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# A MANUSCRIPT MALTSTER'S DAY BOOK FOR THE MALTING SEASON 1886/87: AN ASSESSMENT

PETER BROOKES

Victorian authors of works on malting[1,2] give 'text book' descriptions of malting practice at that time. But practical records of day-to-day controls and operations are rare.

A manuscript day book for an unknown maltster for the 1886/87 season has come to the hand of my friend and former colleague, Tom Martin. The maltings, probably in the East Anglian region were operated with a 35 quarter (qr) batch size and 68 steeps were carried out between 11 September 1886 and 18 June 1887. This would probably have yielded a production of around 2,700 quarters of malt (~412 tonnes). The book relates to No. 1 kiln. There is a small reference at the end of the flooring descriptions on Lot 6 that, 'it is more open than the other two kilns'. If this means that two other similar malt houses are operated we would have a total annual production of around 8,000 quarters of malt (~1,200 tonnes). This would make for a more commercially viable business. I have analysed the data in the book in the light of knowledge at the time and where appropriate I have related practice to that of the present day. Illustrations of the data given for individual steeps, Lots 5, 15 and 36 are shown as figures 1, 2 and 3.

## Location of maltings

It is difficult to establish the location of the maltings from the records. There are some notes relating to barley drying on a kiln. This was common practice and was still being used in Allied Breweries' maltings at Mistley in Essex as late as 1975. There is reference to the use of Saale barley which is from Halle in Germany. This suggests the location may be close to an east coast port in Norfolk or Suffolk.

## Barley

The season is started on 11 September 1886 with kiln dried Norfolk barley. This is from the 1885 crop and will have been 'held over' from the end of the last season in June 1886. There is no mention of variety. Variety would not have been an important issue at this time.[3] Of more importance to the maltster was the location of barley growth. In the nineteenth century barleys were mostly 'land races' of mixed origin but selected to give the best results in a particular area. The earliest known variety was Chevallier selected from a land race in 1824. This would have been known to our maltster but he makes no mention of this in the 1886/87 season. The superior variety, Goldthorpe, was not selected until 1891. Barley from Lincoln is used for Lot 11 (21 October) and then interestingly Hungarian barley for Lot 12. This may have been used as a specific trial or it may be an indication of scratching around until 1886 crop was ready for steeping. It was certainly known in 1886 that barley could not be effectively malted until at least a month after harvest;[4] but dormancy was not properly understood.[5] Systematic germination tests on the barley would have been unlikely to have been carried out.

The new season opens with Lot 15 (Fig. 2) and this is Saale barley, undried from the 1886 crop. This again is interesting. Does the use of German barley indicate that the English barley had not recovered from dormancy? The Saale barley would probably have been drier at harvest than the English barley and hence was not dried. Maltsters from mainland Europe have steeped undried barley throughout the twentieth century but this has always been a risky practice with the cool temperate oceanic climate of Great Britain and Ireland where

moisture content of the barley can be in excess of 16% at harvest. Germinative ability of the grain will rapidly deteriorate if it is stored at > 16% moisture for long periods of time and this should have been known to our maltster in 1886. It is worth noting that in the 'sinker' test Lot 15 gave 9% sinkers and was described as 'hard'. The sinker test was first described in 1757.[6,7] Interpretation of sinker test results is notoriously difficult. A rule of thumb was that malts showing >5% sinking corns were undermodified and likely to give trouble to brewers. This is not necessarily so. A good malt may yield 20% sinkers. This is because floaters depend partly on air trapped beneath the husk and if this escapes owing to cracking then corns will sink. The results reported by our maltster must be interpreted with caution.

