THE

ART OF BREWING

INDIA PALE ALE

AND

EXPORT ALE,

STOCK & MILD ALES,

PORTER & STOUT.

BY

JAMES HERBERT,

PRACTICAL BREWER,

BURTON-UPON-TRENT.

FIFTH EDITION. PRICE 10s. 6d.

PUBLISHED BY THE AUTHOR.

1872.

CONTENTS.

A Practical Treatise on Brewing.

I am induced to write this small work on Brewing, through having a long and varied experience, both in London and different parts of England; and having practised the various systems, I have formed my own conclusion as to the best method of brewing practically to produce a good sound article, combined with good keeping qualities. Not having a knowledge of chemistry, you will perceive at once that this treatise is based on practical experience, and not written from theory. Chemistry is a great science no one can doubt, and its advantage in brewing seems quite patent to the ordinary practical brewer; although I must confess I am not so enraptured with the science myself in respect to brewing, inasmuch as I am quite satisfied that with pure spring water, immaterial whether it is Burton water or from any other part of England, and being supplied with the best materials in Malt, and the best East Kent Hops, for Pale Ale, I should be fully satisfied that I should not require the aid of a chemist. It is quite evident that chemistry has nothing to do with the production of Malt liquors. For analytical purposes it is invaluable. Very well, the scientific brewer has a gyle of Ale gone wrong; he immediately has recourse to the chemicals; he detects the cause, but he cannot alter the evil, and attributes it probably to atmospheric influences; or perhaps the worts were pitched with unsound yeast; or he might attribute it to other causes; however, he has detected the evil, and will endeavour to prevent its occurence for the future; but why does he not prevent the evil? The fact is simply this,—that neither the scientific brewer, nor any other human being, can prevent Ale from acidifying. Surely, if it can be done by the aid of chemicals, after so much experimenting I think it is high time it was brought to light. There can be no doubt that the scientific brewer is often carried too far by his science, and is apt to make more mistakes than the ordinary practical man, who pays far more attention to the fermentations, or, I will say, the most important part of the process, than the gentleman brewer, who is fond of sitting in the chemical room

experimenting on the Ales. If statistics could be obtained as to the quantity of Beer spoiled by the scientific brewer, and also by the ordinary practical man, I am confident that it would be favourable to the latter; for I believe that there have been more Ales spoiled from experimenting, and scientific men brewing from their theoretical knowledge, than from any other cause; inasmuch that Ales brewed from theory will not keep good, the least change of the atmosphere, particularly in summer, making the Ales turbid and in a state of ferment, which would be called a second fermentation, and the action of such ferment takes the flavour from the Ale, causing it to drink hard and raw, the same as though it had not been boiled its proper time. It also takes the colour, and considerably weakens the Ale, and there is no remedy to alter the evil. Probably a little knowledge of chemistry would be useful to discover the cause, not to cure the evil in the present Beer, but to prevent it for the future. The art of brewing has derived very little benefit up to the present time from the progress of chemical knowledge, as far as discovery goes, in the production of good sound keeping Beers.

The rules that I am about to lay down are so strictly practical, that even the uninitiated will be able to carry out a brewing of any class of Ale specified in this work, without the least fear of spoiling the article he is manufacturing, provided he adheres closely to the rules as they are laid down. I will commence with a thirty pound Ale, that being a moderate weight compared with the Burton Strong Ales, whose gravity varies from thirty-five to forty pounds. In this I will leave to the operator to exercise his own discretion, as I do not consider it my duty to dictate to the tradesman the exact strength he should brew the Beers he sells; there are so many different sorts of Ale brewed, more so in London than any other part of the Kingdom, consequently the brewer must study his own interest as well as his customers.

BREWERY.

I have seen a good many curiously constructed breweries in different parts of England; some have not been worthy the name of brewery, and to describe the principal part of them would be a waste of time. I am not alluding to publicans who brew their own Beer for a retail trade; it is very seldom they have sufficient room to manufacture their small quantities judiciously for their home

consumption, they have no alternative but to let the brew-house remain in its old state, and carry out the same system they have done for years; probably, however, a few suggestions thrown out in the way of improvement would not be amiss. I will say a five or ten quarter plant, or less size than the above, that would be immaterial if you brew by steam power, excepting the boiling of your worts, which should be boiled in an open copper; there should be a water tank or iron boiler on the top part of the brewery, with a coil of pipe placed in the same, connected with the steam power, for heating the water to mash with; underneath the above tank or boiler you would place the mash-tun; a little on one side of the mash-tun, on the next story below, should be the wort copper, whereby the worts can run from the mash direct into the copper, consequently you would not require an underback, and the worts would not be so liable to take acid as they would by remaining in the underback for an hour or two. The worts in the copper, you can be raising the heat for boiling. I would also have the coolers on the same floor as the wort copper, thereby doing away with pumping of worts; underneath the coolers should be placed the fermenting rounds or squares, and from them you run the Ales into the cleansing cask. A brewery fitted on this principle, the proprietor would save a great expense in labour, and get his brewings over in a third less time, which is most essential to prevent the worts from acidifying, which often takes place by hanging about either in the underback or on the coolers. A brewery for a publican who brews Home Brewed Beer, as it is generally called, could be fitted on the same principle, only on a much smaller scale; he would find it very beneficial to his own interest, his article would give universal satisfaction, and he would do away with all dipping of worts, handling them from one utensil to the other, and be able to carry out his brewings upon the same principle and method as the wholesale brewer.

WATER FOR BREWING,

The water certainly has a great deal to do with brewing, and it is not every county that is able to boast of such pure and excellent spring water as Burton-on-Trent; to which most persons attribute the excellence of the Burton Ales. I am not so decided on this point. Admitting the qualities of the water to be second to none,

that the materials are the very best the country can produce, that the breweries are fitted on the most modern plans, and the best operators that can be had for money; if you take the above into consideration, the qualities of the Burton Ales are easily to be accounted for, and should be clear to every one. Even if you have good water, and a good brewer, but use bad Malt and Hops, it is a matter of impossibility to produce a good article. There are bad Ales brewed at Burton as well as other parts of the country, chiefly by the small brewers, who probably are not so choice in the selection of their Malt and Hops as the larger firms; moreover their system of cleansing is very detrimental to the Ales, and almost certain to bring on a second fermentation in the Store Ales that are brewed in cold weather. There are other brewers whose Ales are as good as those of Burton, according to my humble judgment, and I may instance those of Messrs. Flowers & Sons, of Stratford-on-Avon, which are equal to the best Burton brands. I am confident that wherever a good supply of pure spring water can be obtained, and the very best Malt and Hops that can be procured, and a good operator, you will then be able to compete with the Burton brewers. There are many people who are under the impression that the Burton brewers infuse some noxious ingredient in their Ales, so as to give them that soft and agreeable flavour, but I am of a different opinion, and cannot entertain the idea for a moment; they would never run the risk of such a dangerous proceeding, inasmuch as the Excise are always on the alert. If there was the least suspicion attached to any firm, the excisemen would be sure to find it out; and if the brewer should be detected the firm would lose its reputation as a respectable house of business; besides, the ingredients for adulterating Beers would be of no benefit whatever to the brewer, they would not give the Ales a pleasant flavour, but would cause those who drink them to be very soon intoxicated, and make them feel it very acutely in the morning.

Mr. Molyneux, F.G.S., says:—"The waters used in connection with the breweries of Burton consist of no less than seven different kinds, each of which, with one exception, is derived from different distinct deposits of local occurrence, *viz.*, Bunter conglomerates, Keuper sandstones and marls, the valley gravels, and from two separate deposits by ancient river action. The seventh is the water from the river Trent. Of these, two only—those from the valley

gravels and Keuper marls—have hitherto been used for brewing purposes. The recent artesian borings by Messrs. Allsopps & Sons and Messrs. Salt & Co., into the conglomerates and Keuper sandstones, have resulted in the opening up of secondary supplies from those beds, of which, although there exists no complete analysis of their chemical contents, an examination has been made sufficient for the purposes of determining that they are free from organic matter; that they contain a low per centage of sulphate of lime, and that although carbonate of lime is present in large quantities, it does not amount to anything like the proportion of sulphate of lime contained in the waters of the valley gravels or of waters obtained from boring in rocks directly associated with the Keuper marls; and hitherto these waters have been applied simply to cooling and other ordinary purposes connected with the breweries, and their value as brewing waters is a point as yet undecided.

"These latter Keuper marls are, I think, scarcely entitled to the distinction of water-bearing beds. Except at Messrs. Bass and Co.'s new brewery in Station Street, their old brewery in High Street, and at Mr. Marston's brewery at Horninglow, I do not find them yielding water in any available quantity; and at the former borings I believe the supply to be derived from faults or fissures cut diagonally through the marls, and not from any undisturbed beds of that formation. I think the isolated position of the supply is indicative of this. Neither at the borings at the middle brewery, which were only about ninety yards distant to the N.E., nor at Messrs. Allsopps & Sons, nor Messrs. Salt & Co.'s borings, adjoining those at the old brewery, was the second stratum touched upon, although not more than about one hundred yards north of it, and neither has it been struck elsewhere in the valley. The wells at Mr. Marston's brewery, Horninglow, occupy a different position to any other wells used for brewing purposes in the neighbourhood, being sunk through three feet of terrace gravels into twenty-seven feet of shaly, blue, and gypseous marls, the water of which appeared to come from a basement band of hard, blue, skerry marls, at fifteen feet below the level of the Trent valley gravels, in which the old wells of Burton are generally sunk.

"The water obtained from the valley gravel wells are very dissimilar in their chemical constituents—two of any locality, however closely connected, never thoroughly agreeing in their separate

quantities of inorganic matter. The following Table of the analytical contents of the Burton waters may, I think, be taken as representing both the maximum and minimum, and also the ordinary, amount of sulphate of lime with which they are charged:—

Analytical contents of samples of Water obtained from Artesian Borings, and from Wells sunk in Valley Gravels, Burton-on-Trent.

	No. 1. ARTESIAN BORINGS. Grains in an Imperial Gallon.	No. 2. VALLEY GRAVELS. Grains in an Imperial Gallon.	No. 3. VALLEY GRAVELS. Grains in an Imperial Gallon.
Sulphate of Lime	70·994	25·430	7·050
Carbonate of Lime	9·046	18·060	15·526
Carbonate of Magnesia	5·880	9·100	2·128
Sulphate of Magnesia	12·600	—	—
Sulphate of Soda	13·300	7·630	3·689
Chloride of Sodium	9·170	10·010	6·636
Chloride of Potassium	·966	2·275	13·447
Chloride of Magnesium	—	—	7·350
Carbonate of Protoxide of Iron	1·218	·900	Trace.
Carbonate of Manganese	—	—	Trace.
Nitric Acid (as Lime Salt)	—	—	Trace.
Silica	1·120	·840	1·904
Total solid residue	124·294	74·295	57·730

"The sample No. 1 was obtained from artesian borings beneath seventy feet of Keuper marls; No. 2 from a well sunk in thirty feet of valley gravels, on the east side of High Street; and No. 3 from a private well on the west side of High Street, but in the line of the old breweries, and in about twenty feet of gravel. Two things are specially noticeable in the result of these analyses, *viz.*, the remarkable difference in the total amount of inorganic substances contained in the three samples of water, and the striking preponderence of sulphate of lime present in the waters from artesian borings, as compared with that mineral contained in waters from the valley gravels. In the first place, as already explained, with the exception of the wells in Keuper marls at Horninglow, none of the borings or sinkings in the marls of the valley show them to be, strictly speaking, water bearing strata. They are mostly dry, and springs have only been tapped in underlying deposits of sand or shingle, and each at different levels in the deposits penetrated; consequently we must not assume for the marls, subjacent to the town, any particular credit as contributing either to the chemical properties of its waters, or as being to any appreciable extent the storehouse of the supply. We must look for the source of the calcareous ingredient rather in that vast tract of Keuper marls lying west of the valley, and which, stretching over the old area of Needwood Forest, contains, in a greater or less degree of development, those curous gypseous aggregations of which the quarries at Fauld, and an enlarged district surrounding it, afford such interesting examples, and which, in order to meet the demand upon them, must be, comparatively speaking, of almost inexhaustible extent and resource.

