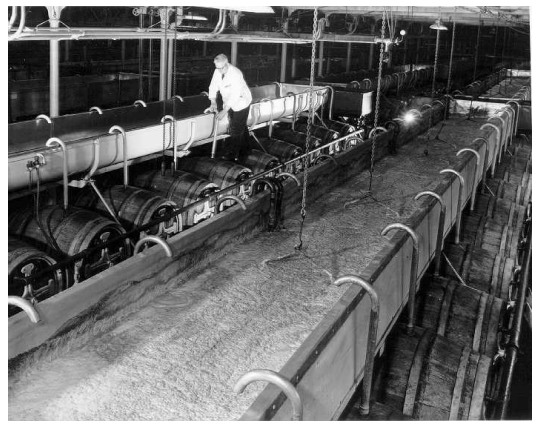


Figure 6. The Bass No2 Brewery union sets (NBHT).



Figure 7. Redox tanks behind a posh fascia at Cape Hill, Birmingham (NBHT).

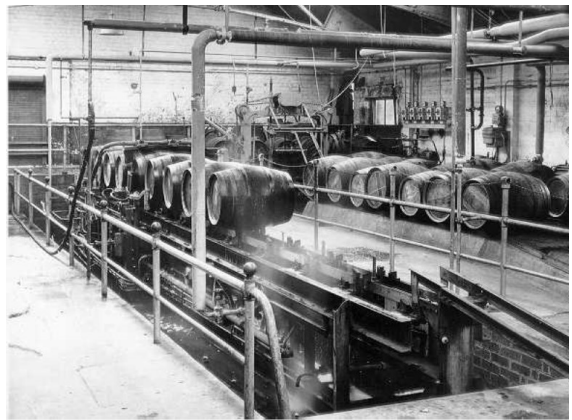


Figure 8. Cask washing at Joules, Stone (NBHT).



Figure 9. Rotary vacuum filters for drying yeast at Guinness in Dublin. Photo courtesy of Diageo Archive.



Figure 10. Hard work at the Guinness hop store. Photo courtesy of Diageo Archive.



Figure 11. Coopers at Guinness.



Figure 12. heaving hops into the copper at Castlemaine Perkins in Brisbane .



Figure 13. Upending a metal hogshead at Holts in Manchester (2001).



Figure 14. Scouring inside the 12000hL 26M fermenter at Guinness in Dublin. Photo courtesy of the Diageo Archive.



Figure 15. Adlam's makers plate at Elgoods.



Figure 16. The future according to Bass Charrington. The Runcorn Brewery was originally conceived to produce some 3.6m barrels; half the firm's output. It opened in 1974 and first brewed 2m bbl in 1979 (NBHT).



Figure 17. The power of steam at Hook Norton. Belt driven pumps.



Figure 18. Sack hoist at Hook Norton.

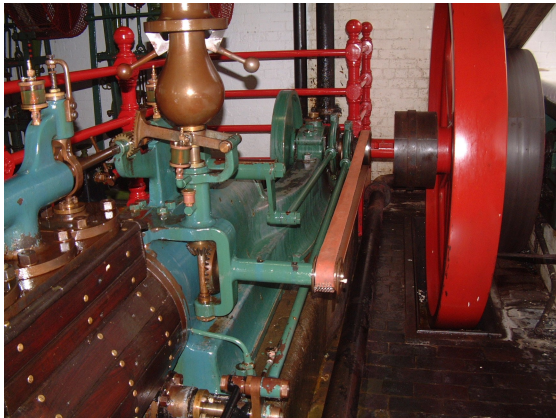


Figure 19. The Hook Norton 25hp steam engine dates from 1899 and cost £175. It was still in use in 2002.

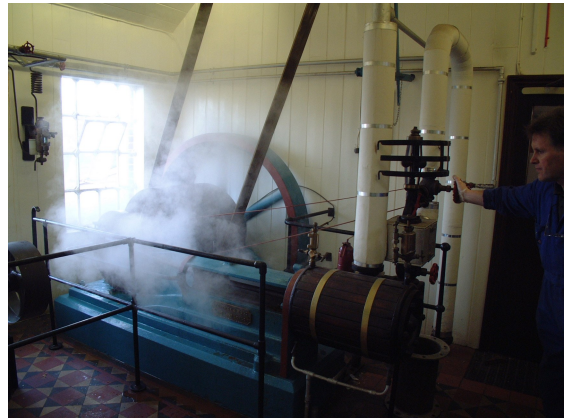


Figure 20. At Harveys the steam engine is hooked up to the brewery supply to impress visitors.



Figure 21. The power of water at Donnington, Stow on the Wold.

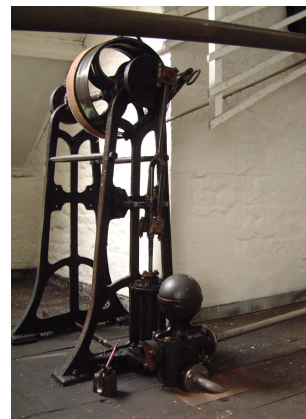


Figure 22. Donnington brewery's wort pump in 2001.



Figure 23. Malting floor at Tuckers in Newton Abbot (2010).

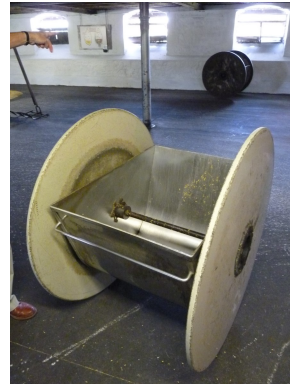


Figure 24. Bobby barrow at Tuckers.

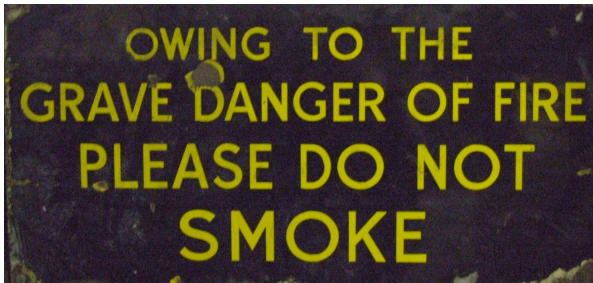


Figure 25. Smoking notice at W&D Langley Maltings (2006).



Figure 26. The kiln exteriors at W & D Langley Maltings.



Figure 27. Steep vessel and malting floor at W & D Lichfield (2003).



Figure 28. Anthracite kiln furnace at Lichfield.



Figure 29. Malt deliveries in sack. The malt loft at Palmers, Bridport.



Figure 30. The malt loft at Harveys, Lewes.

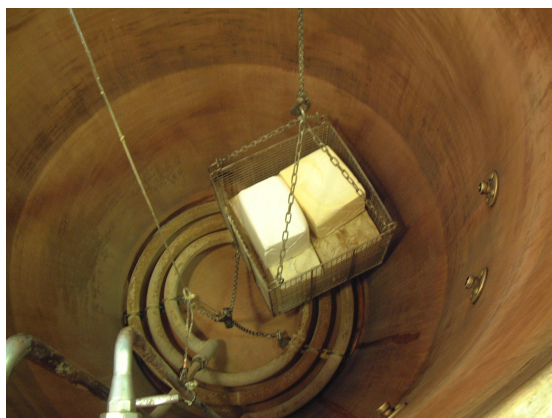


Figure 31. Dissolving Ragus invert sugar at Bathams, Brierley Hill (2005).



Figure 32. Many oast houses have been converted into houses; this one is at Chiddingstone in Kent.



Figure 33. A modern oast at Claston Farm, Herefordshire (2001).



Figure 34. Hop picking machine at Claston Farm.



Figure 35. Inspecting samples at the English Hop Competition held at Robinsons in 2007.



Figure 36. Half ounce T100 hop pellets for dry hopping .



Figure 37. Hop pockets in store at Highgate, Walsall (2003) .

There had been interest in using growth regulators; gibberellic acid to speed things up (0.2ppm) and bromate (100ppm) would make sure it did not go too fast. The gibberellic acid was found to be useful in unattemperated malthouses to get the piece off to a good start during the winter. Some brewer maltsters played with abrading the grain which helped the uptake of any additives. Barley was bashed against a rough surface so that water uptake into the aleurone layer could be enhanced but that practice produced malt of a rather gnarled appearance so was not favoured by sales maltsters. Other maltsters developed barley syrups in an attempt to force themselves out of business; Crisp had Brewmalt which was evaporated from a barley and enzyme mash, it worked tolerably well in robust darker beers but was not a satisfactory match in paler more delicately flavoured beer. More recent attempts by Novozymes have still to gain any traction in the business and maltsters carry on.