This is highlighted by comparing the results for Lots 19 and 22. For Lot 19 we have 1886 crop dried Danish barley which may have been expected to show greater malting potential because of drying. But this gives 8¼% sinkers. In contrast Lot 22 is a blend of undried Saale and Norfolk barley and yields a malt with only 2¼% sinkers and is described as 'tender'. I imagine this blended steep was a result of expediency rather than planning but it is noteworthy that our maltster never blends dried and undried barley. This practice would lead to very uneven malt. We also have interesting comparisons between Lots 5 and 36 (Figs. 1 and 3). Both malts are prepared from Norfolk barley. Lot 5 (27 September) is from 'held over' dried 1885 crop and gives 16¼% sinkers and is described as 'hard, chiefly ½ grown'. Lot 36 (29 January) is from 1886 crop barley

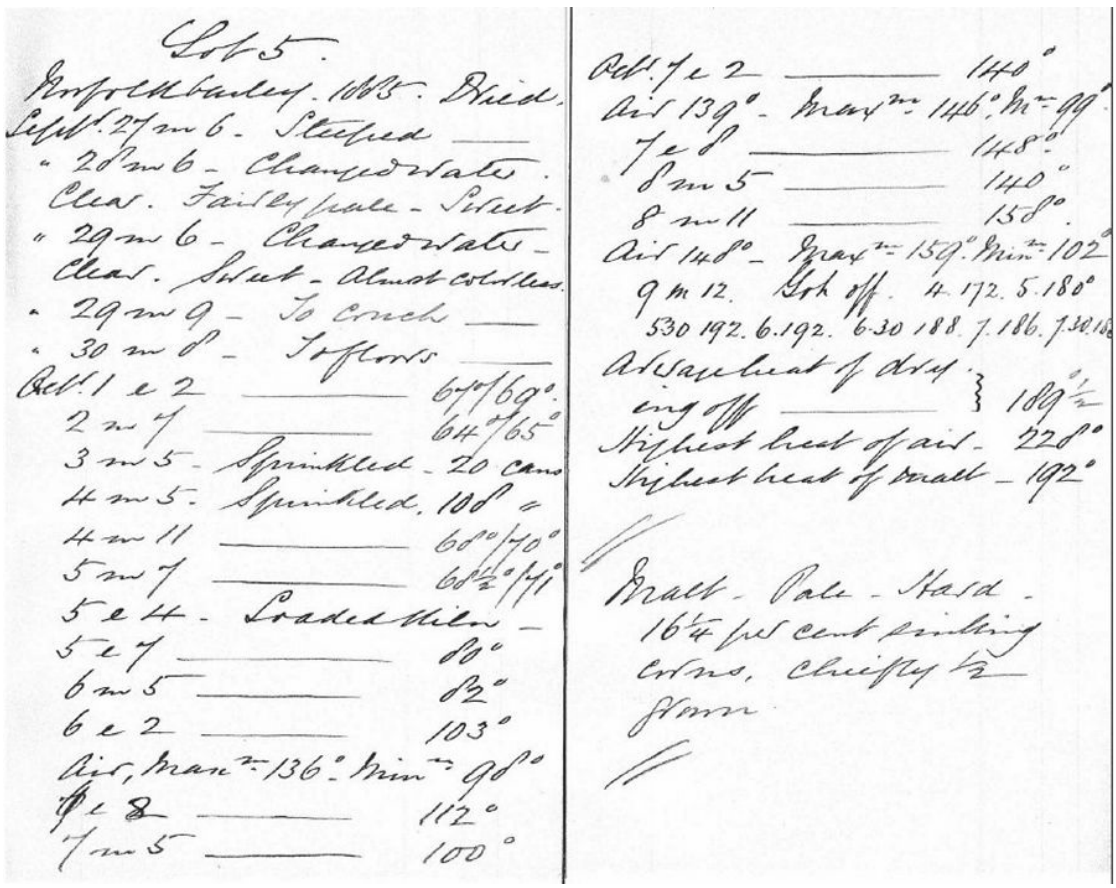
Lot 5.
Norfolk barley. 1885. Dried.
Steeped 27 m 6. Steeped ____
" 28 m 6 - Changed water.
Clear. Fairly pale - Sweet.
" 29 m 6 - Changed water -
Clear. Sweet - Almost colorless.
" 29 m 9 - To couch ____
" 30 m 8 - To floors ____
Acht. 1 e 2 ____ 64°/69°.
2 m 7 ____ 64°/65°
3 m 5 - Sprinkled - 20 cans
4 m 5 - Sprinkled. 100 "
4 m 11 ____ 60°/70°
5 m 7 ____ 60½°/71°
5 e 4 - Loaded kiln -
5 e 7 ____ 80°
6 m 5 ____ 82°
6 e 2 ____ 103°
Air, Max^m 136° - Min^m 98°
7 e 8 ____ 112°
7 m 5 ____ 100°
Acht. 7 e 2 ____ 140°
Air 139° - Max^m 146° Min^m 99°
7 e 8 ____ 148°
8 m 5 ____ 140°
8 m 11 ____ 158°
Air 148° - Max^m 159° Min^m 102°
9 m 12. Grk off. 4. 172. 5. 180°
530 192. 6. 192. 6.30 188. 7. 186. 7.30 18
Arrangement of drying
ing ____ 189½
Highest heat of air - 228°
Highest heat of malt - 192°
Malt - Pale - Hard -
16¼ per cent sinking
corns, chiefly ½
grown