"Herr Griegs, F.R.S., kindly informs me that, in any calculations I wish to make, I may take the average amount of gypsum derived from the water used in brewing 1,000 barrels of Ale at 250 pounds weight. Assuming therefore, by way of illustration, that Burton produces annually 1,400,000 barrels of Ale, no less than 350,000 pounds of this mineral are raised from the valley gravels, assist in the manufacture of that quantity of Ale or bitter Beer, and are, with those beverages, imbibed at different points in the four quarters of the earth. If for every barrel of Ale we allow two barrels for washing and cooling purposes, the total weight of gypsum contained in the 4,200,000 barrels of water thus disposed

of amounts to 1,050,000 pounds. Enormous however as, under the circumstances, these figures show the consumption to be, they do not represent one-tenth of the actual amount of gypsum that is annually derived from the parent beds, and passed seawards beneath the town in a state of solution; and when it is considered that this process, this work of distribution, has been in operation century upon century, age upon age, back, it may be, to remote geological epochs, and that—except by the aid of chemistry, which reckons by grains—we have but little evidence of its action, we cannot, I think, fail to be struck with the magnitude of the deposits from which the sulphate of lime is obtained, and the remarkably persistent and wonderful character of the operation by which it is distributed among the gravels of the valley."

GRINDING THE MALT.

Levesque says:—"This operation is performed with stones or rollers, or a steel mill, adapted to horse or hand power, which will, if in good order, answer the purpose required; yet rollers have the preference, inasmuch as they make but little waste of flour, and are kept in repair at a trifling expense; care being taken that the Malt passes through a wire screen from the feeder, to keep hard substances from accidentally passing through the rollers. It is necessary to regulate the feed so as to prevent an overcharge, and to set the machinery so as to grind and crush every corn, to imbibe the liquor freely. Make it an invariable rule to grind the Malt the day before brewing, for the benefit of cooling.

"When a mixed grist is used, as for Porter, grind the paler Malts first into the tun, and the browner Malts last; and level each, because the paler qualifies the liquor before it touches the browner Malt. When patent Malt is used instead of brown and amber, let that also be put upon the pale Malt: and remember to grind it finer."

MASHING FOR STOCK ALES.

There are many different opinions in regard to the water. Some are favourable to soft or rain water, others prefer water from a running brook; and there are those who like the water pumped into a tank, and let it be exposed to the atmosphere; of course in the winter the latter can do neither harm nor good, but in the summer in a very

short time stagnant water becomes impregnated with filth, and quite unwholesome, and unfit for brewing purposes. Some prefer boiling the water some time previous to mashing, and let it stand awhile to allow the sediment or lime to deposit; and that, from my own experience, is neither injurious nor good. It is requisite to heat the water considerably higher than you want it, I will say 190°. The water having attained the above heat, turn into your mash-tun one barrel and a half of water to each quarter of Malt, no matter how many quarters you wet; having turned your water into the mash-tun, you now add a little cold water to reduce the hot water to the required heat. In cold weather the heat should be 170° in the mash-tun, but in the summer 5° lower would suffice to extract the saccharine matter from the Malt. Having got the water to the above mentioned heat, you now shoot the Malt into the mash-tun, either from the sacks, or if you have a hopper over the tun it would be preferable to sacks, inasmuch that you can let it in gradually, or as you require it; however, if you have not this convenience for a bin or hopper, you must abide by the sacks, taking care not to shoot in too much Malt at a time; if you have not a machine to mash with, of course you must have recourse to the oars, and you also require more hands to mash with the latter, as it is necessary to get through the first part of the process with as little delay as possible, because it is most essential to retain the heat to obtain a good extract; the quantity of liquor mentioned will make a good stiff mash, and the stiffer the mash the better the extract. Having thoroughly wetted the goods—Malt—turn one barrel more of water into the mash-tun, at a temperature of 185° to 190°, to raise the heat. It is quite immaterial whether it be turned over the goods or under. The large brewers turn the water on under the goods, but I prefer turning the water over the goods, particularly in a small mash, the machine, or mashing oars, whichever are used, should be kept going at the same time the water is being turned on. Having completed the first mash, you now cover the mash-tun, and let it stand two hours. Having stood its proper time, the taps should now be turned on gently, so as not to draw the goods and block the taps, thereby causing considerable delay. The taps being turned the worts run into the underback, or the copper, the latter being far preferable to the former, as you can then be raising the heat, whereas in the underback the worts are loosing their heat and hanging about for an

hour or two, and by that means acidity often takes place. Having run off the first wort, you now commence sparging at a temperature of 185°, turn on two barrels of water to each quarter of Malt; it is quite immaterial whether the goods are mashed the second time or not, but as it is usual with most brewers to mash up the second mash, I shall not advise them to depart from their custom. Having turned on the above mentioned quantity of water, you cover the mash-tun the second time and let it stand one hour. Having stood its proper time, you again turn the taps to run off the second wort. The first and second mashes being completed, turn on for a return wort, or small beer, about two barrels of water to each quarter of Malt, at a temperature of 170° to 175°, mash up the goods, and after this has been done let the mash stand one hour; and if you are desirous of making small beer, add 10lbs. of the best Jamaica sugar to two barrels of wort, which should be infused in the copper during the time of boiling.

LEVESQUE ON MASHING.—"Previous to and at the time of performing the important operation of mashing, observe the temperature of the air, and note it down in the brewing book, with the day of the month, the hour of mashing, and the quantity and quality of the Malt and Hops; the quantity of liquor intended to be brewed, the number of barrels of liquor for each mash, and the heats of the liquor (*see the table of heats*). In all cases, one barrel and a half to one barrel and three firkins is sufficient for a stiff mash, either with a mashing machine or with oars. The machine is much quicker, and more certain in its operation, by preventing the malt from running into balls, which is not only a loss, but a serious injury; because such portions of Malt having escaped breaking or mashing, form into balls, and is the consequence of careless mashing with oars; the Malt will likewise be more subject to run into balls, if more liquor is applied than recommended for the stiff mash, and give more trouble to break them. The Malt is not only wasted by balling, but those balls being but partially wetted inside, and surrounded by a greater heat, generate acidity in the second degree, if unbroken in the second mash, which may be fully proved by inspection.

"As soon as the Malt is uniformly broken add the remainder of the liquor, and mash all together for five minutes; or, if with a

machine, let it go once more round the tun with the quick movement; at this period take the heat of the mash, which should be done in the following manner with a thermometer, invented by the author for that purpose. Take this instrument, and at arm's length sink the bulb into the middle of the depth of the goods, the heat of which should not exceed 148°, nor be less than 143°.

"Another method of mashing is, to turn all the liquor intended for the first mash boiling into the mash-tun, and cool down to the required heat, and then add the Malt; but for this method, the heat must be taken considerably lower than when the liquor is applied to the Malt, by running under the goods; the heat for the latter method must be 8° lower, but the final heat, at the finishing of the mash, must be the same.

"Attention and judgment, united with caution and practice, will render this method of taking the heat at the conclusion of the mash more perfect than any hitherto practised; for, at the time of turning on for the making up the mash, with the man at the copper-cock, the machine or the oars working at the same time, the brewer, with the thermometer in the mash, directing his eye to the index to ascertain the degree of heat, has only to say the word 'stop' to the man at the cock. The method here pointed out is applicable to every kind of Malt, in respect to colour, dryness, slackness, weight, friability, or tenderness.

"The author has observed that the heaviest and palest Malt will absorb the greatest quantity of liquor, because being of greater substance; consequently, in proportion to the substance, more or less, so will be the absorbing power. The colour and dryness, or slackness, will also cause a variation in the liquor and heat; always taking into the account that weight and colour must direct the brewer as to the quantity of liquor, as well as quality of heat requisite; for light coloured or pale, being much heavier than brown Malt, will absorb more liquor in proportion: or, if more liquor is not put to the heavier Malt, the heat must be added accordingly. The author having found the best results arise from the method of bringing the mash always to the same degree of heat in the mash-tun, at the conclusion, is thoroughly convinced that the plan may without fear be universally adopted, and will be more certain in its effects, as it excludes all intervening circumstances between the copper and the mash-tun, varieties of Malt, &c. To render this

more clear to the reader, suppose there be any question relative to the quality of the Malt—as to its newness, hardness, weight, slackness, or dryness, all which circumstances require a variation of the heat or the quantity of liquor: the brewer being already acquainted with the final heat of the first mash of a good operation, has only to copy it for his future direction.

"The first mash ought not to exceed one hour, in large quantities of Malt; smaller quantities in proportion, down to 20 minutes, with a machine. If oars are used, strength should not be wanting, in order to mash as quickly as possible. As soon as the mash is made up, re-charge the copper instantly, open the fire dampers, and prepare liquor for the second mash; this gives the stoker an opportunity, not found in any other part of the brewing, to burn up all the rubbish to clinkers, which it will do with a little attention: the fire is to be damped with the rubbish when required for the first mash. Half-an-hour before the time of standing has expired, the underback is to be cleanly scalded and mopped out dry, to receive the extract, or sweet-wort. Note down the time the mash has stood; as also the heat of the tap, when about half spent, the taps varying from 142° to 146°. In warm and very hot weather, let the first mash stand less time.

"In setting the tap, be careful to turn on very gently at first, and gradually increase to not exceeding half-cock; faster than that is likely to draw the grains into the underback. To raise one degree in the mash will raise one degree in the tap. The proof of a good tap: the head should be close and tough, and of silvery whiteness; and when examined in the brewer's silver pint, the head should resolve into a delicate cream on the surface, full of effervescing, and fine flavoured. This is the character likely to produce a good yeasty fermentation, and a liquor that will chop fine.

"In raising the heat of the first mash, the liquor must always be let in under the false bottom, because heat ever ascends, and will quickly indicate increase by the thermometer. In heats taken too high, the silvery white head has a tinge of brown; and the higher the heat the browner will be the head. In low heats the silvery head does not appear, neither is it so close, firm, bright, or lively in flavour; in very low heats the head will not stand, but fly off instantly, and the tap will be thick and muddy. Here arises the

danger of acidity, from the penetration of the external air, which, if once caught, will never be a sound liquor.

"In brewing very small quantities in places exposed, the same retention of heat in the mash cannot be expected; and although the heat of the tap will on this account differ, yet the character of the tap will be similar. Such exposed places should be remedied; and the best remedy is, in not letting the mash stand so long, because the liquor will not draw the Malt while thus cooling.

"If two mashes are made for the strong, the second mash may be taken 10° or 12° higher than the first mash; if three mashes, instead of 10° or 12°, take 5° or 6° for each; and the fourth mash 160°. A large body of Malt will obtain the required heat in the mash with a heat somewhat lower than a small quantity, on account of the greater capacity and depth, and the less surface of wood and metal; the effervescence and powers of retention of heat, for the above reasons, are increased. No brewer need feel at a loss in making up his mash, with such ample assistance as my thermometer will afford him in taking the heat in the mash-tun. The author having had experience in this method of finally obtaining the heat in the mash-tun, gives it as a test, to prevent many errors creeping in, to which every brewer is more or less liable in every change of weather, and particularly the less experienced, in reference to the component parts of the heat of the mash, consisting of the air, the malt, and the liquor. In making due allowance for the loss or gain of heat, there must always be a loss of heat from evaporation, and a gain of heat when a higher dried Malt is used, &c.; and the liquor must be raised or lowered accordingly. There is also a great loss of heat in cold weather, which must be counter-balanced in the application of mashing heats; the errors may not be very great, yet nicety in this point is most essential, and may be thus finally and safely corrected by the foregoing method, which certainly appears reasonable to common practice, that every first mash, to be correct, must finally arrive at the same degree of heat in the mash-tun, whether of small or large quantities of Malt; and that heat is composed of the temperature, heat of liquor, the dryness, and the weight or substance of the Malt; and thus the Table of Mashing Heats and quantities per Quarter, together with the thermometer, will assist the brewer to the fullest extent of his wishes and demands.

"The wort of the first mash being weighed, the character observed, the heats taken, and the quantity ascertained, it may all be pumped up into the boiling-off copper. Record all these particulars in their proper places in the brewing book; they will enable the brewer to ascertain how much is drawn per quarter with any given quantity of liquor, and how much will be required of the second wort to make up the strength, making due allowance for the waste in boiling, evaporation, &c. Here it must be strictly observed that no delay takes place; and when the tap is spent, it must be narrowly watched, to prevent the thick running after the clear; then it is the brewer's province to be ready with his next liquor instanter.