Floor maltings used to be a common adjunct to the industrial landscape and many have been converted into apartments. There are now but three major floor maltings in the country with plants at Warminster, Fakenham (Crispmalt) and Castleford (Fawcett) although a few Scottish distillers also have such facilities attached. In the States and Australia, artisan micro maltsters have sprung up to support the craft beer industry.

Although floor maltings were labour intensive, once the building was erected they represented a fairly low cost operation without the need for investment in large vessels, humidifiers and huge fans. One tonne of barley needed a floor space of around 100m² so when the last floor maltings in Britain was built at Grimsby in 1952 (only 6,000 tonnes in 15t batches), buildings were large indeed although by then a degree of mechanical turning equipment was available. In Britain's climate, with care, a floor maltings could produce good quality malt throughout the year part from a few hot weeks when the plant would get a summer clean down anyway.

Air resting had been developed and even aspiration of the steep vessels to remove CO₂ but it was not easy to adapt square cornered self emptying steep vessels and aerate homogeneously. Once cast on to the floor, the grain would be kept at 14.5°C up to 24 hours ex steep and then be allowed to rise to 20°C after 3 to 4 days. The depth of the grain would be increased or thinned to achieve these temperatures and the piece would need turning twice a day to prevent the rootlets from matting together.

Kilns were usually anthracite fired and its sulphur content meant that when potential carcinogenic NDMA was detected elsewhere that no palliatives were needed. Other maltsters

had to use sulphur candles, low NOX burners or else install indirect heating. Yet there was a lot of wood about, the gullies between the roof sections were the first to leak and cause rotting and the buildings were very prone to catching fire. More stringent hygiene rules in food manufacture demanded shoe coveralls and it was not always possible to keep rodents at bay and the maltings cat had to stay outside. Although floor malting worked well with modern barleys, the sums gradually failed to stack up; Marstons stopped in 2006 and Tuckers succumbed in 2018. The remaining floors provide a niche product but it is debatable whether the term 'floor malted Maris Otter' is widely appreciated by the drinking public!

Other cereals

Other mash tun adjuncts will be familiar to today's brewers. Crystal malt would be used at around 2%, black gave a superior flavour to dark milds compared to caramel. Torrified barley and wheat would go through the malt mills and being unmalted they were cheaper sources of extract. Wheat flour itself was relatively cheap as a by-product of the milling industry, it had a low nitrogen content and contributed glycoprotein to enhance beer foam. Usage beyond 8-10% would have to wait for the introduction of the diaphragm mash filter and also on the down side it needed special handling to avoid explosions.

Some brewers, notably Courage, swore by the use of flaked maize 'to get a bit of sunshine into the beer' – around 8-10% and others used a touch of Dixon's Enzymic malt which was no more enzymic than other malts but it was treated with lactic acid bacteria at the maltings and that helped lower the mash pH and enhance enzymic action. Such an addition was probably a throw back to an earlier brewing problem and its use persisted rather like adding proprietary yeast feeding when you could easily tweak the mashing conditions to avoid such usage.

Glucose brewing sugars went in the copper to sterilise them and contribute to extra steam usage but did extend the mash tun yield; a 10% addition would have been typical. These syrups needed warm storage at 60°C to avoid crystallisation so many used blocks of solid invert sugar and the only bit of extra kit needed was either a frame in the underback to hold them or else a frame to lower them into the copper. It was always best not to heave them straight in through the copper manway for fear of damaging the base of the vessel! EDME malt extract offered a more expensive means of increasing summer yield as did Paul's Green Malt Syrup. No kilning paid for the concentration and Flowers were using it up to 25% to increase peak yield before they were closed in 1969.

Over to the hop yard

In the hop gardens, the oast house with its familiar white wooden cowl would be converted into an upmarket desres. Hop varieties were all tall grown and Fuggles, Goldings and Whitbread Goldings Variety had served brewers for decades. Progress, Challenger, Brewers Gold, Northern Brewer (originally developed for Scottish & Newcastle) were being introduced offering an increase in alpha acid content. At the time Bramling Cross was around but not appreciated then for a catty aroma which today is prized for adding a black-currant flavour. Northdown and Target were all waiting in the wings taking the alpha up over 10%. Admiral of course will yield over 19% today. Foreign hops were used by some, from the old Yugoslavia, Clusters from British Colombia and sometimes hops from Belgium; all offering a cheaper source of alpha acid. Citrus and stoned fruit were still confined to the fruit bowl. As we shall see later, a hoppy aroma in the glass came from adding hops to the cask rather than adding them late to the boiling process. Although Flowers at Stratford did experiment with an ultrasonic treatment of a hop tea where the liquid was added to the hop back and the vegetable solids went back to the next copper.

Hop extracts were available for copper addition or isomerised for post fermentation addition. They were not hugely popular being extracted with noxious chemicals like benzene or methylene chlorine and flavour matching was generally not too satisfactory. The advantages of adding bitterness after the yeast had done its work was appreciated but the widespread use of the technique had to wait for CO₂ extraction to be developed. Hops were packed into 75kg hessian pockets which took a good deal of deft handling. These were then cold stored at considerable expense and brewers would call off a working stock. Pockets tended not to be stored cold in the brewery and were often kept close by their point of usage in rather warm conditions thus accelerating the oxidation process. The milling of hops and then vacuum packing them was developed in Germany and Britain's first plant started up in Eardistown in the early 1970s. The process allowed ambient storage, an increase in utilisation as the particle size was smaller and a ready means of seeing whether the vacuum seal had been compromised were all advantages which would have to wait for the future and would need the installation of a whirlpool. By 1975 over a fifth of the UK hop crop was pelletised. Vacuum packing whole hops had to wait until the mid 1990s.

Inside the brewery

In the breweries there were lots of men about, there was plenty of manual labour to be carried out, batch sizes tended

to be small and automation was patchy often confined to malt blending and weighing and some nifty plastic cams fitted into Negretti and Zambra controllers to modulate fermentation temperature by altering the flow of coolant to the vessel panels.

Malt was in silo or else held in half quarter (76kg) sacks. The arrival of a trailer of sack malt would virtually stop production as all hands were deployed to off load it and hoist it up into the malt loft. Then, as now, no brewer trusted the maltster, even his own, so malt was screened to remove chaff and small grains and magnets removed any metallic objects. Some sieves separated the malt into two fractions and they were milled separately through two roller machines set at different gaps. Most other mills had two sets of rollers, some had a sieve between the two sets to shake out the husks and flour leaving only the coarse grits to go through the second set. Six roller machines were known on the continent where traditionally malt was less well modified and there were hard ends of the corn to be dealt with.

The mash tun ruled in those days. Of the dozen or so breweries I visited while at the Birmingham Brewing School in 1969 only two had lauter tuns and they both belonged to Bass Charrington. No3 Brewery at Cape Hill produced 400 barrels of M & B Mild wort about seven times a day through a 1959 Ziemann block brewhouse while the Bass No1 plant in Burton on Trent was producing 11,000 barrels a week including some Carling Black Label Lager through a 1967 Weigelwerk AG installation from Essen in Germany. One man and an assistant could control the process from malt intake to wort receiver from a central console. The brewhouse was fabricated in copper and served by a six roller Miag mill. There was a Wittemann hop separator and the first whirlpool I ever saw. A Sangamo gravity meter was used to dilute the wort on its way to collection. Ale in the 24 x 400 barrel fermenters was turned round in 72 hours using a 200bph centrifuge to cleanse the green beer allowing 44 x 330 barrel brews weekly. Sounds pretty futuristic!

Everyone else had to manage with Steels mashers and mash tun. Only a single temperature mash was possible. All were covered to keep the heat in. The tops were wooden and hinged on counter weights to allow relatively easy inspection. The plates were gunmetal or brass. Over time the plates would develop gaps which allowed bits to pass through. The tun bottoms could be evened up with a coat of epoxy resin, but you must check that the material actually used does not taint rather than testing maker's samples. Cape Hill had to recall about 4,000 barrels released to trade before anyone noticed. I imagine that a formal sign off for flavour between each point in the process is now followed more rigorously.

Often the sparge arms would be covered when a muffled voice from above shouted 'two bags' and then 'all in' so that the brewer could shut the hot liquor supply off. The larger breweries had 72 quarter tuns (11t) and the grain bed was deep with Guinness and tiny Davenports in Birmingham reporting depths of 80" or 2m. The biggest mash tun I saw was at the old Georges plant in Bristol where there was a 120 quarter beast (18t). I was working there as a student when the graining arm failed and it had to be dug out by hand. Hot work but several buckets of beer appeared.

A mash tun would have a bed loading of around 300kg per square metre so run off was longer with the deeper beds. Add to that the mashing in time and the stand for the enzymes to do their work, you could only turn the tun round in eight hours or three brews a day if you were lucky. Yet you could not brew at that intensity for more than a couple of days as the underplate area would clog and the plates needed to come up for a manual rinse. Brewers thus sought to separate the unit operations of mashing and wort separation into a mash vessel and a lauter tun which, if you loaded to 200kg/m², could easily manage eight brews daily and today 14-16 brews are possible with even lighter loadings.