*Figure 1. Lot 5.*

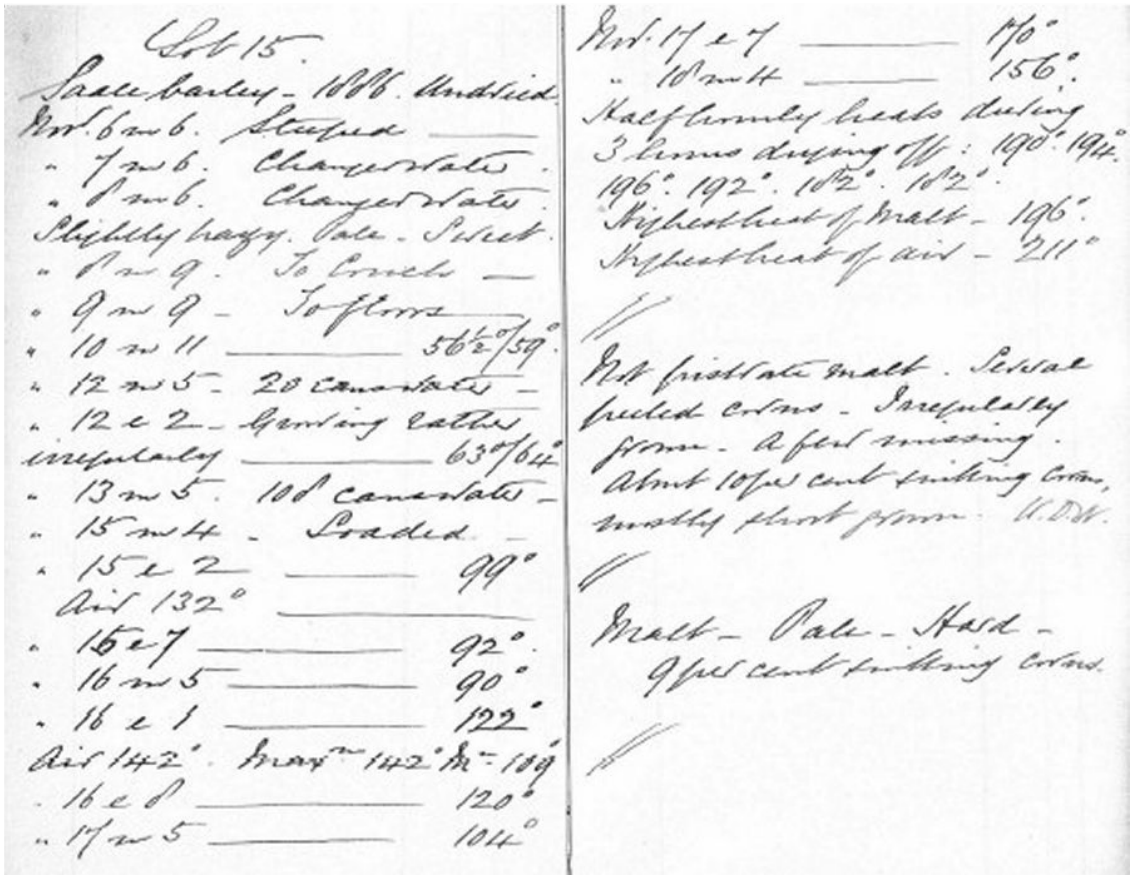


*Figure 2. Lot 15.*

not dried and yields a malt of 3¼% sinkers described as, 'fairly tender'. Initial interpretation may have expected the reverse sinker analysis.