"Fly-mashing, which is modernly termed sparging, is to pass the succeeding liquors over the goods, while the tap is spending; for instance, as soon as the goods have sunk about four inches from the original mark, the top inside cover being put on after the conclusion of the first mash, to break the force of the liquor; the force of the liquor being thus broken, it will scarcely mingle with that underneath, but will follow and supply the place of the former, and displace it, thereby obtaining a greater quantity of the rich first wort, and drawing the goods with a smaller quantity of liquor, for strong Ales, &c. This is repeated, instead of the second and third mashes; and mashing the last for small, or returns. In this method of fly-mashing, the after liquors pass through every interstice of the goods; by which method, concentrating the strength, saving, valuable time, and helping return worts, as they contain nothing but the worst quality, and are by no means desirable. It may seem extravagant to throw away a return wort, the gravity of which is five or six pounds per barrel; it is however, like skimmed milk, but of little value.

"Column 1 shows the temperature of the air.

"Column 2 shows the heat for mashing, at any required temperature; the degrees and cents. of a degree, are exhibited; therefore 25 is a quarter, 50 the half, and 75 is three-fourths of a degree. When above 50, or the half of a degree, take one degree; when under 50 abate one. This exhibition is merely to show the effects of calculation; for without which it would appear in some parts of the Table that the graduations are unequal, when the reader might expect to find equality.

"Column 3 shows the hours and minutes for the standing of the mash; observing that when the air is higher than temperature, the time of the standing of the mash is to be diminished in ratio through the four classes of mashing heats.

"The other heads show the firkins per quarter required for mashing, and the heat of the mash at the conclusion.

"The heat of the tap is to be taken in the middle of the spending.

"For every shade of Malt higher than the palest a reduction of five degrees must be made. If the liquor is cooled down in the mash-tun to receive the Malt, the liquor must be taken eight degrees lower than in the other method.

"The heats of the tap will correspond very nearly with the statement in well-constructed breweries, and when the tun is mashed full, or nearly so.

Temperature of the Air at Mashing.	CLASS I. Heat of the Mash, 146° *to* 148°	Time of standing of the Mash.	Temperature of the Air at Mashing.	CLASS II. Heat of the Mash, 145° *to* 147°		Time of standing of the Mash.	Temperature of the Air at Mashing.	CLASS III. Heat of the Mash, 144° *to* 146°		Time of standing of the Mash.	Temperature of the Air at Mashing.	CLASS IV. Heat of the Mash, 143° *to* 145°		Time of standing of the Mash.
	Firkins per Quarter, 6			Firkins per Quarter, 7	Firkins per Quarter, 8			Firkins per Quarter, 9	Firkins per Quarter, 10			Firkins per Quarter, 11	Firkins per Quarter, 12	
		H. M.				H. M.				H. M.				H. M.
10°	197-00	4-00	10°	189-00	184-00	3-00	10°	178-00	175-00	2-00	10°	172-00	170-00	1-00
15	195-17	4-00	15	187-42	182-59	3-00	15	176-84	173-92	2-00	15	171-00	169-19	1-00
20	193-34	4-00	20	185-84	181-18	3-00	20	175-68	172-84	2-00	20	170-00	168-28	1-00
25	191-51	4-00	25	184-26	179-77	3-00	25	174-52	171-76	2-00	25	169-00	167-37	1-00
30	189-68	4-00	30	182-68	178-36	3-00	30	173-36	170-68	2-00	30	168-00	166-46	1-00
35	187-85	4-00	35	180-10	176-95	3-00	35	172-20	169-60	2-00	35	167-00	165-55	1-00
40	186-02	4-00	40	179-52	175-54	3-00	40	171-04	168-52	2-00	40	166-00	164-64	1-00
45	184-19	4-00	45	177-94	174-13	3-00	45	169-88	167-44	2-00	45	165-00	163-73	1-00
50	182-36	4-00	50	176-36	172-72	3-00	50	168-72	166-36	2-00	50	164-00	162-82	1-00
55	180-53	4-00	55	174-78	171-31	3-00	55	167-56	165-28	2-00	55	163-00	161-91	1-00
60	178-70	3-40	60	173-20	169-90	2-45	60	166-40	164-20	1-50	60	162-00	161-00	0-55
65	176-87	3-20	65	171-62	168-49	2-30	65	165-24	163-12	1-40	65	161-00	160-19	0-50
70	175-04	3-00	70	170-04	167-07	2-15	70	164-08	162-04	1-30	70	160-00	159-28	0-45
	Heat of the Tap from 144° *to* 146°			Heat of the Tap from 143° *to* 145°				Heat of the Tap from 142° *to* 144°				Heat of the Tap from 141° *to* 143°		

BOILING THE WORTS.

There are great differences of opinion in reference to boiling the worts. The theoretical brewer, or gentleman brewer, will tell you that he is very undecided as to boiling worts any length of time. His theory is that the fermentation is quite sufficient to preserve the keeping qualities of Ales; but your humble servant differs very much from that system of procedure. Worts should be boiled according to the gravity, and the length of time you purpose keeping such Ales; the heavier the worts the more they waste in boiling, consequently if you can boil the first and second worts at one boiling, instead of two, you save in time and fuel as well. Such Ales as are about 30 lbs. in weight should be boiled two hours. If by long boiling you lose in quantity, you certainly gain in quality; and if the worts should be above the average gravity by the saccharometer, instead of reducing the strength with the return raw worts, it is preferable to use liquor (water) that has been boiled, and bring them to the strength that you may require. The quantity of Hops to be used for such a class of Ale as before mentioned, should be regulated according to the length of time you wish to keep them; from 10 to 12 lbs. of the best Hops would not be an unreasonable quantity for keeping Ales a twelve month. These Hops should be put in the copper as soon as possible, and a man kept by the side of the copper with a mashing oar continually stirring them down. Having boiled the worts two hours, they are now to be turned into the hop back and remain for about twenty minutes or half an hour, when the Hops become settled to the bottom of the back. The worts should now be turned into the coolers, and should be got ready for the fermenting tun with as little delay as possible.

BOILING.

Levesque says:—"Let there be plenty of room in the copper, for it is favourable to quick boiling. The author recommends short boiling for the preservation of the fine aromatic flavour, and the medicinal quality of the Hops; therefore to aim at long boiling, and to use more liquor for brewing on that account, is to deviate from the purpose in view, incurring at the same time an extra expense of time and fuel. The criterion to be observed in boiling is, the separating and coagulating of the farinaceous particles of the

extract of Malt and Hops, which will generally take place in about fifteen minutes, when the interstices of the wort become transparent, denoting the union, or combination of the same, in the first period; nevertheless the boiling is erroneously continued far beyond this period, sometimes two hours, for the first wort, dissipating those fine qualities which it was the brewer's intention to preserve, under the idea that the Beer will not keep without it, which is an error in judgment; because the defect lies in the mashing heats, or in some extraordinary delay in the passage of the worts from the underback to the copper.

"Observe, in ordinary Ale brewing, to boil the first wort one hour, the second two hours; and if there be three worts, boil the first one hour, the second one hour and a half, and the third two hours.

"In ordinary Porter brewing, boil the first wort one hour, the second two hours, and the third three hours; observing that when strong Ale or Stout is brewed for long keeping, and is heavily hopped in the copper, that longer boiling is necessary for penetration, to the amount of one-fourth part of the time allotted for each wort.

"*Second method.* Boil the first wort forty minutes; then add the Hops, and boil until the separation of the farinaceous particles takes place: fifteen minutes will be sufficient for this mode; less time being given for evaporation, the fine flavour will be preserved in a greater degree. Boil the other worts as before directed.

Third method. Boil until the breaking of the farinaceous particles, and the transparency of the interstices of the wort takes place, then discharge the whole together, Hops and all, into the cask in which the liquor is intended to be kept, and bung down for the present, the cask then being quite full; at your leisure fix the safety valve, and there let the liquor remain untouched, to ferment and depurate, without any addition of yeast, which will require twelve months for ordinary Ale.

"The vacuum caused in cooling will furnish room for the expansion occasioned by this mode of spontaneous fermentation. The time required for fermentation and depuration will be from eighteen months to two years for the strongest Ales, or of a gravity of 45° in a temperate cellar.

"Each succeeding wort will require the addition of fresh Hops,

which will give the liquor an improvement of flavour not to be obtained by boiling the Hops over and over again. Worts of meaner strength will, of course, require less time for fermenting and depuration in proportion.

"*Fourth method.* Boil the wort, without the Hops, thirty or forty-five minutes, having the intended quantity of Hops previously rubbed with the hands, and deposited in the cask in which such liquor is intended to remain, then turn the boiling wort into the cask, and when full to the bung fix the safety valve. The treatment of this, and the succeeding worts, is the same as observed in the third method.

"It may be inconvenient to adopt this method of boiling a considerable quantity together; but in the smaller movable bodies, there can be no objection, if the time of keeping is not an object. This process will suit the nobleman or private gentleman, where expense is not spared to procure that wholesome and exhilarating old English luxury of superlative quality.

"*Fifth mode.* Boil but a small quantity of Hops with the worts, to the amount of one fourth part, or, in fact, any quantity the brewer's judgment may dictate; and reserve the remainder to be put in the vat at the time of racking and storing Beer.

"In respect of obtaining the fine flavour of the Hop, long boiling is totally at variance with that desirable object; consequently short and quick boiling is favourable to that purpose. It is impossible to boil without dissipation to a certain extent.

"It may be objected by practitioners of minor experience, who are unacquainted with the principles and the chemical operation of brewing that the liquor will not keep without long boiling the worts with the Hops, which is a mistaken idea, and extremely fallacious; for the preservative quality of all malt liquor is resident in the soundness and purity of the extract drawn from the Malt in the mash-tun, by the judicious application of the mashing heats, in which alone the brewer can expect to find the principles of the preservative quality; and the smallest degree of acidity, in this stage of the operation, can never be extinguished. It may be neutralized by a chemical application for a time, but no boiling will ever restore a wort, unsound before going into the copper; therefore the greatest nicety is required in obtaining a true care and knowledge of the fundamental principles of the Art of Brewing.

In the general process of making wine, no boiling is required for the extract; the fruit is mixed with the extracting medium in the state of nature, and boiling is not requisite, and yet there is no acidity in the result. Why is it? Because it is allowed to ferment spontaneously; the principles of which being solvent in a cold menstruum, pays from the vinous to the spirituous quality, without the application of heat to open their pores for the reception of the acetous particles, of which the atmospheric air is composed; the wine drawn off when the vinous fermentation is completed, and the depuration is going on, at which time the atmospheric air is excluded to a certain extent.

"The precipitating principle of the liquor brewed and fermented without the addition of yeast need not be doubted, if the place provided for the purpose is within the limits of temperature, where the fermentation and depuration is allowed to progress without the interruption occasioned by the sudden transition of heat and cold. Such favourable situations can only be obtained underground, or in the cliffs, contiguous to towns and cities, in different parts of the kingdom; in some of which the author has had opportunity of experience and observation, where fermentation and depuration were conducted with the greatest nicety and advantage, as to brilliancy and flavour, till the last pint drawn from the cask.

"The author does not, under any circumstances, approve of the erroneous and anti-chemical method of steeping the Hops, either in hot or cold liquor, previous to putting them into the copper, under the false idea of extracting more of the bitter of the Hops; it is a mistaken notion.

"The author fears not but his readers will readily admit that his plan is superior to all others yet discovered; except where a double expense is incurred, as in that of boiling in the double or inverted wort copper, surrounded with liquor, on which the force of the fire is intended to operate, totally excluding the slightest empyreumatic flavour to the worts, or wasting a particle of the saccharine quality.

"The brewer is well aware that the infusion of Hops in either hot or cold liquor will draw a far greater proportion of the bitter quality. The same method may be pursued to an unlimited extent, and still extract a bitter liquor, or fluid, which is of no value. It may be truly conceived and said that the first operation of extract-

ing the bitter with *aquæ pura*, is founded in error: and the last certainly confirms it. The liquor thus used had far better be turned into the mash-tun. There again excess is to be studiously avoided.

"If the richness of the worts require an alteration in the bitter, increase the quantity of Hops, by putting them into the vat or cask, where the spirituous qualities, obtained by fermentation, is of a thinner and more penetrating nature, which may be compared with the powers of alcohol; therefore, for all philosophical and chemical reasons, totally refrain from steeping the Hops in liquor; and avoid, by all possible means, the evaporation of the aromatic quality, when it can be retained by the adoption of the means I have before recommended.

"The virtue of Malt, when extracted by the application of heats, and properly blended with Hops, will produce a perfect combination of the essential qualities of both.

"The author approves of the tap spending upon the Hops in the underback, or pumping the worts to the Hops in the copper-back; but strongly recommends the adoption of his newly-invented copper and movable pan, which stands directly under the mash-tun to receive the wort, instead of the circuitous method of the underback."

FERMENTATION.