Meura built its first mash filter back in 1890 to take advantage of a very low grain loading against a woven sheet. The machines in use in 1970 suffered from being filled and pressurised from one end only so the working pressure dropped away from the inlet and extracts were not as good as they should have been. Improvement came much later when diaphragm plates allowed each one to work like a mini mash vessel with a bed depth of only a few centimetres.

The mash tun run off could be controlled by a single valve with an experienced and attentive operator. There were valve ladders with a series of valves starting near the top of the bed with the lowest differential pressure and during run off successive valves were opened down the stack. That was the theory anyway and the Valentine device involving a swinging arm which was dropped as the run off proceeded was a lot easier to operate.

Sparge arms were usually driven by the water pressure from the hot liquor tank and the temperature might be raised over the run off period to reduce the viscosity and get the weak wort off faster. Extracts in the early 90 per cents were deemed to be good.

The secret to effective use of mash tuns was to get the strong wort off slowly and to avoid waiting for the subsequent sparge there were often a pair of coppers. The strong wort was boiled with a minimum hop loading as high gravities do not favour utilisation of the bittering material. The bulk of

the hops went into the weak copper. This was all well and good if the two parts met up again but brewers practicing partigyling, where different strength worts were collected and fermented to produce different products, had to be more careful.

Coppers were usually made of copper and fitted with internal calandria often sitting on top of the dome in the base where direct coal firing had been employed long before. Such arrangements did not encourage the best mixing. There was often a can or two of Hopcon added once brewers learned that a tin spared for 45kg of hops. Evaporation might be as high as 7-10% probably because that had always been the target or else to concentrate the wort for the collection of stronger brands. In the old days, there had been an obligatory '*coup de feu*' when the stokers would load up the fire to maximum heat for the last ten minutes of the boil and then furiously pull the fire to avoid charring the wort as the vessel was cast. The '*coup*' continued with the boilerhouse often having the reduce supply to other parts of the brewery to cope. Some coppers were open which were a potential hazard and had the distinct disadvantage of filling the copper hearth with steam if the wind was in the wrong direction! Advertising departments now make a virtue of such processing inferring that the boil is somehow superior! It was likely to be less vigorous to avoid splashing passers-by. Many other coppers at the time were pressurised to 2psi to increase the boil temperature and thus utilisation.

After the boil, the hops and trub were removed using a hop back which had a slotted base and again some were open. Wort would be recirculated to trap the trub particles in the bed before bright wort was sent forward. If there were multiple brews each day the hops would normally be left *in situ* and cleared at the end of operations. Usually as first job the following morning when things has cooled down a bit.

Some brewers had installed Wittemann hop separators where an Archimedean screw inside a mesh cylinder separates the hops and a sparge at the discharge end of the device helped to reduce losses. These took up a good deal less room than a hop back but a lot of the trub would go forward necessitating the use of a whirlpool which would come into its own when hop powders became popular later in the decade. After the whirlpool, I have seen long woven socks spread over an open cooler floor to trap further protein.

Before we leave the brewhouse I must mention the Strain-master which came from the States where it had been patented by Anheuser Busch and developed by the Nooter Corporation in St. Louis. European examples were manufactured by Meura. It consists of a rectangular hopper bottomed tank that is fitted with downward opening 'bomb bay' doors to



Figure 38. This 60bbl copper at Harveys in 2004 was built by Scottish coppersmiths Forsyth in 1999.



Figure 39. The Wrexham Lager brewhouse, photo from the Brewery History Society (BHS).

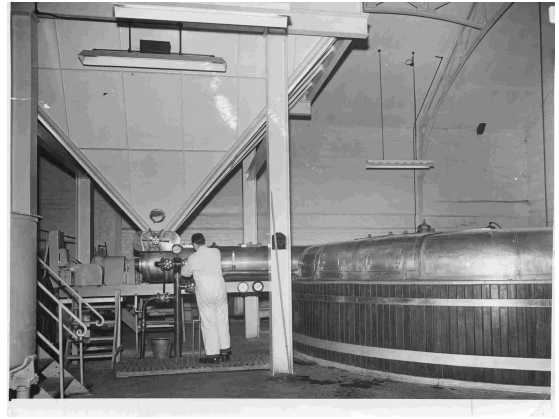


Figure 40. The 120 quarter monster mash tun at Georges in Bristol (BHS).

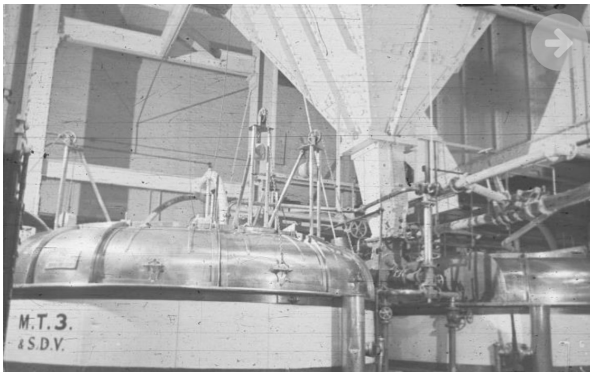


Figure 41. Mash tuns at Joules in Stone, Staffordshire (NBHT).



Figure 42. Breaking up the hops before adding to the copper at Georges (BHS).



Figure 43. The Wittemann hop separator at Castlemaine Perkins in Brisbane.

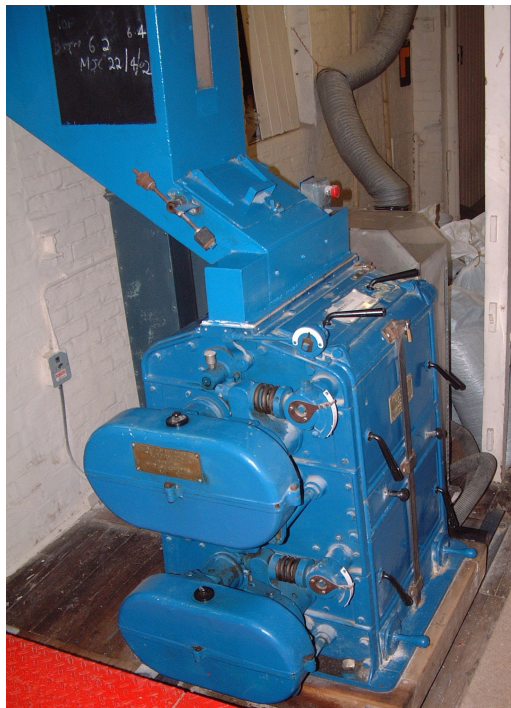


Figure 44. The four roller mill at Bateman's in 2002.



Figure 45. At Hook Norton, a screen separates large and smaller corns and they are crushed through two-roller mills with different gaps. (2002).



Figure 46. The mash tun at Holden's takes a charge of 375kg yielding 36 barrels a time (2012).



Figure 47. Warming the pot at Hook Norton (2002).

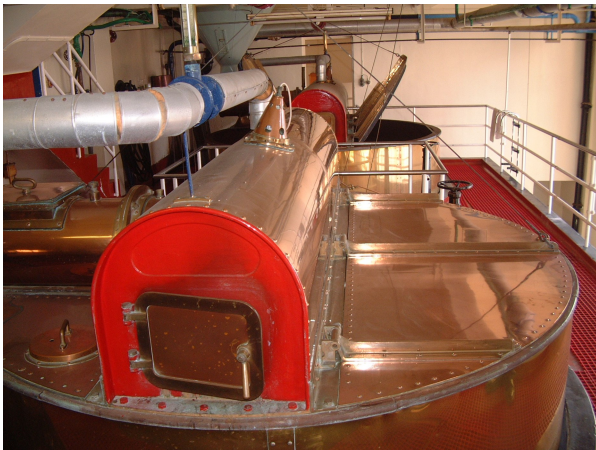


Figure 48. This inspection chamber at Jersey Brewery allows mashing and sparge checks to be carried out without raising the heavy lid. (2004).



Figure 49. A Valentine swinging run off flow control device at Arkells in Swindon (2001).

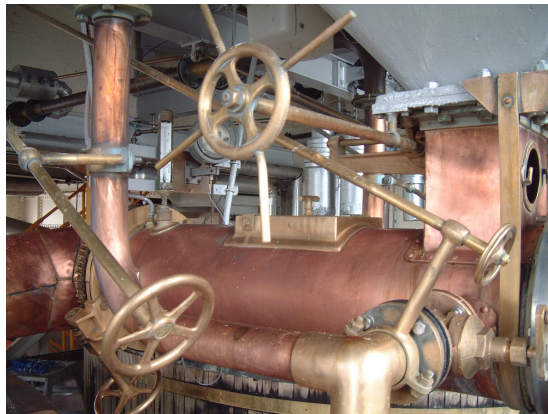


Figure 50. Brass and copper around the Steel's masher at Robinsons (2005).