The season continues with Norfolk and Lincoln barley which is either dried or undried; no pattern seems to emerge. However we see that Lot 42, Lincoln undried yields 6% sinkers and is described as 'very discoloured and hard', whereas Lot 46, Lincoln dried yields a malt of only 1¼% sinkers described as 'tender, nice flavour'. Lot 52 is from local barley described as 'Birkett'. Birkett is presumably the farmer. But what is local? This is the only steep described as such.

The season then ends with a run of Norfolk barleys which are either dried or undried. A couple of steeps in this final run are with Bedfordshire barley. The malts produced had 9% and 10¾% sinkers respectively and both are described as 'fairly tender'.

The final steep is on June 6th 1887 with Norfolk undried barley. Now this barley would probably have been harvested in August of 1886 at around 16% moisture. It is surprising that it was fit for steeping in the following June. Stopes is adamant that all barley benefits from sweating on the kiln prior to steeping. White says that 'barley will not vegetate properly if it is damp in the store'. These factors would be known to our maltster. Why was he taking a chance on steeping undried barley in June? The only answer can be the saving of operating costs.

Our Maltster makes no mention of any cleaning or grading of the barley prior to steeping. Stopes makes it quite

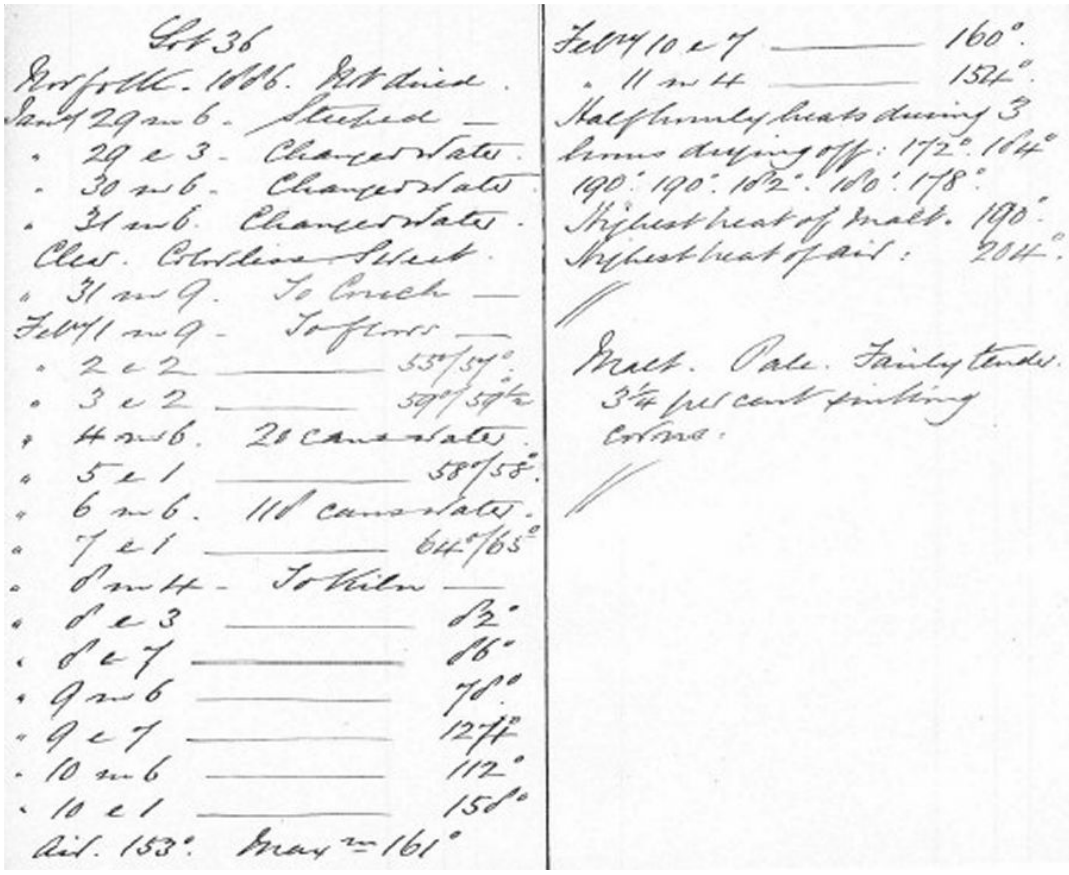


*Figure 3. Lot 36.*

clear that the quality of malt is better if barley is cleaned and graded before malting. He particularly makes reference to the removal of damaged corns and half-corns which make the resulting malt less prone to mould and 'fungoid growth'. Equipment was available to do this. But the treatment was expensive and added to the maltsters' loss. As a result at this time many maltsters did not clean (screen) the barley before steeping. Stopes pithily remarks that whilst maltsters pay little attention to the appearance of the malt as a result of not cleaning brewers increasingly do.

**Steeping**

Steeping regimes seem to be very similar throughout the malting year. Lot 1 is steeped at 6am on 11 September and cast to couch at 10am on 13 September. Water is changed at 6am on the 12th and 6am on the 13th. We thus have 52 hours continuous immersion with two water changes.

This regime continues basically unchanged to Lot 53 steeped on 7 April 1887. We now see three water changes and this continues to the end of the season with two exceptions: Lot 61, two changes and Lot 68, the final steep, four changes.

We have no information on steep water temperature. Stopes is very clear on the importance of temperature but also states that he has 'yet to meet three maltsters in Britain who take the trouble to record the temperature of their steep liquor'. White says that barley should be kept in the steep long enough such that when the ends of an