To get the cooling part forward there should be a fan fixed in the coolers that could be worked either by hand or steam power, the latter depending on the extent of the business, also a refrigerator. The worts should now pass over the refrigerator, this being the last process for cooling. A great many refrigerators have been brought out, but I do not know of one equal to the Capillary Refrigerator, patented and manufactured by Messrs. Lawrence & Co., of London, —it is cheaper and more effective for cooling purposes, more durable than any other machine in the market, and can be bought to suit any size brewery. There are some breweries that have dispensed with coolers altogether, and refrigerate from the hop-back; but I cannot see the necessity of such precipitation. They contend that their worts are sounder, and they produce a better article. I am not so favourable to that system of cooling. I know of one brewery in London that has no cooler, but refrigerates from the hop-back; and for the size of the plant, and the amount

of trade they do, they have more returned Beers and Ales, gone acid, than any one brewery of the same size in London, so I cannot see the benefit of dispensing with coolers. Granting it is necessary to cool the worts in a reasonable time, and not allow them to hang about in the coolers day and night, particularly during atmospheric changes, which are more frequent in the summer than winter, and the worts more liable to take acid, therefore it is requisite not to have the worts too long exposed if you perceive any change in the weather, such as thunder, although the latter would act on the Ales in the fermenting tun as well as on the coolers; probably the effects of thunder would be more injurious to the worts on the coolers than in the gyle-tun. The gravity of the Ales being 30 lbs., you pitch the worts at a temperature of 58° by thermometer, the quantities of yeast to be used should be regulated according to the strength of the Ales that are being manufactured; 1½ lbs. weight of yeast to each barrel of Ale would be enough; the second day's yeast is preferable, as you will have no cause to fear as to its soundness. Having got the worts in the fermenting tun at the above mentioned heat, add the yeast and well rouse the gyle. Having done this, take the heat of the whole gyle and weigh the worts—heat 58° thermometer, gravity 30 lbs. per barrel; this being done, the gyle-tun should be covered to prevent the carbonic acid gas escaping, as the latter materially assists the fermentation. After the worts have been in the gyle six hours, it is necessary to see how the fermentation is progressing; take the heat merely to satisfy yourself that the fermentation is going on all right, and if the heat has risen to 60° thermometer the attenuation should be reduced to 28° by saccharometer, and so on as the heat rises, the attenuation should be reduced until the heat has risen to 74°; the Ales would then be reduced in attenuation to 14 lbs. weight by the saccharometer.

CLEANSING.

It is necessary now to cleanse the Ales in small casks, such as hogsheads or puncheons. In London the cleansing casks are fixed on stillions, or troughs for cleansing, the fermenting tuns being elevated, and a hose connected with the tun of sufficient length to reach any part of the cleansing room; the end of the hose is inserted in the bung hole, and the casks are filled at one time.

Each cask being filled to the bung, they are moved about half an inch or little more out of their perpendicular on the stillion, so as to allow the yeast a free course to the stillion. It is requisite now to pay great attention to the filling up of these casks, which is generally entrusted to a confidential servant. They should be filled once an hour, or oftener, should it be required, for the first ten hours, after which the fermentation begins to slacken, and does not require filling so often, although it is necessary to give your attention to the cleansing, so that the fermentation shall not become too languid for the want of being filled up, which should be done every two hours until the Ales are thoroughly cleansed. The Ales are now racked into different size casks to suit the customers. There are a great many brewers who cleanse their Ales in firkins, kilderkins, and upwards, and are sent out without racking; and the Ales probably have not been out of the gyle-tun more than two days. Into each of these small casks the brewer or cellarman would infuse half-pint of isinglass finings, which would be regulated in proportion to the size of the cask, this being the London system of cleansing.

I will now give you an exposition of the Burton system of cleansing and fermenting. As far as the mashing at Burton, their system is precisely the same as mine, which I have treated on, their boiling of the worts for strong Ales being very little varied from my system; the length of time for boiling strong worts averages from one and a half to two hours simmering; they never boil their worts hard, their object for that being to preserve the aromatic properties in their Ales, which causes to a great extent that soft and agreeable flavour which is most predominant in the Burton Ales; hard boiling will extract a very strong and unpleasant bitter, but the aromatic qualities would evaporate with the steam, no saccharine matter is evaporated, and the worts lose none of their gravity by evaporation. Having gone through the process of mashing and boiling, the worts are now turned into the underback, from thence into the coolers, and passed through the refrigerator to the gyle-tuns or fermenting squares or rounds, the latter being preferable to the former, to my mind, as they are easier to clean than squares. If squares should not be properly cleaned out in the corners, and any stale yeast remains, it is sure to affect the fermentation; then chemicals are used to discover the cause. The Ales are passed into the gyle-

tun at a temperature of 58° to 60°, being regulated according to the temperature of the atmosphere. The gravity of these Ales is from 35 to 40 lbs. weight of saccharine per barrel. The heat of the gyle-tun is not allowed to exceed 72°, and the attenuation would be reduced to 14 lbs. by the saccharometer; but as this is impossible without the aid of a temperator, which would be placed in the gyle-tun, and a continual stream of cold spring water passing through the temperator, keeping the heat stationary until the attenuation be reduced to the desired gravity; it is then passed into a yeast trough placed above the cleansing cask, the latter containing a plug hole to each union cask. The plugs having been taken out, the union casks are filled. This done, the plugs are replaced. At one end of the trough is a small cistern, which takes the Ales for feeding the cleansing cask. There is a chain of pipe connected with this cistern which leads to every cleansing cask, so that by turning the tap the casks are then what you may term self-feeding. There is a pipe with a crane neck, from which the yeast discharges itself into the trough above. It is perceivable at once the advantage of these union casks over the old system of cleansing; that is, for convenience and cleanliness, and saving a vast amount of labour; not that I am going to infer that you can brew better Ale because you have union casks, for I am of opinion that it is more for economising labour and convenience. The Ales are allowed to remain in the cleansing cask until they have discharged the whole of their yeast, or are thoroughly cleansed. Underneath the union casks there is placed another trough of a much smaller size. At the lower part of the cask is inserted a screw tap, and by turning this tap the interior sucker is so far elevated as to be above the sediment that has deposited, and therefore none of the impurities are carried off in the liquor, but remain in the casks. It often happens that the yeasty matter, or grounds disseminated through the Ale in the casks, does not precipitate, and the consequence is that it causes the muddiness to remain (see second fermentations). The Ales having discharged the whole of their yeast, or have become thoroughly cleansed, the screw tap at the lower part of the casks is turned, and the Ales are passed to the clarifying or racking squares; it remains in these squares from twelve to eighteen hours, so that the Ales become almost bright; it is then racked into different size casks, and 1 lb. of the best Hops infused into each barrel of Ale; it is then either

stored or sent to their Agents at different parts of the country, and stored away by the latter. Having supplied their Agents, they fill up the stores at home, which are something considerably large. You will perceive by the many processes the Burton Ales go through, that it is almost a matter of impossibility for Ales to undergo a second fermentation, which is the most injurous effect Ales can be subject to. The system of the small brewers at Burton is quite different to the larger firms. It is not a matter of surprise to see so much returned Beer come back to the brewer, taking into consideration the system he carries out for cleansing. His method will answer very well in mild weather, but as soon as the cold weather sets in he is competent to brew yeast-bitten Beer with the best of his day, such Ales being stored away for the summer consumption, and as soon as the hot weather comes, or a change in the atmosphere, the Ales at once become turbid, and causes a second fermentation to take place. The same system of cleaning is adopted in many parts of England. A tin tube is let into the top part of the casks, the end projecting outwards over the head of the casks, with a small tub for the tube or pipe to discharge its yeast into. Surely stillions are preferable to a lot of tubes scattered over the cleansing room; but it is customary, and people cannot depart from it. My advice would be to every brewer, use stillions for cleansing, and let the Ales cleanse themselves from the bung hole. The yeast will discharge itself from the cleansing casks much freer than from these tin pipes. I prefer stillions fixed around the cleansing room, with a small tank at one end, into which the Ales from the cleansing casks would run from the stillions; and above this tank should be placed a small five or six barrel vat, elevated sufficiently to command the whole of the cleansing room. There should be a small wort pump fixed to pump the worts from the tank into the small vat above, for feeding the cleansing casks. There should be a pipe connected to the above mentioned vat or feeder, fixed to the wall around the cleansing room, and unions or joints made for branching off into each cask, with a small crane neck pipe leading to the bung hole; by lifting this pipe you stop the feeding, or can turn it on as the case may be, consequently topping up with cans is dispensed with, and by this means you save a vast amount of labour, the Ales are much better cleansed, and the cask would be self-feeding, similar to those in use at Burton.

LEVESQUE says:—"Ferment all keeping Beers to one fourth part of their original gravity, in a temperature of the gyle not exceeding 70°; which is most preferable for fine flavour, high condition, and spirituous quality. In the brewing season in many instances, the gyle may be kept within the limits of 70° by the attemperator.

"When lighter Beers are brewed, the temperature may be kept in the gyle-tuns within the limits of 70°, by the assistance of the attemporator, or refrigerator, in the gyle-tuns, which every brewer will find it absolutely necessary to adopt, to enable him to compete with others.

"Without the attemporator the brewer must regulate the cleansing point by the advance of heat or temperature of the gyle; but, having the attemporator or refrigerator, he may with safety affix the cleansing point at 70°, observing that his attenuation are within the limits of one third or one fourth of the original gravity.

"Acetous fermentation arises, either from premature fermentation, or from liquor not having been sufficiently fermented. It will commence in underfermented liquor, which, from its peculiar sweetness, is of that fretty nature as to be continually generating acidity, in direct opposition to the precipitation of the grosser particles which are included and entangled in the sweet liquor; this precipitation takes place when the gravity of the worts is sufficiently diminished by fermentation or attenuation, within limits before described, 70°.

"Acetous fermentation will also occur in the mash-tun, from the application of mashing heats taken at too low degrees of heat, whereby the pores of the liquor are so much opened that they readily imbibe too large a portion of atmospheric air; so that it is possible for the whole body of goods in the mash-tun to be changed from sweetness to acidity before the tap is set. Worts of this description will ferment very rapidly, and produce a large quantity of yeast; but the liquor will be acid. Acidity may be caught in any of the mashes, although the first mash may have escaped; but if caught in the first, all subsequent mashes must share the same injury: neither extra hopping nor boiling will be of any avail.

"Acetous fermentation ensues when the mashing heats are taken too high, thereby, in a great measure, closing the pores of the wort to the fermentation matter, or yeast; the consequence is, that the

fermentation proceeds with great difficulty; the head is very low, and brown or fiery in appearance, with a hissing noise; sometimes it will appear as if boiling. Worts of this description require more yeast, to force the fermentation to discharge the yeast; yet the discharge is not sufficient: the rest remains in the liquor, which is the cause of acidity and fret in the opposite degree of mashing heats taken too low.

"*Racking.* This process requires ability and care to retain the effervescing spirit and fine flavour of the liquor.

"If the liquor is drawn off in too flat a state, it will not recover in the cask without art; and even that is insufficient for the perfect recovery of flatness; therefore the best brewing and fermenting may, by neglect in this stage, be rendered useless; for if the liquor is tapped while flat, it will not afterwards recover.

"The brewer must be well acquainted with the time necessary for recovering liquor from flatness, as well as the time it will require being in the vat, or in the cask, when racked new from the stillions, and the time it will require in the publican's cellar, or that of the private customer; so that here are many considerations that he must absolutely bear in mind at every season of the year, or disappointment must follow. The arrangement necessary for this unerring regularity requires no small experience, to have all Beers ready in successive and effervescing order for sending out.

"*Racking from the Stillions for sending out.* The liquor must be drawn off within twenty-four hours after cleansing, and bunged down immediately, so that a little yeast may rise again; the bungs may be drawn when sufficiently recovered.

"Racking into the vat may be deferred a little longer; it is there to form a large instead of a small body for mild Beers. Let them remain in the vat, close stopped, with a safety-valve, until the effervescence is full up; then rack and hop in the cask (with Hops soaked in the same liquor), bunged down tight, and let it remain so until the effervescence is again up, before tapping. A quick draught is necessary for liquor, to retain its briskness and goodness to the last.

"*Examine the Liquor previous to sending out.* Draw the bung of a cask of such a number as you wish to send; and, if it is fit, its effervescing quality will appear in a delicate cream arising on the surface of the liquor.