Figure 51. The innards of a Steel's masher at Elgoods in 2006. Note the screw to move grist forward and the tines to mix the water in.



Figure 52. Chucking the grains out the hard way at Skinners (2013).



Figure 53. The world's only surviving Strainmaster is at Cameron's in Hartlepool (2003).



Figure 54. The Strainmaster has five banks of run off lobes inside.



Figure 55. Running off to the open copper at Wadworth (2002).



Figure 56. The calandria inside the copper at Arkells (2001).



Figure 57. Direct firing of the copper is now very rare. At Batham's it makes great toast! (2005).

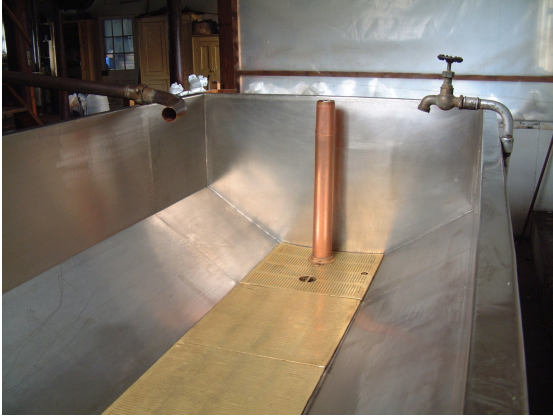


Figure 58. The open hop back at Donnington (2001).



Figure 59. Casting over late hops at Theakston (2009).



Figure 60. The open wort cooler at Hook Norton (2002).



Figure 61. The old trickle open wort cooler at Palmers in Bridport (2008).



Figure 62. The more hygienic stainless steel paraflow at Arkells. Note the hop seed filter in the foreground (2001).



Figure 63. 39 x 480hL Nathan vessels were installed at Allied Breweries in Burton to allow the closure of the Allsopps historic round room with 80 x 120bbl wooden lined vessels (BHS) .

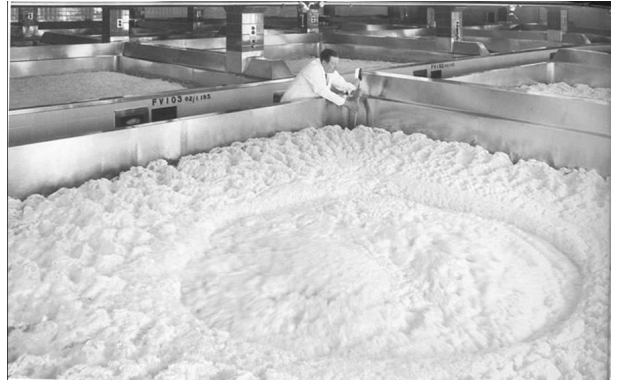


Figure 64. The open 445hL Yorkshire squares at Tetleys in Leeds which dated from 1961 (BHS).



Figure 65. One of many rotary vacuum filters for yeast drying at Guinness in Dublin (Diageo Archive).



Figure 66. Enclosed metal squares at Wrexham Lager. (BHS).



Figure 67. Lined wooden fermenters at Batham's.



Figure 68. Open stainless-steel vessels at Thwaites in Blackburn (2003).



Figure 69. Open stainless vessels complete with parachutes for skimming at Robinson's.



Figure 70. Lined wooden fermenters at Palmers (2008).



Figure 71. A yeast skip at Bathams complete with a woven cloth to allow barn ale to drip out.



Figure 72. A parachute at Harveys wound back up after use. Note the attenuation panel.



Figure 73. Burton Unions at Marstons.



Figure 74. A slate Yorkshire square preserved at Heineken's John Smith's plant in 2008.



Figure 75. A group of round Yorkshire vessels at Black Sheep (2006).



Figure 76. Skimming the yeast from the top deck of a Yorkshire vessel (Black Sheep 2006).

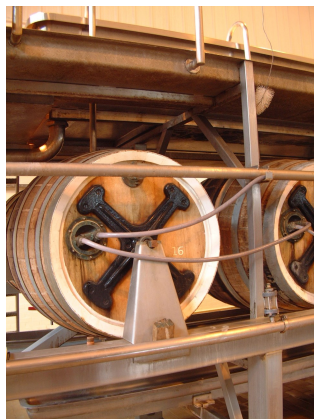


Figure 77. Details of the Marston's union casks.

discharge the spent grains rapidly. Within the vessel are five header pipes running longitudinally and attached to these are perforated straining lobes. The header pipes are connected to wort draw-off pumps.

Whitbread installed a pair at the new Luton plant in 1968. I remember the escalators rising to the brewhouse and kitchen sieves being used to trap particles so that a wort sample could be taken! Cameron's in Hartlepool still use a 1970 example where Chris Deakin assured me that it had been well and truly 'lauterised'; wort was bright and extracts were 96%. The 8-10 tonne charge is mashed using a Steels masher into a stirred mash mixer. After an 80 minute stand the mash is transferred and the wort is recycled for a full 30 minutes to achieve clarity. A filter bed is built up around the lobes and then wort can be run to the coppers. Sparge water is sprayed on the top from two fixed nozzles. As the sparge percolates into the bed each wort header is shut off in turn as the wort PG reaches 1008°. After a final draining the bottom doors are opened and the grains drop into the discharge system. It is even possible to do a half mash by judicious control of the wort pumps. The runoff takes 120 minutes and I believe this is the only Strainmaster left in the entire world.

Over to fermentation

The hopped wort would now pass to a collection vessel above the heat exchangers in the fermenting block. The vessel could be an old open coolship but most were enclosed with a swinging floating arm which drew bright worts from the top and ensured that the rate of cooling did not affect brewhouse operations. Today's brewers will cool directly off the whirlpool.

The old open Baudelot coolers were largely dispatched to brewery visitor centres as the more hygienic and efficient stainless steel paraflow heat exchanger had been around since just after the war. A hop seed filter would be placed in line so that seeds did not get into the plate pack and eventually clog up the wort flow. This comprised a fine mesh or a wire coil to trap any solids bits coming from the brewhouse. Aeration would be on the hot side from an oil free air supply so there were no issues with air sterility and the flow rate was controlled by a rotameter.

Yeast would be pitched as barm (yeast and beer from an earlier crop) at 1lb/brl (280g/hL) or else cool-stored yeast cake would be slurried with wort before tipping in over the side of the vessels which were usually open. An earlier dogma persisted that somehow enclosing a vessel led to undesirable flavours while Professor de Clerck opined that the maximum wort depth should be 2m for rapidity of sedimentation and ease of manual cleaning.

Most brewers would ferment to completion in the one vessel which might be square or round, lined wood, resin lined iron, copper, stainless steel or even aluminium. Ales were collected at 16°C and were allowed to rise to 21°C before being checked. I remember collecting the first brew of the week at 20°C so that it would run down for racking on the Wednesday night and later on the collection would be at 14° to allow for the weekend spent in the vessel. No one seemed bothered that a range of collection might temperatures might be causing subtle flavour changes in the beer!

Being labour intensive, few brewers bothered to remove any dirty head which appeared after a day in vessel preferring to rely on an Irish Moss copper finings addition to reduce protein levels by leaving it upstairs in the cooler. Attenuation was achieved with cold walls, internal panels or coils. The yeast would come to the top for cropping, sometimes with the help of a bucket of slurried kieselguhr filter powder or wheat flour to provide gas nucleation. The yeast head could be manually directed to one end of the vessel where it weired over for collection or else a parachute could be lowered into the yeast head. Other systems used an inverted hood under vacuum (supplied from the Scott tanks below) which was lowered on to the surface to collect the crop.

There were variations to fermenting techniques. Some favoured the dropping system where the wort was moved soon after collection, usually on to the floors below into a pair of vessels with the same cross section but half the depth. The depth favoured rapid settling of the yeast and the move left much trub behind upstairs and gave the wort a degree of aeration. The move was usually carried out after 24 hours but there was a variant called the Edinburgh system where this cleansing of the green beer took place after four or five days in the first vessel.

Getting the yeast count right before filling casks was of course vital to a consistent performance in the pub cellar and down the years, before the use of centrifuges, systems evolved to deal with the challenge. The large London brewers had abandoned the Ponto system at the turn of the century; this involved tunnelling actively fermenting wort into an array of large casks (around 13hL) set on their heads with a hole in the top which directed the froth into a trough. The settled beer was laboriously ladled back to keep the level up in the casks. As recently as the early 1950s Batemans in Lincolnshire were fermenting the beer in the same casks it went to the pub in. Froth was allowed to flow out of the shive aperture, would settle in a wooden trough below where it was collected and ladled back into the cask every couple of hours. Both were laborious and Batemans hardly hygienic despite the fact they had cut down some neighbouring fruit trees thought to be harbouring infection!