individual corn are squeezed between thumb and forefinger they are 'brought together'. White says that 48 hours steeping should accomplish this. Our maltster should have been aware of White's book if not of Stopes' which was published in 1885. Stopes makes the point that thin barley requires the shortest time and new barley requires a longer steep than old. But in no case would he give less than 50 hours. It seems then that our maltster is in line with what was current practice.

After steeping the grain is put into a couch (heap) for 24 hours. Couching of the steeped barley was a requirement of the malt tax which was repealed by Gladstone in 1880 and so would not have been a concern to our maltster in 1886. However it is likely that the principles of malting to the requirements of the tax would still be uppermost in the maltster's mind and so the use of the couch would be quite normal. Couching as a technique was still being used at the Allied Breweries floor malting at Shobnall in Burton on Trent when I became manager in 1978. The idea was to promote the onset of germination by increasing the temperature. In practice germination was frequently delayed as the grain lay in a heap with restricted access to oxygen. I replaced couching by the 'strip' malting system where the piece was laid out on to its full ground after steeping in a bed no more than 4 inches thick. This promoted the onset of germination with resulting improvements in malt quality. This change was only made after a Stage 4 industrial dispute as we were changing the 'status quo' (frequent occurrences in Burton in the 1970s; Stage 4 involved the Site Director and the full time Union Officer).

The batch size given by our maltster is 35 qr of barley. This leads us to consider the shape of the steeping cistern. By 1885 Stopes is adamant that only one type of cistern is to be considered and that is a self-emptying vessel with a hopper bottom; all other restrictions on size and shape having been removed. It just so happens that Stopes had his own design ready for sale in this year. However it was a requirement of the malt tax (Act 7&8 Geo. IV.cap 52) that if steeping more than 8 bushels (1 quarter) of barley that the steeping vessel must be permanently made and rectangular and the depth must not exceed 40 inches nor the width 8 feet. This vessel 'prepared' the barley for the couch frame where it took up a greater volume and so was subject to more tax. Now our maltster was not subject to the malt tax in 1886/87 but would he have invested in new plant between 1880 and 1886? I think not and so I think that the steeping cistern was rectangular of the type required by the strictures of the malt tax.

We can conclude on steeping that the techniques used by our maltster are quite typical of the time and these systems would remain unchanged for nearly 100 years. It was the work at the Brewing Industry Research Foundation (BIRF) in the 1950s that would change everything.[8]

**Germination**

Germination time appears to be 6/7 days. Recording of temperature is haphazard. The temperatures that are recorded reveal wide variations. This is to be expected with the limited means of temperature control available. Temperature would be controlled in the main by regulating the thickness of the piece and careful setting of window apertures.