"*Hopping in the Vat for keeping.* Fill the vat sufficiently to allow room for the Hops. Rub the intended quantity of Hops to pieces into a stand tub, and well mash them in some of the same liquor; then start them into the vat; well rouse, and stop down, air-tight, and cement round the hatchway.

"When a vat is intended to be drawn off, sufficient dry casks must be in readiness, that it may be accomplished without delay; bung down tight; ullage vats are bad. If you have Beer ready, the vat may be filled again, on the same grounds, several times without injury, so long as there is no delay; but keep it close stopped.

"*Hopping in general.* The brewer must in a great measure be guided by his customers' palates. Bitterness is often complained of, as being disagreeable, which may be owing to two causes; one of which is from ill-flavoured Hops; the other from long boiling; the aromatic properties, which give the pleasant gust, are dissipated into a disagreeable rankness; therefore let the brewer be particular in his selection. Hop lightly in the copper, and reserve the remainder for the period of storing, or racking when in a mild state, which should not be drunk until the liquor begins to bite the Hops; then the liquor will be effervescing and fine flavoured.

"If the brewer wishes to increase the quantity of Hops in his Beers, he must do it by small degrees: by which means he may increase the bitter almost imperceptibly."

Black says:—"*Fermentation: Quantities to be used.* It is a very generally received opinion that the stronger the worts, the less yeast is necessary. We cannot, however subscribe, to this opinion, but on the contrary, must contend that if an artificial ferment be at all necessary, the quantity should be proportional to the work it has to do; or, in other words, in proportion to the saccharine matter to be attenuated. A smaller quantity might perhaps ultimately have the desired effect, as we see in very long fermentations; but this is leaving in some degree to chance what may be effected with certainty, in a much shorter time, by a different, and certainly a better process. All sorts of Beer, both Ale and Porter, may be produced equally as good, or perhaps better, by comparatively shorter fermentations, as by the longest now in use; and they will always be found to retain their vinosity and soundness much longer than the others.

"The quantities of yeast to be used, however, must necessarily vary according to circumstances. When the worts are got together in the gyle-tun at high temperatures, such as 65° to 70°, less yeast will be necesary than when got together at temperatures which are lower, say from 53° to 60°. If the proper quantity of yeast be applied to sound worts, we generally find that for every degree of temperature gained the worts will attenuate one pound in gravity by Long's instrument, or 2° 78′ by Allen's and Bates' instruments; the quantities of yeast to be applied should therefore be so regulated as to preserve this uniformity, which is a sure guide to work by. This rule will not apply, however, where long fermentations are practised.

"Many brewers conceive that, by long fermentations, their Beer retains more fulness on the palate than with a shorter process. We entirely differ from them, however, on that subject, and maintain that when worts are kept in the gyle-tuns ten to fourteen days or more, the fermentations are much more liable to suffer injury from the atmospherical or other fluctuations which may take place during that period, than can possibly be the case in a process of from forty to seventy hours, or even sometimes shorter.

"It will always be found also, that Beers having undergone a healthy and not too vigorous fermentation, will acquire fulness from age; while on the contrary, those undergoing a long fermentation lose their fulness, and very often become sour.

"Many brewers are in the practice of using yeast by measure. This is a very uncertain mode of procedure, as yeast will vary in weight many pounds per gallon. The surest and best mode of applying yeast is by weight, and when we are not thoroughly acquainted with its quality, it should always be mixed with a small portion of worts at a temperature of from 80° to 90°; and should be seen rising in whatever vessel it may have been mixed, before it is added to the worts in the fermenting-tun.

"When worts are got together in the gyle-tun at a temperature under 60° F., about 1 lb. of yeast to 10 lbs. gravity per Long's instrument, will be found to produce a loss of 1 lb. in attenuation for every degree gained in heat. This is a good working rule. When the fermentation (from unsoundness in the worts, or other causes) does not go on regularly, the Beer is apt to get yeast-bitten; and the quantity of yeast used is blamed as the cause. This evil,

however, more frequently arises from too little yeast than from too much. It is impossible to describe by writing the different anomalous appearances which take place in fermentation, and therefore equally impossible to say what should be done under certain circumstances, unless by personal inspection and examination; when the causes of the different anomalies which takes place must be traced, and when unfavourable, rectified, before any permanent improvement can be expected.

"*Best temperature for Vinous Fermentation.* It has been generally found that, what may be called a medium temperature during fermentation, has the best chance of producing Beer of the proper vinosity and preservative quality. We have seen Beer brewed in this country, for which the fermentation was carried on at very high temperature, say from 80° to upwards of 90°. We are also told from very high authority (Professer Liebig) that the fermentations for Bavarian Beer, so celebrated in Germany, are carried on at very low temperatures, say from 42° to 50° F., which could only be done in this country at a very great expense. The first of these, although it answers very well for immediate use, particularly in summer, soon acquired a mawkishness in flavour, and had always a want of vinosity, which, to those unaccustomed to drink it, would not be agreeable. The Bavarian Beer that we have seen is precisely similar in these respects. It very much resembles in taste the Beer brewed in this country for the Indian market, but neither in vinosity nor flavour would it bear any comparison with the best British Beer of a similar description. Having thus given some account of the two extremes, we are still disposed to think that medium temperatures during fermentation will be found to produce the best Beer in every respect. Let us therefore take a range of 52° to 78° F., thus allowing 26° to be gained during the fermentation, which is enough for the attenuation of any sort of Beer when brewed in proper season. We must now keep in mind, that if the proper quantities of good yeast have been employed, for every rise of one degree in temperature, there should be a corresponding loss of gravity in the worts of 1 lb. per Long, or 2° 78′ by Allen's or Bates' instruments. For example,—if worts of 42 lbs. gravity per Long be got together in the gyle-tun at 52°, when the temperature rises to 78° they should have lost 26 lbs. of gravity, and thus be attenuated to 14 lbs. when tried by the instrument.

"*Inert Fermentation.* This is perhaps the most dangerous, because it is the most deceitful. This fermentation to inexperienced, and even to many experienced brewers, has every appearance of proceeding remarkably well, and they of course think that all is right; the Beer, however, will always taste mawkish and heavy, and without vinosity; although the attenuation may have been carried to its proper extent, there can be no doubt of its proceeding from some of the causes of unsoundness already mentioned. It first makes its appearance in the second change, *viz.*, the curling top, which, instead of assuming the fine cauliflower appearance, diverges into long flaky curls, hanging downwards; as soon as the 'stomach' or smell of the gas begins to rise, a mawkish want of pungency and vinosity is discoverable by those who are acquainted with the proper odour.

"The light yeast head, instead of rising with a rocky appearance is smooth all over; it however often drops regularly, as in a healthy fermentation. The proper close yeasty head never rises; instead of which, if it does again rise, we have the same frothy appearance as before, smooth all over, with no appearance of air, as in a healthy process. The 'stomach' also retains the same mawkish want of pungency and vinosity.

"We have been thus minute in describing the progress of the above fermentation, because it is the most insidious and dangerous, as also the most common and least known or understood; how often do we hear of mawkishness in the taste, which cannot be accounted for. We may rest assured that, in nine cases out of ten, it proceeds from the inert fermentation, and not from want of boiling, to which it is generally ascribed.

"Before the remedy can be known, the cause must be traced; every experienced brewer will then know how to proceed.

"*The Boiling Fermentation.* This, to look at, is the most formidable of the irregular forms of the process, and proceeds also from unsoundness in the worts, or occasionally from bad yeast; for which also there is no certain remedy, but tracing and removing the cause. It commences like others with a creamy top, but the curl rises very light and faint, and in patches over the tun. The light yeasty head has an ugly bluish white appearance in some parts of the tun, while in others it has a fretful blistering appearance, and only just covering the beer; this is accompanied with little or no

attenuation. The 'stomach,' although sometimes pungent, is neither healthy nor vinous. When the light yeast-head disappears, no other head rises, and the fermentation very soon assumes the appearance of a boiling cauldron.

"In the early part of our practice we have had occasion to see a good many boiling fermentations, which we could not then account for; since that time, however, we have been enabled to trace the causes, and invariably to remove them.

"Of close fermentations, many think that fermentation goes on better when the gyle-tuns are accurately closed, so as to prevent contact with the atmosphere. In as far as regards the atmosphere, this opinion is correct; but when fermentation goes on vigorously, there can be no connection with the atmosphere, the great production of carbonic acid gas excluding it. Carbonic acid gas is heavier than atmospheric air, in the proportion of 1527 to 1000, and while it floats on the surface of the Beer, and at the same time is produced in such quantities as to be constantly making its escape, atmospheric air cannot possibly interfere.

"About the year 1824 Mr. Gray, of West Ham, on Madame Gervar's principle, attempted to introduce close fermentations into this country. It was tried in several places, but we have never heard of its having been permanently adopted. What may be denominated close fermentations are, however, still practised in many parts of the country. When the worts are gathered together in the tun, a certain portion of yeast is added; the gyle-tuns are then shut up as accurately as circumstances will permit, and fermentation is allowed to take its own course, until the yeast falls to the bottom; thus trusting the whole process to chance. The Beer so produced is invariably what is technically denominated foul or yeast-bitten, leaving a nasty disagreeable bitter on the palate; a taste to those unaccustomed to it quite nauseous. It also, like all foul Beer, stupifies without exhilarating, and produces, especially amongst sedentary people, heart-burn and head-ache; custom, however has so reconciled this unwholesome beverage to the palates of the consumers, that the stupifying quality is thought to proceed rather from the strength of the Beer, than from its foulness from the yeast improperly combined with it, or perhaps sometimes from narcotics improperly introduced during the process. We trust, however, that other brewers, by following a more healthy process,

and thus producing a better and more healthy beverage, will be able to convince those who follow the above mentioned unwholesome and erroneous mode of fermentation, that a more scientific process must be adopted.

"Of long and short fermentation, we have always contended that long fermentations are more hazardous than the shorter processes, it being understood that the temperature of the fermenting tuns can be controlled by proper means. It cannot be disputed, that when worts are kept a fortnight, or perhaps more, in the gyle-tun, they are much more liable to be injured by the different atmospheric fluctuations which may take place during that period, both with regard to the influence of electricity and temperature, than they can possibly be in a period of from forty to seventy hours, or sometimes less. If therefore, equally good, or perhaps even better results, both as to soundness and flavour, can be produced by the shorter process, it must be preferable. It saves both room and expense. Indeed, we have known Beer brewed by a short process of fermentation, entirely consumed before Beer by the long process was out of the gyle-tun. If worts be partially unsound, and the proper quantity of yeast added for a vigorous fermentation, it will no doubt often lead to the boiling, and other erroneous fermentations, which do not, in the slow process, assume an appearance so alarming to the inexperienced brewer as the rapid. We generally find, however, that where the causes of unsoundness have been traced and removed, and the quick fermentations introduced, they have been found to be not only much safer, but to lead to better results than any other; and they, in consequence, have been permanently adopted.

"We know that vigorous fermentations always produce the best Beer for consumption in warm climates. For Stock Beers therefore, which have to stand the summer of this country, the same process will be found the more certain.

"*Fretting Fermentation.* The fretting, or fretful fermentation, proceeds either from using stale or languid yeast. It is often preceded by unsound worts. The first indication is soon after the tun has creamed over. Instead of rising to a curling top, blue patches make their appearance in different parts of the head, and no proper light yeasty change takes place. In about eight or ten hours a sort of undulating motion is apparent all over the top of the worts, and

soon after this the head, which has never been above three or four inches high, begins to drop, and is replaced by large and rather opaque air-bells, which always denote acidity. There are various ways of making the appearance more healthy. But prevention is better than cure; and, as we have already stated, the causes may be easily traced and removed. The Beer so fermented will be either mawkish or yeast-beaten, or perhaps both.

"*Yeast-bitten Fermentation.* As this term may not be thoroughly understood, we shall endeavour to explain its meaning. Some Beer when drunk leaves a very unpleasant bitterness on the palate, which hangs there for a considerable time. This bitter taste is supposed by many to proceed from Hops; the Hop bitter, however, is quite different, being highly aromatic and pleasant, and, technically speaking, goes clear off the palate.

"This disagreeable bitterness proceeds from using stale, languid yeast, which, instead of carrying on the fermentation properly, seems to get so incorporated with the Beer, as to become a component part of it, which cannot be discharged, as happens after a proper fermentation. Such Beer, therefore, must be injurious to all constitutions, but particularly to delicate females and sedentary people. It produces acidity on the stomach, consequently heart-burn and a stupifying effect, without exhilerating. Yeast-bitten Beer often appears bright enough to the eye, and from this circumstance many people are induced to think it must be good, wholesome drink. The harsh disagreeable bitter, however, which hangs for a length of time on the palate, is at once perceptible to any good judge, and warns him against its continued use.