The Burton Union system developed sometime after the pontons and 'automated' the return of beer to the casks which were set on their bellies with a swans neck protruding from the top leading the froth into a trough running the length of thirteen 150 gallon casks. With another thirteen casks the other side of the trough, the unit could ferment 100 barrels. The froth collapsed and the beer ran back down into the casks via a transverse trough and a feeder arm. When all the yeast was upstairs and the casks cleansed to a yeast count of 1×10^6 cells per mL the casks were cooled by an internal coil and emptied into a trough below by unscrewing a bottom valve. Bass had 60 such sets in 1970 and they carried on until 1982 leaving only Carlsberg Marstons also in Burton still using the method.

One further survivor is the Yorkshire square once popular in the north of England and originally constructed in slate; it had a usually open cleansing chamber above an enclosed lower deck. The bottom compartment would be completely filled plus about 5cm flooded on to the upper deck. A hole with a deep 15cm lip around it allowed fermenting froth to foam up on to the upper deck which gently sloped towards the edge where collapsed foam would flow back down 'organ pipes' which were latterly just a couple of holes to join the bulk of the beer below. Again the yeast crop collected on the top. The nature of the flocculent yeast meant that a pumped rousing loop would aerate the process by spreading the wort across the upper deck from a fish tail.

Tetley in Leeds had 48 x 445 hL vessels dating from 1961 and added another 19 x 890 hL in 1996, this time fully enclosed for easier in-place cleaning. At the desired attenuation, the 'organ pipes' are plugged off and the yeast is skimmed to tanks below the vessels. The beer from the lower compartment was pumped to packaging after a residence time of five days with a top heat of 23°C. Removing the yeast grounds from the bottom chamber did demand full protective gear and a harness while another operator standing to ensure nothing went wrong.

Britain was slow into larger fermenting vessels probably because the wort lengths were relatively low and it would take an age to fill them. In Japan Asahi installed 5000hL 7.5m diameter sloping bottomed vertical tanks in 1965 while Rainier in Seattle had their unitanks at 5500hL with a shallow (12.5°) cone by 1968. Genesee in New York had a pair of Asahi type vessels which held 10600hL! The Aguila brewery in Madrid installed a bank of 3000 and 5000hL spherical conical bottomed unitanks; this would have the optimum volume to stainless steel ratio but welding, particularly applying the four cooling jackets, must have been quite a challenge! It is sad we were unable to find a picture.

We have already seen Guinness 26M and Bass had a pair of deep 700 barrel vessels but there were very few of the now ubiquitous conicals. Leopold Nathan took out a patent for a tall cylindrical vessel with a conical bottom in 1906 and once aluminium welding became effective some 100 hL 'Nathans' were installed in Australia in the 1930s. These did not take up much floor space, drained to a point and there was a distinct phase change when taking the yeast off the bottom. Being enclosed, CO₂ collection and in place cleaning was easy and they could be pressurised for maturation in the same vessel. Fermentation was faster by virtue of increased gas agitation inside the vessel.

Larger examples had to wait for fabricators to be weaned off copper bashing and invest in tools for stainless steel working. The steel could be rolled (or dishes and cones spun) and welded in relatively thin sheet, some of the early ones were <3 mm, but usually 3 to 6 mm but this needed the right grades of austenitic stainless steel and the development of welding techniques. Squares with flat bottoms and sides were very weak and needed structural frames, a vertical conical was structurally stronger and was supported by a single ring skirt where the straight side met the cone. The body could be in the open with only the cone area below protected from the weather.

Ind Coope installed 39 x 750hL vessels indoors and Luton had 850hL conicals outside before 1970 but it was the rapid rise in lager popularity after that date which led to a proliferation in usually 2000hL conicals as lager took longer to ferment and spent longer in maturation. The size was limited by the UK's rules on road transport but Bass in Burton did get four 4000hL vessels delivered on a Sunday morning from Robert Morton's less than a mile away! Changing the maximum road transport dimension rules over the years explains why the profile of some conical installations look a bit like the Giants Causeway! Today vessels can be fabricated on site and the Piedras Negras plant in Mexico has dozens at 10m in diameter with a capacity of 14,000hL.

For lager brewing, more volume was needed quickly and conicals represented an economic building option. The same challenges were apparent with conditioning tanks. 400 barrel horizontal tanks were common but size was limited by support stresses, loads on saddles and rings etc, so unless supports could be very thick going large was not an option. Indeed until stainless welding and forming techniques were available the tanks would be thick, heavy lined carbon steel. Vessel suppliers at the time included Briggs, Robert Morton, Henry Balfour, Burnett & Rolfe and Porter Lancastrian as well as makers in Ireland and Europe. How many of those could supply you with a conical in 2022?

We have been considering a lot of technological issues but there was one administrative driver to which the 1970 brewer would devote a lot of attention. The excise duty on beer was charged on specific gravity when the wort was collected. You had to declare that you intended to brew at a specific time and enter the planned materials. If you did not declare as much as the materials would yield you got charged on the potential yield as Her Majesty surmised you had probably salted it away somewhere! Every vessel was gauged and tables were created to relate a dry dip reading to volume. Tales of gaugers in dinghies inside the new conicals I think are apocryphal but certainly the earliest ones had scaffolding erected inside them. Eventually the Government Chemist agreed to calibrate the brewers' flow meters. Dipping Ind Coope's new conicals with a low ceiling indoors was a problem and later vessels had sight panels with the dry inches tack welded to the sides.

There was an allowance for production losses of 6% so if you had losses of 4% you got a useful 2% of volume duty free. Thus all residues were valuable not just in the materials and labour consumed in production so far. Pitching yeast was pressed dry and stored in shallow trays in a cooled room or else reslurried with water to save paying duty again after it was pitched. Most of the big boys tried hot wort collection without the yeast and that was essential when operating tower fermenters.

Vessel residues from conditioning tanks was usually 'dried' using a rotary vacuum filter. A filter cloth was stretched over a horizontal drum which sat above a trough. With a vacuum applied to the drum, a slurry of filter powder in the trough was layered on to the drum as it rotated. Once the drum was coated, vessel bottoms were pumped into the trough and sucked through the powder to remove the liquid. A knife shaved the dried yeast which dropped into a skip. If there was finings in the recovered residue, the knife would advance to keep the powder surface clear. The operator had to be wary not to cut too far into the powder as the Marmite factory would complain that their pumps etc were being abraded by excess powder and reject the load!

This approach to husbanding beer residues led to problems with oxygen levels and sterility. Beer had to be blended back and had to be pasteurised which introduced inevitable cooked flavours. I remember in Burton that the hot summer of 1976 collected some ten 400 brl tanks of recovered 'beer' which luckily the brewery was allowed to destroy which is what should have happened to it in the first place. Duty payment on invoiced sales at a nominal %ABV was finally introduced in 1993 and the 6% allowance disappeared. Commentators say that the poor reputation of Watney's Red Barrel was due to inconsistent blending of excess ullage. Incon-

sistent blending of tower continuously-fermented Worthington E affected that brand too but operating the towers is another story.

On to packaging and the pub

As most beer was destined for cask, the overriding technical issue was getting the yeast count right. Water was banged on as soon as the finished gravity was reached so that lower temperatures encouraged the yeast to drop out of suspension.

The yeast count before packaging was controlled by settling for longer in racking tank or increasingly by the use of self cleaning centrifuges. Depending on the upstream yeast count, a bypass period was calculated to get the required result as it was doubted whether yeast which had actually gone through a centrifuge would get going again. This applied to yeast for pitching as well. Cask beer would 'condition' to remove raw fermentation flavours like acetaldehyde and diacetyl in the cask both in the brewery and pub cellar while it built up the CO₂ level. Priming sugar was added, while some brewers played with adding amyloglucosidase to produce fermentable sugar; luckily a strategy which did not take hold.

The beer in cask was clarified using isinglass finings, this was usually injected into the cask at despatch using Morrison & Carpenter machines but increasingly it was added at rack to save a very manual operation which often held the draymen up. At filling, casks would have been closed with a porous tut to allow gas evolution in the brewery store and the M & C machine would replace that with a plastic coloured tut to seal the cask and indicate that it had been fined. A sealed cask with the finings in from filling meant that publicans had to be more wary when tapping the cask in the pub cellar, particularly when it was hot. Not all cellars were cooled and chilled brewery stores were rare and delivery wagons were open.