There is no record of temperature on Lot 1, did our maltster forget? On Lot 2 we see 56/58½ºF (13.3-14.7ºC) on coming out of the couch and 84/85ºF (~29ºC) at kiln loading. This is an atypically high temperature and is not repeated. Pieces in general are loaded to the kiln at around 60-70ºF (15-21ºC). Neither White nor Stopes are definitive about germination temperature. It is the craft of the maltster in controlling the vigour of the piece which is stressed as important. The fact that our maltster managed to load the majority of his pieces at 60-70ºF suggests that germination is well controlled. Writing in 1908 Lancaster says that piece temperatures should not rise above 70ºF. In the Allied Breweries floor maltings in the 1970s it was the objective to load to the kiln at =20ºC.

Of great significance in the control of the rate of germination on the floor was the use of sprinkle water. It is stated on Lot 1 that the steep weight is 35 qr. On Lot 1 14 cans of water are used after 3 days germination and 60 cans of water are used at day 5. Now our maltster does not tell us the capacity of the cans used for sprinkling. Capacities were commonly 4 gallons but cans of 2 and 3 gallon capacity were available. If we assume that a can contains 4 gallons of water we have rates of 1.6 and 6.8 gallons /qr at days 3 and 5 respectively.

Briggs states that typical sprinkling rates throughout malting history were from 1 to 5 gallons/qr.[8] If our maltster is using a can of 4 gallon capacity then he is applying sprinkling volumes at the high end of common practice. In the nineteenth century and in the twentieth century for that matter sprinkling rates have been subject to much controversy and debate. In the days of the malt tax sprinkling was controlled by statute. Stopes calls the regulations on sprinkling absurd and as a result the knowledge of United Kingdom maltsters on the value of the technique was poor. Our maltster was, of course, malting after the repeal of the malt tax. He was likely to have been influenced however by work carried out when the tax was in force. Ford reports on experimental steeps designed to evaluate the result of sprinkling.[9] He finds that sprinkled malt yields 2lbs/qr less extract when brewed than non-sprinkled malt and also weighs 2lbs/qr less. Less duty was thus paid on the sprinkled malt. There is no doubt that the use of sprinkling leads to greater root growth and hence increased malting loss. But there was a desire after 18802 to have acrospires 'fully grown' i.e.to the length of the corn but not protruding from the end. In this respect sprinkling was an advantage and would make up for inadequately steeped grain. Buyers of malt would often examine the acrospire growth before agreeing a price with the seller.

Our maltster invariably gives two applications of sprinkle water in germination. As the season progresses rates increase to 20 plus 120 cans (2.2 plus 13.6 gallons /qr for a 4 gallon can). He does appear to be inflexible on steeping time and so is probably trying to make up inadequacies in immersion by sprinkling. He may have been better advised to increase steeping beyond 52 hours and avoid excessive sprinkling.

There is no mention of the moisture content of the germinating grain. This would be unlikely to have been determined in a laboratory. Hand evaluation would be the measure for moisture and would have been the criterion for deciding the sprinkle volume.

In the floor maltings of Allied Breweries we were not great users of sprinkle water. From the 1950s onwards we had the knowledge derived from the work at the BIRF at Nutfield of Essery, Kirsop and Pollock.[10] Steeping techniques with air rests resulted in better water distribution in the barley corn and lower malting loss and improved extract yield.

Hygiene procedures are not discussed and these would not be uppermost in our maltster's mind. However there is a comment made on Lot 7, '108 cans of water no 'phite used'. Now this almost certainly refers to a sulphite. Bisulphite of lime was in common use in the nineteenth century.[11] It was used in the steeping cistern or on the malting floor. Stopes gives the rate in sprinkling liquor as half-a-pint per can of 4 gallons. Our maltster does not tell us how frequently he makes use of this technique.

Germination time used by our maltster is quite short by the standards of the time. This suggests he was skilful in flooring and in 'window-craft' to control temperature.