"*On the Acetous Fermentation.* As the fermentation of malt worts for making Vinegar is generally carried on at a much higher temperature than that commonly used for Beer, it has been thought that this high temperature is absolutely necessary for their after acidification; and it probably in some way facilitates that change. This mode of working being peculiar to the manufacture of Vinegar, has procured for the process the name of the Acetous Fermentation; but we know that no more acidity is generated in the gyle-tun during the fermentation for Vinegar than in that for Beer, unless it proceeds from other causes. It is so far, therefore, only the vinous fermentation of a malt wort, to be converted into Vinegar by an after process.

"It is even doubtful, however, whether the after process can be properly called a fermentation; for at the time the greatest acidification may be going on, there is often very little appearance of effervescence or fermentation. The fermented wort is converted into Vinegar by its being exposed in open vessels, to imbibe oxygen from the atmosphere; and the acidification appears to be accelerated by heat, which is obtained by exposure to the sun in summer, or from stoves in cold weather. But from exposure alone acidity would take place in time, without any artificial heat being applied. We are now treating of Vinegar made from Malt, without reference to that made on the Continent from grapes or wine; but heat, we believe, is also had recourse to there to accelerate the same process. The vinous fermentation, in Vinegar made from every vegetable matter, must, to a certain extent, precede what is called the acetous, as it is alcohol only which imbibes oxygen, and become acetic acid.

"Chemists inform us that the acetous fermentation may set in during the fermentation of Beer after it exceeds a certain temperature in the gyle-tun; but they cannot afford any chemical proof of this statement. We have seen Beer, the fermentation of which was begun at 80° F., and carried to upwards of 90°, and which Beer at the end of twelve months bore the test of litmus paper as well as any Bavarian Beer that has been met with by us, and this notwithstanding that the latter Beer had never exceeded perhaps little more than half that temperature in its fermentation. It is proper, however, to add that the former Beer, as well as all the Bavarian Beer which I have seen, wanted vinosity, and had a mawkishness in flavour which would not generally please in this country.

"It is well known, and can be easily shown, that positive electricity excites acidity in worts or Beer, while negative electricity prevents it. This accounts for the tendency to acidity in all Beer which has been subjected to positive electro-chemical action in any part of the process of brewing, but particularly in the gyle-tuns during fermentation.

"From what has been said, it would appear that there must be some doubt as to whether what is called the acetous fermentation has ever as yet been properly defined; and, with all due deference to much higher authority, it seems at least very doubtful whether the term acetous fermentation is scientifically applicable to any stage of the process of converting Beer into Vinegar. At all

events, no undue acidity takes place in the prior vinous fermentation, unless produced by galvanic action, or other accidental causes.

"*Further Remarks on Fermentation.* It happens sometimes in long fermentation that, although the heads on the worts assume in certain stages very unhealthy appearances, they afterwards, even spontaneously, become more vigorous and healthy; and this the inexperienced brewer assumes as a certain indication that all is right. He may rest assured, however, that if an unhealthy appearance takes place in any part of the process, it denotes either more than the common acidity in the worts, or acidity produced in the process of fermentation by electro-chemical action, or other causes. And, however healthy to appearance the fermentation may become, the Beer, instead of being what is denominated 'sound ale,' will fly off to an acid. This in a great measure accounts for the difficulty of procuring any really sound Beer, after it has attained a certain age. We have very often on pointing out some very irregular appearances in certain stages of fermentation, been met by the remark, 'Oh, that is nothing; it will all be quite right before cleansing.' The Beer, however, notwithstanding its healthy appearance, will always retain a mawkish, subacid flavour, very disagreeable to those who have accurate palates, and also highly prejudicial to the health of those who drink it.

"Many brewers, however, rather than allow their own knowledge of their business to be called in question, will persist in this erroneous mode of working, trusting that their Beer will be all consumed before any of the anticipated bad effects can take place. Such brewers obviously look more to their own profits than to the health of the consumers."

Scottish system of Fermenting, by Dr. Thomson.—"It has been proved by chemical analysis that glucosin, the starch-sugar of Malt, is resolved by decomposition into equal parts of alcohol and carbonic acid; and the conclusion has been arrived at, after the strictest examination of yeast, that it is sugar in a state of partial decomposition that acts as the fermenting principle. The appearance, therefore, which brewers' and distillers' worts assume while under the process of decomposition, is caused by the escape of carbonic acid, and the arrangement of the particles of vegetable matter, and other acids and substances which the worts contain, and agglutinate

and separate from the solution in the shape of yeast, carrying over with it a portion of the sugar partially decomposed, and which, when applied to fresh worts, commences the same action of fermentation. The theory of fermentation, therefore, is no longer a matter of conjecture; the decomposition of sugar establishes a law in chemical science, by which, in all time coming, brewers and distillers may regulate their processes without working in ignorance. I shall now proceed to describe the fermentation and attenuation of the brewing in hand; and, as it is during this process that the Ale acquires a character for flavour and keeping, I propose to enter with some minuteness into the subject.

"The worts having been cooled down to 53°, and six gallons of yeast prepared, the first part of the process is to pitch the gyle; that is to say, to mix the onset of yeast and the worts together in the gyle-tun, to commence the process of fermentation, the weight or saccharine extract being 94 lbs. per barrel. One barrel of wort is first run into the gyle, to which six gallons of yeast are added, and thoroughly mixed; the remainder of the worts are then pitched in full flow from the coolers, at the temperature, as already mentioned, of 53°. The quantity of yeast, and the heat of the worts, must be varied a little, according to the season of the year, both in the slow and quick methods of fermentation. In the slow method, one gallon for every four barrels of wort during the winter, and two-thirds of that quantity for the warmer spring and summer months, may be taken as the average quantities used. The degree of heat of the worts at which the yeast store is added, is of the utmost importance, as it regulates the time of the process of fermentation.

"In the Scottish system of brewing, it ranges form 50° to 55°, according to the season of the year; or more particularly, according to the existing state of the atmosphere. In the English system of quick fermentation, the range of heat is from 60° to 65°; in both cases being the best that can possibly be used for carrying through the respective processes, and obtaining the desired combination of alcohol and solution of starch-sugar, to constitute strong Ale.

"These precise heats require to be completely understood, several writers having given latitude to a much larger range, which is apt to lead into error. When the heats are lower than 50° in the slow and 60° in the quick method, the fermentation is languid, and

recourse must afterwards be had to heat the worts in the gyle by artificial means. When above 55° or 65°, in these methods, in the first instance, the worts are apt to spring from the slow into the quick fermentation, and endanger the brewing; and if the heat is above 65° in the latter method, the fermentation runs too quickly up, and renders the Ale liable to commence the acetic fermenting process.

"The mean heat for commencing fermentation I have formerly stated as 52½° in the Scottish, and 62½° in the English, system; and it cannot be too earnestly urged, that in both the chemical principle is the same, although the action differs in manner and time, the result required being the resolution of part of the starch-sugar into alcohol in such proportion as to bring out the Ale in the highest state of richness of flavour, and fit for keeping until required for use.

"The quality of the yeast, it need hardly be mentioned, must be of the best description. The rule in Edinburgh is always to work with yeast obtained from Ale of equal strength to that which is in operation, and stronger, if possible; but never with weaker. The effect is obvious in practice, though the reason is not generally understood. The principle of fermentation in yeast being sugar in a state of partial decomposition, yeast made from weak wort contains less of the fermenting principle than that obtained from worts of greater strength, and acts accordingly.

"There is another point which requires explanation. Store yeast for onset requires to be changed occasionally in both systems; or, to be more explicit to the general reader, the process of fermentation requires to be commenced by a change of yeast from another brewery, as when too long continued in use in the same brewery, it is found to work languidly, and become deficient in strength and quantity. It may be said to work in and in to weakness, until it loses the capacity of carrying over a due proportion of the sugar in a state partially decomposed, and thus loses the power of acting with energy when applied to fresh wort. The brewer should be very much on his guard as to the district or brewery from whence the fresh onset comes. He should know the kind of water which is used, as the yeast acquires a character from its quality, and affects another fermentation accordingly. In practice, I found it useful to have a change of onset every four months. Much

depends, however, on the care taken in keeping the yeast from one brewing to another as strong as possible.

"Mr. Black, in his Treatise on Brewing, observes that there is no occasion for a change in the fermenting principle at all, and that he never attempted to make it; but there cannot be any doubt whatever that it is requisite. The utility of the practice is universally acknowledged, care being ever had that the yeast is from Ale made from worts as strong as that to which it is applied, and that it is as strong and fresh as can be procured.

"After the worts are pitched, and the yeast has struck, for the first ten or twelve hours a decided alteration takes place, and they are turbid and unsettled in appearance; and a scum of a greyish colour has gathered on the surface. In twelve hours more a white circle, narrow and regular appears round the edge of the gyle, the surface begins to chip, and show irregular patches of white breaking through; then these unite and shoot up in little pyramids, a proof that the yeast is begining to form on the surface, and that carbonic acid is escaping from the worts. This is the first stage of the fermentation, which the brewer looks upon as an assurance that his gyle is in a healthy state. The whole head of the worts is now covered with froth, which the brewer watches, and as soon as he judges that the yeast is sufficiently formed, the head on the surface of the worts is beat down, and the process of fermentation allowed to go on for twenty-four hours.

"At this part of the process, the Alloa district brewers have a method of quickening the fermentation, which is very serviceable. They prepare a half-fermented wort, which is termed fillings. Reserving half a hogshead from the coolers, they put this to quick fermentation at 62°, and by the second day of the gyle's age these fillings are ready. They throw into the gyle ten or twelve Scotch pints—about five gallons English measure—the effect of which is to make the fermentation lively and healthful. These fillings serve another purpose, for which they are chiefly intended. By the Alloa method of fermentation, the contents of the gyle, when finished, are cleansed or run into butts, from which the Ale is racked into casks as required, and the fillings are added, to preserve its keeping quality. This method, however, is incidental, as their chief markets for consumption are too distant to admit of their following the Edinburgh mode of cleansing into barrels at once,

and sending out to customers. The Alloa Ale, from this cause, is liable to become a little hard. In my opinion, when judiciously ordered by the customer, and used in time, it is all the better for this, the Edinburgh Ale being sometimes complained of as being rather soft; but this is no fault of the brewers—their customers cannot endure the least taste of the bitter principle of Hops. The Edinburgh trade, therefore, use particular care to extract the aroma, without permitting the bitter to be much infused, except in their summer keeping Ale. When Ale is exposed to heat, either in a warm apartment, or by a change from very cold to mild weather, the aroma of the Hops held in it escapes, and not having sufficient bitter for support, sometimes acquires a soft, weak taste, but brewers must study the public demand; and such occasional condition, even of the best kind, cannot be avoided.

"To return to the process of fermentation of the brewing. Twenty-four hours after the head of yeast has been beat in, the renewed yeast comes thicker to the surface of the worts, of a light cream colour, and of a firmer appearance. The process of the heat and attenuation, or resolution of the starch-sugar into alcohol, must be carefully ascertained. The increase of heat altogether, to the finishing of the Ale, must not exceed 10° or 11°; but the attenuation required, being according to the future views of the brewer, cannot be fixed by any arbitrary rule. In the present case, 94 lbs. saccharine extract is the strength of the wort, and the attenuation required is that it shall be carried down to 45 lbs. per barrel. The duration of the process, therefore, depends on regulating the heat until the attenuation is accomplished. The heat should advance progressively, and is either kept in check or encouraged by the use of the tube, which is fixed round the inside of the gyle, taking five or six turns from top to bottom, through which hot or cold water can be run at the pleasure of the brewer. In eight days the heat has increased 10°, and the attenuation, as indicated by the saccharometer, is down to 50 lbs. per barrel, the head of yeast on the worts having been plunged occasionally during that time.

"There cannot be any rule established for beating in the yeast; sometimes it is requisite twice in one day, sometimes not for two days together; neither can time be fixed on to determine the duration of the process of fermentation. Much depends on the

quality and quantity of yeast employed to commence the process, and the heat of the worts when set to ferment.

"The appearance of the gyle gives the brewer a good notion, during the process, of its healthy state; the head of yeast should have a broad rolling appearance, full to the sides of the gyle, and swelling a little to the centre. The yeast is of a close texture, not glassy, nor studded with bubbles of carbonic acid, nor of a flat surface. When it assumes that appearance, either in the slow or quick method of fermentation, it is more than time that it should be cleansed.