Isinglass is the dried swim bladders of various topical fish. Yeast has a preponderance of negative charge on its surface and the isinglass collagen molecule in acid solution is positive. Many brewers made their own finings, purchasing from very affable salesmen from James Vickers or Savilles Hydrological; this was in the days when there was no such thing as an afternoon for brewers but that is not the subject of this article! Dried leaves would be shipped from Indo China or Venezuela with names like Penang, Long Saigon, Brazil Lump or Maracaibo Pipe, these seemed to refer to geographic source rather than the actual type of fish it came from. At Bass, 84lb of Penang and Saigon was soaked for 24 hours and then cut using an old tobacco chopper. The cut



Figure 78. The classic shot of cask pyramids at Guinness in Dublin (Diageo Archive).



Figure 79. Filling casks with Ryder cocks (NBHT).

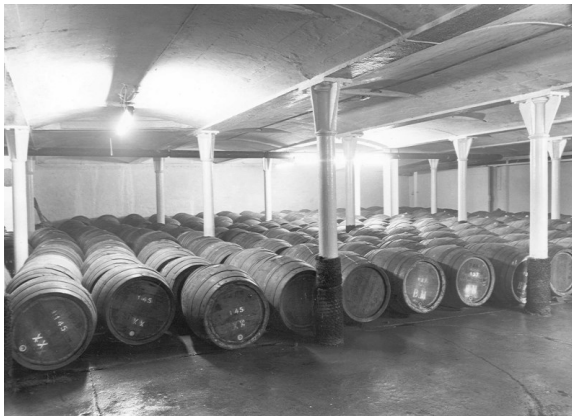


Figure 80. Casks in the cellar at Cornbrook Brewery in Manchester (NBHT).

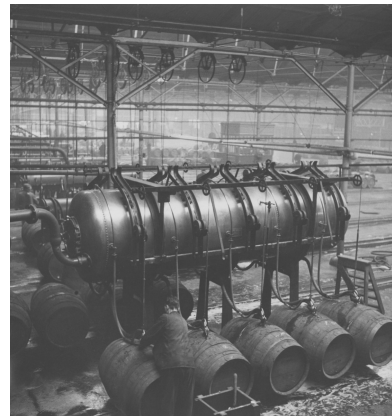


Figure 81. Racking back and hogsheads in Dublin (Diageo Archive).



Figure 82. Loading railway trucks at Bass (NBHT).



Figure 83. The racking room at Cape Hill, note the white-wash stencilled code. (NBHT).



Figure 84. The keg racking line at Bass in Burton (NBHT).



Figure 85. Details of the rousers, sightglasses and pressure control valves at Joules in Stone. (NBHT).

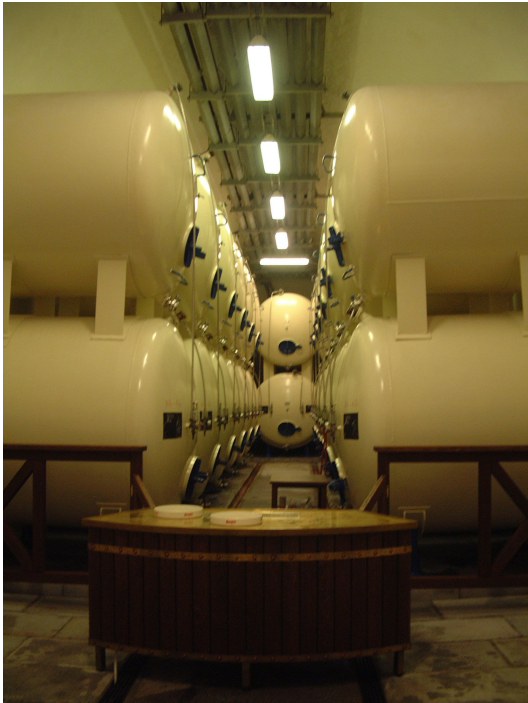


Figure 86. Horizontal conditioning tanks at Budvar in the Czech Republic (2005).



Figure 87. Schloss Kaltenburg near Munich.



Figure 88. A few of the 36 Enzinger charged-mass pad filters still in use at the MillerCoors Golden, Colorado brewery in 2013. Photo courtesy of Dave Thomas.



Figure 89. Reforming the cellulose pads at Golden. Photo courtesy of Dave Thomas.



Figure 90. Seitz Orion 100cm plate and frame filter at John Smiths in Tadcaster in 2008.



Figure 91. A bank of Nellie filters at Thwaites in Blackburn in 2003.



Figure 92. The cooper was a common sight in the days of wooden casks. This is Alastair Simm at Wadworth in 2002.



Figure 93. Leaves of isinglass at Banks's in Wolverhampton (2006).



Figure 94. The old Wagner cask washer at Palmers in Bridport (2008).



Figure 95. The cellar at the Bull and Bladder beside Batham's plant at Brierley Hill. These are epoxy lined cast aluminium barrels ...



Figure 96. ... and hogsheads at the Bull and Bladder.



Figure 97. Filling wooden casks at Wadworth (2002).



Figure 98. Filling metal casks at Harveys (2004).



Figure 99. Fining casks just before dispatch at Palmers (2008).



Figure 100. Stacking brand new empty kegs at Guinness in Dublin (Diageo Archive).



Figure 101. Unloading cases of empties at Brisbane (Castlemaine Perkins Archive).



Figure 102. Feeding the bottle washer on the left and refilling the cases on the right at Georges in Bristol (BHS).



Figure 103. Loading the bottle washer at Joules [NBHT].

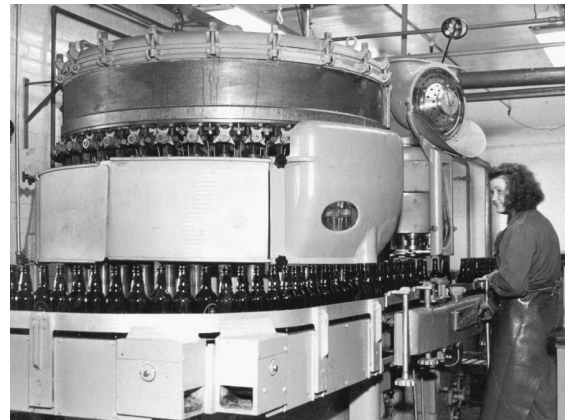


Figure 104. The bottling machine at Joules [NBHT].



Figure 105. The palletiser at Charrington's Mile End [NBHT].

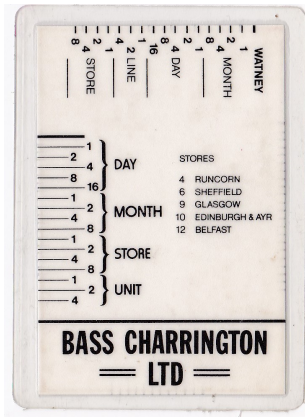


Figure 106. A Bass Charrington code edge.



Figure 107. The bottle washer at Donnington in 2001.



Figure 108. Cases were wooden, aluminium or in this case waxed cardboard from Mitchells and Butlers at Cape Hill.



Figure 109. A pair of redundant Worssam fillers at Holden's bottling store (2012) – too expensive to remove from position.



Figure 110. A flat end can by Felinfoel.

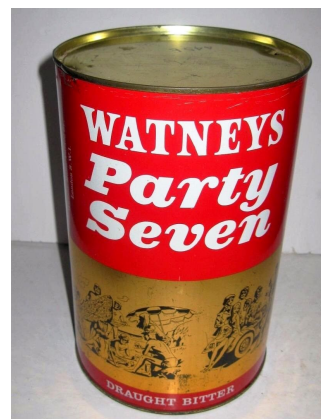


Figure 111. The 1970 student's Party Can by Watneys.

leaf was put into five barrels of distilled water with 14 lbs of tartaric acid and six gallons of sulphurous acid. The room was kept at 50°F and the wooden vessels stirred twice daily. Over three weeks the finings was diluted gradually and eventually made some 45 barrels. The final dilution was carried out using a crude viscometer where a cylinder should empty in 60 seconds. A long winded lab analysis to test for intrinsic viscosity (indicating the length of the collagen molecule) reported in decilitres per gram was not carried out very often but the Bass specification was a minimum of 20.

Otherwise cask racking was much the same as it is now. In 1970 there were still a lot of wooden casks around, some were lined with Dukeron paint (developed by Vanguard in the 1920s and later absorbed into Murphys) while others secreted light weight stainless steel inners. Wooden casks were expensively soaked with boiling water after washing to encourage sterility. Wood meant an army of coopers were on hand to see to repairs. There were still hogsheads being filled while the firkin and pin were quite rare since volumes of cask were still high without the proliferation of brands we are familiar with today.

One final difference would involve dry hopping into cask. These were half ounce T100 pellets usually East Kent Goldings. As well as leaching desirable hop oils into the beer, the dispersed hops were supposed to present a bacteriostatic surface as the cask was on dispense in the pub cellar. A classic two ounces per barrel probably did not give the desired hoppiness throughout the sale of the cask and as rates climbed to 4oz or eight pellets of Styrian Goldings you wondered whether operators could keep count of how many they had added! Far easier to move to late hopping in the whirlpool while some resorted to hop oils.