**Kilning**

Kilning time is reported to be around 72 hours. We do not know the detail of the kiln but it will probably be an entirely natural draught kiln or have air flow assisted by a top fan. The loading is likely to be no more than 8 inches deep. There is no mention of any kiln turners or hand turning on the kiln.

Temperature recording is meticulous. I think that the temperatures recorded are those in the malt bed. On Lot 2 at loading we see a note of air temperature as 125ºF (~52ºC) and a malt temperature of 84/85ºF (~30ºC). This indicates a typical gentle start to a traditional kilning process. There are only occasional recordings of air temperature and yet we have detailed recordings of malt temperature. This reflects the relatively poor knowledge of the maltster of the physics of kilning. This was probably typical of many maltsters at the time. Stopes wrote extensively about kilning. He generally recommended the two-floor kiln where drying starts on the upper floor and then curing takes place on the lower floor another piece having been introduced above. This practice was common in continental Europe but not in the UK. It is unlikely that our maltster's kiln was two floor; there is no mention in his day-book of this type of operation. A record is always made of the highest heat (sic) of the malt and the highest heat (sic) of the air-on. These temperatures are typically 195ºF (90ºC) for the malt and 215ºF (101ºC) for the air. The temperatures are typical of ale malt kilning and would be on the higher side of those common in 1886. But would follow the generally held view that malts finished at high kiln temperatures

(>210ºF) produced the soundest and best flavoured beer. Records are made of half hourly heats during 'drying-off'. This probably relates to what we would call curing when the temperature is increased to impart colour and flavour to the malt when the moisture content is less than about 7% (the time for this would be evaluated by hand). The temperatures fall towards the end of the drying off and suggest some cooling taking place as the furnace would be dampened down. The kilning regime suggest that the off-kiln malt would be quite dry (<3% moisture). Any slackness indicating poor kiln control would be revealed by hand evaluation. It is unlikely that moisture determinations would be regularly made on the off-kiln malt at this time.

There is no record of fuel consumed on the kiln. This would likely have been known and was perhaps recorded elsewhere. Considering the temperatures used it is probable that the fuel was anthracite or coke. Our maltster would certainly be concerned about the amount of fuel used. But the first real analysis of kiln conditions and fuel consumption was not reported in the UK literature until Beaven in 1904.[12] This paper revealed the importance of kiln air-on temperature control and air flow in gaining fuel efficiency.

Looking at the detail of the operational sequencing it appears that steeping is organised to ensure continuous operation of the kiln. This would make sense from a fuel efficiency standpoint but would require careful management of the kiln furnace.

## Malt analysis

The only analysis we have in the day book is the sinker test and hand evaluation. Results for the sinker test vary widely from 1% to 16¼% (Lot 5, figure1) sinking corns. Results in the sinker test cannot be predicted from study of the malting conditions. The results are more likely a reflection of the condition of the barley used.

## Conclusions

This maltster's day book is a fascinating account of a malting season. Records are made of the things important at the time: barley source, steeping time, germination temperatures, sprinkling water amounts, and kiln conditions. What is surprising is that there seems to be little systematic attempt to change malting conditions to improve the malt as the season progresses. But if our maltster has only the sinker test to go on then perhaps this is asking too much. However the environment of our maltster was changing rapidly. The years between 1860 and 1890 saw brewing becoming more scientifically based with interest in the beneficial impact of knowledge of chemistry and biology. Scientists were appointed in breweries with Henry Böttinger joining Allsopp's and Horace Brown joining Worthington's. Pasteur published Etudes sur la bière in 1876.[13] Scientists in Burton established the 'Bacterium Club' in 1876 and the 'Laboratory Club', the forerunner of the Institute of Brewing was founded in 1886. Our maltster could not fail to be touched by these developments. How he was to react we do not know. I hope he was to succeed.

The omens were good. Floor malting was to continue for a long time in the UK and the system benefited greatly from the influence of scientists. At the time of its closure in 1982 Allied Breweries' Shobnall Floor Maltings in Burton was yielding 16000 tonnes of malt (~105000qr) annually with individual pieces processed in 7 days. Our maltster had the prospect for a sound future.

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