"The brewer must determine when the gyle is ripe, and when all is well, relative to heat and attenuation, to cleanse. In Edinburgh, this is done by running the clear Ale from beneath the yeast into the same barrels in which it is sent out to customers. No farther fermentation takes place, sufficient to render it necessary to put the barrels on troughs; they are placed on open stillions, or on the floor of the cellar. In Alloa, as previously explained, the Ale is cleansed into butts, and afterwards racked into casks to be sent out. It sometimes happens that the gyle, in spite of the brewer's care, runs up to a high temperature, and the fermentation becomes unmanageable. In this case, the contents of the gyle are run as clear as possible into a square or clean tun. The Ale cools down a little, and in twenty-four hours it is racked into casks; but this method of tunning ought never to be had recourse to, except the state of the gyle requires it, as it flattens the Ale, and injures its quality.

"I must call the reader's attention to the progressive state of the gyle during the process of fermentation, as explanatory in some measure, of the different action which takes place in the quick and slow methods of working.

"In the slow method of fermentation, when the yeast first gathers on the head of the worts, it gives out carbonic acid; and in proportion as it allowes this to escape, and feels the influence of the atmosphere, it becomes viscid, and were it not beat in, it would sink down through the wort, and leave it almost clear; before it approaches this state it is beat down into the worts. The principle of fermentation it still contains is thus mixed with the worts, and resumes its action.

"The more viscid part of the beat-down yeast disunites from

that which holds the fermenting principle, and attaches itself to the bottom and sides of the gyle. As each successive formation of yeast comes to the surface, and is in turn beat in, the same process takes place. The viscid portion thickens at the bottom and round the sides of the gyle, until the alcohol begins to overpower the fermenting principle, and gradually would destroy it altogether. This is the time for checking the farther progress of fermentation by cleansing, by which term the general reader will perceive, that it means the separation of the Ale from the yeast formation in the in the gyle-tun.

"By the quick method of fermentation, the English brewer pitches his worts at 62°, with a larger quantity of yeast. From these causes they arrive at the full fermentation standard in thirty-six hours, and during that time run up 10° to 12°, leaving the attenuation behind. The yeast is, therefore, beat into the wort, and mixed thoroughly together, and tunned immediately into barrels set on close troughs, to hold the worts that immediately flow into them.

"Now being repeatedly filled up, the yeast begins to assume the viscid state precisely on the same principle as that described in the Scottish process of slow fermentation; but, in place of lodging in the barrels, it settles down on the bottom and sides of the troughs put in the same manner as in the Scottish gyle, until the formation of alcohol checks the fermentation, and gradually stops it altogether.

"In this latter process the repeated overturning of the Ale, and filling up the barrels, diminishes its temperature, and preserves it from the acetic fermenting heat: but it is better guarded against that danger by the formation of alcohol, which now goes rapidly forward, until sufficiently powerful to arrest farther fermentation.

"I have thus endeavoured, as shortly as possible, to give the reader a distinct notion of the nature of both these methods of fermentation; and it remains to say a few words on the proper degree to which Ale should be brought down by attenuation, so as to preserve the richest flavour of Malt and Hop, and to afford the greatest satisfaction to the consumer.

"The attenuation of the wort, so as to combine the exact proportion of alcohol and the sugar of Malt, to constitute Ale of the richest description, has ever been the study of the Scottish brewers; and although every part of the process of manufacturing malted liquor may be said to be of importance, the successful attenuation

of the worts, in the Scottish system of brewing Ale, may justly be deemed one of the most essential requisites to establish the character it has acquired. To brewers, this process must always be an object of much solicitude. When the resolution of the starch-sugar is carried down to rather a greater length than necessary, it promotes, no doubt, the purity of the Ale and its keeping quality; but it renders it too thin to the palate, and unmasks the nauseous Hop bitter, which always, more or less, comes over with the Hop extract. On the other hand, when strong worts have not been sufficiently attenuated, the Ale has a sickly, luscious taste, and is apt to run into acidity. To avoid extremes, and to hit the exact proportion, therefore, requires the skill of the brewer. The future disposal of the production ought to influence the process. Ales for bottling ought always to be attenuated lower than Ale for draught from the cask. In making Ales of this latter description, the brewers of Edinburgh have found it of advantage to keep them fuller of saccharine extract than they had formerly done. Ales for bottling would, in some instances, admit of the same improvement. I have sometimes thought that a table of attenuation, stating the specific gravity of the wort, either for bottling, or to be used in draught from the cask, at the various strengths which the prices indicate, might be of some use to brewers; but it is a matter of taste, for which no rule can be given with propriety."

MILD ALES.

Mild Ales as they are brewed in London, are generally sold as four-penny Ale. The average gravity of these Ales are as near as possible 25 lbs. in weight per barrel. There are some brewers that brew this class of Ale at a less gravity than others, and therefore can serve the publicans at a less price. They make it a rule to run the length of four barrels per quarter of Malt, at a gravity of 23 lbs. per barrel; and if the Malt should be inferior, and not produce the required extract, the deficiency would be made good by infusing a quantity of sugar just before its being turned out of the copper, or it should be allowed to boil fifteen minutes, and not any longer. The class of sugar to be used for this purpose should be the best Jamaica foots, containing, in my opinion, more saccharine matter than any other sugar. There are other kinds, such as the Mauritius,

which can be bought very cheap, and is principally used by the large Porter brewers of London; but I cannot see the utility or advantage of using sugar whilst you can buy good Malt, inasmuch as the saccharine from good Malt is far superior to the saccharine of sugar. It combines more fulness of body, with a better flavour, and its keeping qualities are unquestionably greater than those of sugar, *therefore I contend that there is no advantage in using sugar*; providing Malt be good and cheap, the latter is preferable to the former for brewing purposes. Mash with the same heats for Mild Ales as you would for Stock Ales, and instead of turning on two and a half barrels of water for the whole mash, you would now turn on three barrels of water to each quarter of Malt in the mash. This being done, the mash should be covered and allowed to stand two hours. Having stood its proper time, the taps should be turned to run off the first wort. Having run off the first wort, the water should be turned on at the same heat as for Stock Ales before mentioned, sparge on about two and a half barrels of liquor, *viz.*, water, to each quarter of Malt. The goods should now be moved, either by the mashing machine, or by the mashing oars. This second mash should stand one hour closely covered. This being done, the worts should be boiled as soon as possible. Boil the first wort one hour, and the second one hour and a half; add six pounds of the best Hops to each quarter of Malt, keeping them well stirred down. Having boiled the worts, they should be turned out into the hop-back, and let remain for a short time previous to turning them into the coolers, so that the Hops will become settled in the back. Having turned the worts into the coolers, they should be cooled down with as little delay as possible. Let them run through the refrigerator into the gyle-tun at a temperature of 60° by thermometer. This being done, add one pound and a half of yeast to each barrel of Ale, and well rouse the gyle. The first and second worts should either be amalgamated together in the hop-back, or equally divided in the gyle-tun. The worts got together at the desired heat, and the usual quantity of yeast added, take the heat of the tun and weigh the worts: heat 60° by thermometer, gravity 25° by saccharometer. The tun should now be covered to prevent the carbonic acid gas escaping; because it materially assists the fermentation. The heat of the tun should not exceed 75° for the highest, and the gravity would be reduced to 10° by saccharometer.

The Ales should now be cleansed in the usual way, and kept well filled up as often as required. The Ales being cleansed, they are racked into different size casks to suit the consumer. There are some brewers that cleanse their Ales in the same casks as they send to their customers, and not racked. They infuse half a pint of isinglass finings, or a little more, into eighteen gallons of Ale, and so on in proportion to the size of the cask that is being sent out.

PALE ALE.

Pale Ale is nothing more than Beer made from worts extracted from the palest Malt, and boiled with the palest and best Hops. The East Kent Hops are the best for this class of Ale. Every attention is given to the selection of these materials, in order to ensure the pale colour peculiar to this Ale. There are many brewers who are not so choice in the selection of Malt and Hops, provided they can buy these materials 10 per cent. less. It is the price they study, and not the quality, and a maltser would palm off to a small brewer Malt that he would not think of sending to a larger firm; because he knows perfectly well that inferior Malt would be immediately rejected, and the maltster by so doing would lose his reputation as a tradesman, and also the confidence of the firm. The same remarks apply to the Hop merchant. He would supply a small brewer with Hops of an inferior quality, at 10 or 15 per cent. less than the best quality, and glad to get rid of them; and there really is such a contrast between the large firms and a small brewer in the choice of materials, that it cannot be expected for the latter to compete with the former while he pursues such a bad policy in conducting his business. There are none so choice in the selection of materials as the Burton brewers; and having the advantage of making their own Malt, they manufacture it to their own taste for the different classes of Ale which they brew. The brewer selects the very best pale Malt for home consumption. He, however, sometimes deceives himself, and has too much colour in the Ales; he is then compelled to manufacture them into Mild Ales. Surely such mistakes as these never ought to be made by such scientific brewers as Burton can boast of, not one of whom but what is perfect in the science of chemistry! There they are stationary, the same old thing as it was twenty or thirty years ago. They make no progress in reference to brewing, always analysing and experimenting;

however, we must look out for some wonderful discovery by Professor Somebody after another half century, I suppose; but the professors are a long time bringing their science to a satisfactory issue, as far as brewing is concerned. I am of opinion that brewing at the present time is at its highest pitch, as far as perfection goes.

BREWING INDIA PALE ALES.

There is a difference in the quality of these Ales for export and of those for home consumption; however, I will treat on the Ales for home consumption, and I take the presumable gravity of the Burton Pale Ales to be 25 or 26 lbs. per barrel. The liquor (water) in the copper having attained its proper heat, it is quite immaterial whether the water is boiled previous to mashing; the worts will be boiled quite long enough without having recourse to boiling the water, a mere waste of time and fuel; if the water in the copper has attained the heat of 180°, turn out into the mash-tun one barrel and a half to each quarter of Malt to wet the goods, no matter how many quarters you wet, reduce the heat to 168°. This being done, the Malt should now be let into the mash-tun and the mashing machine set to work, or mashing oars, as the case may be; this should be continued until the Malt is thoroughly saturated and well mashed; it is necessary to get through this part of the process as quickly as possible, so as to retain the heat. Having thoroughly wetted the goods, turn on one barrel and a half more of water to each quarter of Malt, at a temperature of 185° to raise the heat, mashing at the same time. Having gone through the process of the first mash, the mash-tun should now be covered, and remain so for two hours. This being done, the taps of the mash-tun should be turned slowly, so that the taps may not become blocked with the goods; the wort runs into the underback, and from thence it is pumped into the copper. Having run off the first wort, you now turn on two barrels of water to each quarter of Malt, at a temperature of 180°. This should be sparged on over the goods. The goods (Malt) are not to be mashed or disturbed, but sparge the whole on. Having done this, the mash should stand half an hour. Having stood its proper time, the taps are to be turned to run off the second wort. Having run off the second wort into the underback, the worts should now be pumped up into the wort copper.

It is preferable to have one boiling only, if the copper is large enough, inasmuch as that the first and second worts get well amalgamated together, and receive their equal share of the qualities of the Hops. Having obtained the first and second extracts from the Malt, it is usual to turn on a barrel of water, for a return wort, to each quarter of Malt, or for Small Beer.

BOILING THE WORTS.

Some scientific brewers are averse to boiling their worts any length of time. Their theory is, that if the Hops are merely scalded in the copper with the worts it is quite sufficient, and that by carrying out a good fermentation, it will preserve the keeping qualities of the Ales; but I say that long boiling is imperative. If by the latter system you lose in quantity, it is quite evident you gain in quality; and if at the expiration of the boiling the worts should have lost one or two barrels, so in proportion the Ales would gain in quality. The saccharometer must now be called into requisition to test the strength of the worts in the copper, and the worts should prove to be 2 lbs. per barrel heavier than they are required. Very well, there are twenty-five barrels of Ale in the copper, at a gravity of 27 lbs. by saccharometer. The quantity of Hops to be used for boiling this class of Ale should be 16 lbs. per quarter, and the Hops to be the best East Kents. The worts being in the copper, and the Hops infused, the boiling should be got forward with as little delay as possible. The worts having commenced boiling, the time should be noticed, and the boiling continued without intermission for the space of three hours. It is not requisite to boil these worts hard and rapid; slow boiling, or rather simmering, will be found quite sufficient to extract the properties from the Hops. By hard and rapid boiling the evaporation of steam is immense, and it is quite evident that the aromatic qualities of the Hops evaporate with the steam; a quality that it is most essential to preserve in the Ales, and from which is due that agreeable flavour to the palate. By hard boiling you extract a rank bitter, which the Burton brewers avoid by slow boiling for about three hours. It is much better to over-run the length of Pale Ales, and boil them back to the gravity you require. By boiling the Ales hard, I do not mean to infer that the Ales lose any of their gravity; it is the

reverse, as there cannot be any saccharine evaporate with the steam. Having boiled the worts three hours, a small quantity of the wort should be taken from the copper, and its strength tested by the saccharometer. The wort should be placed in a tin can and then put into a pail of cold spring water, so as to reduce the heat, and by that means you will be able to obtain the exact gravity of the wort by referring to the saccharometer table of heats and weights, where you will find the scale fully explained; and should the worts be heavier than you require, the strength should be reduced with boiling water to the gravity that you require. This can be done either in the copper or on the coolers; that I leave to the discretion of the operator. Having pretty well exhausted the subject of boiling, I will now commence with the fermentation.