Brewery conditioning

Just under half of output was destined for small pack, keg and even tank deliveries. There was no thought then of allowing the fermenting heat to rise towards the end of the process in order to metabolise the beer's green flavours. The beer was devoid of much CO₂ content until the advent of the conical and to get rid of diacetyl, acetaldehyde and other raw flavours brewers had to resort to warm conditioning after pumping. With water cooled FVs the usual temperature at run down would be around 15°C and higher in warmer weather. Keg ales were usually transferred to cold conditioning straightaway so the only way of removing any residual diacetyl was to blend tanks. I remember tower fermented Worthington E being primed and roused while on open vent due to an unusually high level of unwanted volatiles. It also got a dose of heading agent (propylene glycol alginate), Manucol Ester B at

the time, none of the other beers did; no wonder CAMRA accused the brewers of using chemicals, which they were and still are of course! It got zinc sulphate as well in a desperate attempt to keep the head retention up.

For bottling, to start fermentation again, the beer would have priming sugar or sometimes krausen (actively fermenting wort) added. The tank would be warm at 13-16°C and stayed on open vent to remove the unwanted volatiles and then CO₂ would be allowed to build up. Brewers tended to frown on opening the CO₂ gas supply preferring natural conditioning and there are still some who will swear that natural is superior appearance-wise although I am hard pressed to explain how a CO₂ bubble can possibly remember its provenance!

Tanks were usually small and vertical with dish bottoms from 20-250hL, they would be fabricated in mild steel lined with Prodorite glass, epoxy resin or enamel and beer would stay inside for 7-28 days before transfer to tanks in a cold room. Care would be taken to avoid fobbing which would lose both gas and foam potential. Cold vessels were a similar size and residence time would be 7-14 days for home sale and 42 for export. Held at around zero, protein and tannin complexes would precipitate out. Proteolytic enzymes would aim to reduce the molecular size of the protein hopefully without damaging the head potential and the addition of tannic acid to export beers removed more of it. The beer would be fined at the end of the cold period and a swinging racking arm in horizontal vessels would hold back the residue before filtration. More modern installations used jacket cooled 'Redox' tanks for both warm and cold conditioning. Before the days of electron spin resonance, scientists were beginning to study the oxidation and reduction (redox) processes involved in the brewery hence the tanks where a lot of this happened were so called. Beers destined for the cellar tank trade got an addition of ascorbate to help scavenge oxygen as did any beer travelling by road tanker. These Redox tanks were usually hidden behind smart fascias which presented a very modern look to corridors of storage tanks.

In order to reduce the haze potential due to polyphenol (tannin) levels, polyvinyl polypyrrolidone (Polyclat AT) was known but was more usually incorporated into filter sheets although some export beers were secondary filtered through a Polynellie filter which contained the Polyclar. These machines from British Filters were prepared in the factory and were tightly packed with cellulose fibres and kieselguhr powder. They were on wheels for easy movement. They represented an effective means of small throughput filtration but the Polynellie version demanded a bright beer intake.

Most beer was powder filtered, usually kieselguhr. Perlite was known but once brewers looked down the microscope at both,

most stayed on the more expensive kieselguhr as it looked spikier and more able to trap particles in depth. Plate and frame filters would soon increase from 60cm square to 100cm. Both horizontal and vertical leaf filters were in use and each had their own enthusiasts. Stella metafilters were similar to today except the gaps in the tubes were engineered with hundreds of individual washers rather than being wire wound.

Cellulose pads were still formed in house and recycled after use in some places. Incorporation of asbestos fibres with excellent properties for particle entrapment was no longer used. Some brewers would rely on Carlson sheet filtration only but would have to leave excess duty paid residues in the conditioning tank to ensure a decent run length through the sheets. As now bright beer tanks would be analysed and passed for packaging. Note that all beer was at sales gravity throughout and nitrogen gas was not in used, keg quality beers were pushed about with air and even the largest brewery had but one dissolved oxygen meter and that remained in the laboratory! Guinness had large nine gallon kegs as there was a chamber containing a ready mix of CO₂ and nitrogen above the beer space.

Packaging

Cask racking was noisy due to the vast scale but operations were much as they are today. Keg lines were linear and extra lanes could easily be added as the package became more widespread. Kegs were filled 'the right way up', they were washed upside down and there was a tipper between the washer and filling sides where the container was held full of steam to sterilise it. It was thought at the time that tipping a full keg would be a challenge! Flowers at Stratford on Avon which closed in 1969 was hot filling kegs at 71°C over 270 seconds which spared for both sterilising the keg and pasteurising the beer.

As lanes increased, the feed of empties and the clearing of fulls became a problem, the Centrimatic machine with an increased number of heads doing different operations did ease these problems but the reinvention of the rotary machine would eventually become the norm for large scale operations. Kegs were washed externally but there was a disconnect between the glue used to keep the labels on in a damp cellar and the ability to wash the residue off later. A 3,000psi jet simply shredded the rubber seal on the top of the spear. Keg spears were screwed in in those days rather than being crimped; a careful cellar man could remove it for illicit purposes. Most brewers of my age will have deliberately stumbled and tipped over buckets of beer found in many a cellar. These slops usually went back into the cask

mild probably accelerating the demise of that style and cask beer in general.

Kegs ranged from 5 gallons for export, 9, 11, 18 and 36 gallons; the 22 (100L) was currently on the drawing board. There were no robots and the use of pallets was not widespread. As trade increased in keg, live stacked storage became attractive to save on floor space. Hand balling on to flat trailers was the norm. Long distance trunkers would be sheeted and roped to keep the load secure.

Cellar tank beer

There was a halfway house between the cask and keg for large throughput pub or club sales. The cellar tank was filled with bright beer from a local bowser, sometimes the beer was pasteurised but usually not as fast throughput was expected. It is however hard to know the level of output from breweries into tank as the Brewers Society (became BBPA) did not report it as separate from 'draught'. Some breweries in the north of England were major users.

Once again Watney was the pioneer back in 1913 with three wooden butts (108 gallons each) set on their ends and filled by a delivery tanker on an electric chassis. Charringtons also in London had three barrel earthenware tanks and Hull Brewery boasted that theirs were made by Royal Doulton! The investment would save on casks, coopers, washers and rackers as well as tally clerks to track containers in the trade. Tanks were soon made of stainless and many held beer in a plastic bag dispensed by air pressure. Porter Lancastrian made thousands of 180 gallon tanks but some were larger; I can remember standing beside a 10 barrel unbagged tank at the Torre Road Social Club in Leeds and actually being able to detect the level going down!

Peter Reeve remembers the bowser operation at Tetley Walker in Warrington. It served some truly huge volume outlets like the Blackpool Tower Ballroom but most were on Merseyside. Three cask products were chilled, filtered and pasteurised before filling into three compartment 60bbl road tankers. He notes that the drivers of these were by far the best paid workers at the plant – only the plant director earned more!

A man in a van used to go around before delivery to clean the cellar tanks as the publican could not be trusted to do it properly but by the early 70s, most tanks were fitted with a plastic bag by the driver, the fiddly bottom plate and old bag were returned to the brewery for cleaning and disposal. Eventually tanks were placed in frames which allowed them to tip up and make bag replacement easier.

Tanks were meter filled from the tanker using a 240 volt pump and CO₂ top pressure on the tanker. Dispense was achieved using air pressure from the pub cellar's compressor. The beer was supposed to have a five day shelf life and most pubs had (at least) two deliveries a week. Quality was good provided they were dispensed within 2 – 3 days. After that the beer would become distinctly oxidised, especially if small volumes were left at the bottom of a tank for a while. Perhaps the liners were not good oxygen barriers and it was probably a false economy not to use CO₂ for dispense. Waste was relatively high mainly due to burst bags sometimes caused by the driver turning pressures up to get the delivery completed faster. It was difficult to assess how much beer was lost as it went down the pub drain, fraud was sadly rife and there were court cases. Picking up beer from cellars using the pub compressor was very slow.

Bass invested considerable amounts in specific lines to fill bag lined five barrel Porter Lancastrian demountable tanks. The tanks were tared and weighed full. A service unit with the same dimensions as the tank was washed back at the brewery. Tanks were delivered by trucker and loaded with a service unit on to urban flat trailers for delivery. The Avery Hardoll meter was Weights and Measures accredited but all the other issues mentioned above remained problems. The delivery trailer could carry more different qualities of beer and the beer would not slosh around in a part empty compartment but also it disconnected tank beer deliveries from a local brewery with Bass closing at least four to the west of the Pennines in the early 1970s.

Times were changing and the days of an outlet selling over ten barrels a week of one quality were numbered and over time tank houses were returned to keg rather than cask containers. The tanks themselves were widely adapted during the 80s and 90s to make very useful small brewery kit.

Bottling was in decline

Fifty years ago bottling was in decline. Most beer was sold in the pub and very often a bottle was used to pep up indifferent cask beer. The increasing popularity of keg beer solved that problem and bottling had dropped from 27% at the start of the decade to just 12% in 1979. Apart from the noise and slow speed of filling, the biggest difference from today would have been the bottle washer, often double decked to save space in larger installations. The caustic detergent and beer residues made sure that the bottling hall in those days had a very distinct smell!

The industry had standardised on the returnable half pint London amber bottle with a crown closure. There was no

embossing and certainly no flint or green ones. Even slower lines would deal with pint bottles and nips of a third of a pint. This latter size was popular for as a winter warmer with the most famous being Bass No1 or Tennant's Gold Label which was in the Guinness Book of Records as the strongest beer on regular sale in the UK. Adverts at the time told drinkers that it was 'Strong as a double Scotch, less than half the price'.

The death knell to the returnable was the rise in the supermarket trade where these giants were able to dictate that customers would not be bothered to return them and handling would take up valuable retail space. Authorities in Germany were more insistent and the practice continues there although it is under pressure as brewers seek a marketing edge with embossing, different shapes and bespoke cases. Any return to returnables will see an end to light weighting so if one trips are widely recycled it would be an interesting sum to assess the viability.

Currently only Harveys with a regional base in Sussex still fills returnables. Its 275mL bespoke bottle is based on the London Standard but in metric. BHS President Miles Jenner is in charge and reports that once he got 10-12 trips out of a bottle but it is probably 5-6 today as everyone is conditioned to recycling rather than returning. He purchased a brand new bottle washer from AKOMAG when the bottling plant was upgraded in 2006. Interestingly he has recently hosted a number of visits from brewers wanting to restart returnables.

Empty bottle inspection would be by eye and the filler bowl would probably have been pressurised with air. 400bpm usually from a 60 head filler would have been fast. Labels would have saw cuts incised in the block before placing in the machine and the bottling/ batch information derived using a code-edge card. Finished fill levels would be checked with a gauge being held over the neck of the bottle and the level checked against markings. Bottles would then be packed into aluminium, wooden or even waxed cardboard cases, sometimes by hand.

Bottle conditioning was rare back then. Bass Red Triangle and Worthington White Shield were exactly the same beer while brewers bottling Guinness had to hold the bulk beer in tank until the CO₂ content came into specification. Red Bass was bottled flat. It was warm conditioned in the brewery with 3oz per barrel of dry hops, the fermentable residue was checked and primings was added to leave 4.3° for the yeast (3.8° in summer) which would give a total of 3 vols in bottle. After bottling the beer was kept at ambient temperature in the warehouse for 14 days to build up condition. At the time the secondary yeast was a diastatic strain which produced notes of 4 vinyl guaiacol but some potentially car-

cinogenic styrene as well, detected after the central lab got a new mass spectrometer device. The secondary yeast was changed to Charrington's highly sedimentary yeast. C & Co IPA had to have a bitterness of 40 to balance a present gravity of 1015 as the yeast settled to the bottom of the fermenter and refused to go any lower!

The first beer cans in the States were flat topped but you needed a church key lever to punch two holes in the top but then the cone top development meant you had to remember a crown opener instead. 'Church key' derives from earlier bottle crown openers which actually looked like an ancient ornate key and the name stuck as they got more utilitarian. The rip off tab appeared in the 1960s and by 1975 drinkers could not be trusted to look after the loose tab and the stay-on version came to market.

Fifty years ago UK beer cans were three piece steel with a base added by the manufacturer but with a very obvious side seam which made all round branding impossible. Drawn and wall ironed aluminium soon appeared from the States and tin plated steel could be similarly treated once precision got better and the steel exhaustively cleaned before the process. In those days the end was 211 and the can was not necked in at the top at all. Over the years the top end diameter has come down to 202 as the metal has to be thick enough to withstand pasteurisation so there are economies to be had if the amount of end metal decreases. The term 202 is itself archaic referring to the diameter of two and two sixteenths of the old imperial inch (54mm).

One development stretched the technology of the time; that was the Party Can or bumper; the one that was always left over after your party and then you took it to the next one. There were four and seven pint versions based on the dimensions of catering packs of marmalade. They were too big to pasteurise effectively so had to be sterile filled. Aseptic filling took place in a clean room with the bottling girls attired in smart white wellies. The beer passed through sterilising sheets and the whole filler needed to be kept better than scrupulously clean. Quite a challenge fifty years ago.

Contrary to what some of our younger members might think, beer was no longer delivered by horse and cart. Youngs in London used horses locally until 1997 and reckoned that some needed new shoes after just ten days pounding the streets of the capital. Happily some brewers still keep horses for show and they get to do a few deliveries around the brewery much to the delight of tourists if not motorists. Dray horses can still be seen at Robinsons, Wadsworth, Hook Norton and Samuel Smiths.

Into the pub

Today's customer would recognise the 1970 pub if he could see it through the tobacco smoke. The bar was full of working men while the lounge with its flock wallpaper and matching floral carpet was where you took your girlfriend for a Babycham. The gents loo was often outside. There were no logged glasses, you returned your glass for a refill which was not particularly hygienic nor was a rather perfunctory dip in warm water and a wipe with a grubby tea towel for the next guy.

That was nothing compared to the famous autovacs or economisers which are still strangely loved in Yorkshire. While Burton and Bristol did not want to see a single bubble on the top of a pint in an effort to get maximum beer value for money, the drinkers in the north expected a thick creamy head which laced down the glass. The barmaid would pull furiously against a tight sparkler and the glass would fill with a mixture of beer and released gas. To fill the glass completely much froth would overspill into the drip tray. To save wastage, a float in the drip tray activated a plug in the base allowing the next pull to draw some of the contents back towards the glass. This well aerated beer was much relished and deemed to be smoother rather like the idea behind the nitrokegs of the 1990s. The next customer got the slops from your pint. The short pipe from the drip tray was never cleaned properly, it was not insulated so biofilms built up rapidly. Surprisingly they have not been banned provided that pub training manuals explain how the risks of cross contamination should be minimised and bar people keep their fingers out of the cascading flow of beer.

The Weights and Measures Act of 1963 demanded that customers got what they paid for and the growth of keg beer and the introduction of cellar tanks saw beer being pushed to the bar using gas or a pump; this raised the opportunity to meter beer into the glass to control the wastage, improve presentation and of course mitigate bar fiddles. The Mills Spheromatic type was a perspex block with a spherical chamber and a diaphragm which moved back and forth to dispense a half pint as a switch activated the electric pump down in the cellar. The block was covered in a plastic box with the brand identification. Deft barmen with long fingers could fill two pint glasses at a time from adjacent fonts. Mills became Coldflow/IMI Cornelius.

Also popular were the Metron meters which morphed into Micro-Matic, here there was a glass horizontal cylinder on the bar. Inside was a piston and a lever was pushed from side to side to activate the piston movement to dispense the beer. Such a system would clearly show whether pipe cleaning had been effective. In both designs, glasses were over-

sized to accommodate the foam. Today the meter is on the cellar lines out of sight coupled to the EPOS system and the bar taps are free flow.

Modernising the bar meant many old manual cask beer pumps were removed and replaced by a pumped and metered flow. Although the process to remove brass and hence the risk of lead contamination from dispense systems did not gather pace until the 1990s, many old handpumps were taken out as a reduction in tube size from 5/8" (16mm) to 1/2"(12mm) to save cleaning losses put too much strain on the mechanism and indeed some of the ancient wooden cabinets simply fell apart. With quarter pint cylinders, Flojets to push the beer towards the bar and even narrower bore piping, the pump handle still indicates the presence of cask ale to the aficionado and they are ubiquitous in that sector.

Finally a word on quality. Control in those days, assurance had not been thought of. All testing was carried out in the laboratory. Most tests seemed to be Excise OG distillations. Very often samples would be left outside the lab door and no one else was allowed in, especially the brewers. We have all known bolshy technicians who would squint at a read out and gleefully record a failure. Without the benefit of software, readings would be processed manually and carefully plotted on to wall charts. Brewers could only spot trends if they visited the chart room or else plotted their own key data points.

As we saw earlier worts and beers were rarely tasted until the head brewer held his cellar sampling, often in the case

of busy brewery like Cape Hill that took place after the casks from the rest of the batch had started to come back for refilling! There would be a strict hierarchy tasting from a single glass which was drawn by a white coated operator. 'Slightly not polished' was a common observation and SNP was entered in the log long before there were any Caledonian connotations! The glass was passed down the line and eventually the newest assistant brewer might get a spoon full but there was no point commenting as the Head Brewer was well into the next sample by then!

Finally, am I going to say the beer was better back in 1970? Emphatically no; there was too much variation across the trade and the ravages of bacteria and the oxygen radical were all too apparent. We have actually made some progress!

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