FERMENTING PALE ALES.

The worts having been turned from the copper into the hop-back, from whence they run into the coolers, it is necessary to get them to the desired heat as soon as possible for fermenting. To forward them in this, there should be a fan fixed in the centre of the cooler, so as to command the worts, and at the end of the coolers should be fixed a refrigerator for the worts to pass through, being the final process for cooling. There is a little attention required here, that is, to regulate the passing of the worts through the refrigerator into the gyle-tun, so as to get the exact heat desired for fermenting. This should be regulated according to the temperature of the atmosphere; and whether it be in the winter, or the summer, the temperature of the atmosphere will also decide the quantity of yeast to be used for the fermentation. In the month of October I should pitch at a temperature of 58° by thermometer. It is essential that the yeast used for fermenting be sound and new, and not more than the second day's brewing, and it is preferable to use that from the same class of Ale that you are brewing. The quantity to be used for October brewings should be one pound and a quarter the barrel. The March brewings, the temperature being somewhat lower than October, the worts should be pitched at 50° by thermometer, and the quantity of yeast to be used should not exceed one and a half pounds per barrel. Having pitched the worts in the gyle-tun at its proper heat, and the above mentioned quantity of yeast

added, the gyle-tun should now be well roused. This being done, take the heat and weigh the worts; heat 58° by thermometer, gravity 25° by saccharometer. The tun should now be covered to prevent the carbonic acid gas escaping, as the latter materially assists the fermentation. It is not necessary to keep the gyle covered after the first twelve hours, provided the fermentation is going on to all appearances satisfactorily. That can be ascertained by taking the heat and weighing the worts. If the heat has risen to 64° by thermometer, and the attenuation has been reduced 6 lbs. by saccharometer, that argues well for the future progress of fermentation. The gyle may now be kept uncovered with safety, inasmuch as that the atmospheric air would have no injurous effect on the fermentation, as the carbonic acid gas is too powerful over the gyle. The heat of the tun should be taken occasionally, and the worts weighed, merely to satisfy yourself that the fermentation is going on all right; and as soon as the heat in the tun has risen to 75° by thermometer, and the attenuation reduced to 8° by saccharometer, the Ales are then to be cleansed in casks suitable for that purpose; hogsheads or puncheons are preferable to the larger size casks, because it is necessary to reduce the heat as much as possible in the cleansing casks. The Ales are then passed from the gyle-tun into the cleansing cask by means of a leathern hose, screwed on to the tap of the gyle-tun, commanding the whole of the cleansing room. The casks being all filled, they should now be paid great attention to. It is requisite to keep them well filled as often as they require it, so that the yeast may discharge free and the fermentation not become stagnant; as the Ales would in all probability become impregnated with yeast in cold weather, and the consequences of that would lead to a second fermentation, therefore it is necessary to look well after the cleansing. This being done, and the Ales thoroughly cleansed, they should now be pumped into a racking square or settling back, and allowed to remain for twelve hours. By that time the sediment or impurities of the Ales would deposit in the square, and the Ales become almost bright. The Ales should now be racked into different size casks, or as the operator directs. One pound weight of the best Hops, as taken from the pocket, should be infused into each barrel of Ale. They are now shived down and ready for storing, or can be sent to the consumer.

A.K. ALE.

This class of Ales has very much come into use, mostly for private families, it being a light tonic Ale, and sent out by most brewers at one shilling per gallon. The gravity of this Ale is usually brewed at 20 lbs. A superior Malt is most essential, and also the best Hops, for producing this class of Beer. Mash in the usual way, running the length of four and a half barrels to each quarter of Malt, or probably more; this of course depends upon the quality of the Malt, and the operator may of course determine the length in the manipulation of the goods.

The worts should be boiled one hour and a half, with about seven pounds weight of the best Hops, pitched at a temperature of 60° by Dring & Fage's instrument, with one pound of good sound Ale yeast; probably it may require a little more, but not a less quantity, which of course depends upon the quality of the yeast, and the temperature of the weather: this point of course can be determined by the brewer at the time of pitching. Having got the worts into the gyle-tun, a good rousing would not be amiss. The temperature of the gyle should now be taken, and recorded in the brewing book, for reference at any future time. Gravity of the wort 20 lbs., temperature 60° by Dring & Fage; the gyle-tun may now be covered close, so as to prevent the carbonic acid gas escaping, and also to prevent the atmospheric air influencing the gyle, or retarding its progress. The heat of the tun may be allowed to rise to 75°, when very likely it would be necessary to check the rapid progress of the heat, or keep it stationary, so that the original gravity may be reduced to 8 lbs. by Dring & Fage's instrument—this being a nice degree of attenuation for this class of Beer for cleansing. Previous to cleansing, the unions or the cleansing casks, whichever may be in use, should be examined, to ascertain whether they are particularly clean or not, and also sufficiently dry to run the attenuated wort into; as the fermentation would not be so powerful, dampness would for a certainty affect its progress, which must by all means be avoided. If the gyle should be cleansed in the ordinary cleansing casks, and not union casks, great attention should be paid to the filling up, and not left for one hour, or two hours, but keep them filled up as often as they should require it, so as to prevent the fermentation from becoming languid. Hopping

this class of Ales, brewers must be guided by their own discretion as to the quantity of Hops to be used, to suit the palates of their different customers, which is no easy task.

PORTER BREWING.

As brewed in London:—There is such a disparity between the London Porter and the Provincial brewed Porter, that I am almost at a loss which to treat on. The Porter brewed in London, usually sold at threepence and fourpence per pot, would not suit the public in the country; they prefer paying sixpence, and have it heavier than the London brewed Beer. The average strength of the London Porter is about 20 or 21 lbs. per barrel. In brewing this article it is necessary to use three sorts of Malt, although there are some brewers in London that use four sorts; *viz.*: pale, patent or black Malt, brown, and amber. In mashing five quarters, or forty bushels of Malt, the quantities of the different kinds of Malt should be as follows:—Four quarters and a half of pale Malt, two bushels of brown and patent or black Malt, can be put in the copper instead of the mash-tun, and thereby please your own taste as far as colour is concerned. There are many brewers in the country that use what is termed high dried Malt, pale and patent; and the first mentioned, and an over quantity of the latter, causes the Porter to taste on the palate more like treacle, or you would be apt to think there had been a large quantity of spanish juice infused into the Porter; in fact, the Porter has no resemblance in point of taste with the London Beer, and this I attribute to the materials used, combined with bad management. I will now commence with the process of

MASHING.

Turn into the mash-tun nine barrels of water, at a temperature of 170° by thermometer; this heat should be reduced to 166° by thermometer; the Malt should then be shot into the mashing tun, and the mashing machine, or mashing oars, set to work. Having thoroughly wetted the goods (Malt), turn on over the mash six barrels of liquor (water) at a temperature of 185°, making in the whole fifteen barrels of water to five quarters of Malt. The mashing machine, or mashing oars, should now be set vigorously to work,

so as to get through the process of mashing as soon as possible. The mashing over, the tun should now be covered, and remain for the space of two hours. The mash having stood its proper time, the taps should now be turned to run off the first wort into the underback. This being done, turn on from the copper into the mash-tun, or rather the sparging machine, about ten barrels of water to the five quarters of Malt, at a temperature of 185°. The goods should now be mashed and then let stand one hour. Having stood its proper time, turn the taps to run off the second wort. The worts should now be got into the copper immediately, adding six pounds of the best Hops, mixed with a few Bavarians; the latter being a much stronger material in the bitter, and are generally used in the London breweries. The worts should be boiled one hour and a half, providing the copper is large enough to boil the worts at one boiling; if, on the other hand, you are compelled to have two boilings, the first wort should be boiled one hour, and the second one hour and a half. This being done, the worts should be turned out into the hop-back, from thence into the coolers, and then passed through the refrigerators into the gyle-tun, at a temperature of 60° or 62° by thermometer. The worts being in the gyle-tun, add one pound of yeast to each barrel of Beer. It should then be well roused. Take the heat and weigh the worts: heat 62° by thermometer, gravity 21° by saccharometer. The tun should now be covered to prevent the carbonic acid gas escaping; let the heat rise to 74° by thermometer, and the attenuation should be reduced to 9° by saccharometer. The Porter should then be cleansed, and kept well filled up for the first eight or ten hours, and as often as it is required after. The large firms in London cleanse their Beer in pontoons, containing six barrels each, and rack from the same into different size casks, to be sent to the consumer or the publican.

LONDON STOUT.

In brewing London Stout the same process should be carried out, also using the same quantities of Malt should be strictly adhered to. The average gravity of the London Stout is 28 lbs.; and in brewing this class of Beer, in boiling, there should be 10 lbs. of Hops to each quarter of Malt, and if the worts are boiled off at one boiling, one hour and a quarter will be quite sufficient. Having

boiled the worts, they should be cooled down to a temperature of 58° by thermometer. In the gyle-tun add 2 lbs. of yeast to each barrel of Beer; well rouse it. Take the heat and weigh the worts; heat 58° by thermometer, gravity 28° by saccharometer. Cover the tun, and the heat should rise to 74°, and the attenuation should be reduced to 12°. It should then be cleansed the same as Porter, and hopped down with the best Hops.

EXPORT BITTER BEER, OR INDIA PALE ALE.

This class of Ale is brewed similar to the Pale Ale for home consumption; the difference in the two articles being this: the export Beer has less saccharine and more Hops infused. After the Pale Ale for home trade has been brewed, the Hops are placed in a machine, and by means of an hydraulic press what saccharine remains in the Hops is all pressed out, and such extract is used for export Beer. This class of Beer is also boiled five to six hours, and attenuated very low; which shews you at once the utility of long boiling for keeping Beers, inasmuch as that the Burton brewers adopt the system above mentioned for export and long voyages, and to stand any climate, therefore it is requisite to boil the Ales well for home consumption. Having gone through the different processes of brewing in detail, so that the most uninitiated may carry out a brewing with confidence, I will now commence with

SECOND FERMENTATION.

There has been much written and said on the subject of second fermentation, and there is no reason to doubt that the complaint is caused partly by bad management, and partly through using inferior materials. In brewing Ales, a bad fermentation is very likely in winter time to occur through the inferiority of the materials used in the manufacture of the Beer, although it is more easily to be traced to the operator. Take the winter for instance, when the fermentation becomes languid, and the heat of the tun reduced by the severity of the weather; the yeast, instead of rising and forming a fine rocky appearance, drops through the Ale and deposits in the tun. This would cause the Ale to be yeast-bitten, and the means

of giving the article a disagreeable flavour to the palate; also the Ales become impregnated with yeast. The Ales being stored away for summer use, as soon as the hot weather sets in, or any change in the atmosphere, such as thunder, they will then commence a second fermentation, and there is no remedy for the evil after it once takes place. To avoid it means must be taken at the time of brewing, or during the process of fermentation. If you perceive at any time a yeasty head that rises on the fermentation dropping through the gyle, the heat of the tun should be immediately taken, so as to ascertain the cause above referred to; and if you find the heat not satisfactory to your mind, the temperator must be brought into use. Place it in the gyle-tun, and have a good supply of hot water passed through it, the thermometer being kept in the tun to ascertain the correct heat. This being done, the gyle should be covered, and the heat of the tun occasionally taken to satisfy yourself that the fermentation is going on all right. If the Ales have been in the tun forty-eight hours fermenting, and the heat has not risen sufficiently for cleansing, the tun should be raised to the desired heat by artificial means: boiling hot water placed in small casks, or large tin cans filled, would have the desired effect to raise it to the heat required. The latter method will answer very well for small quantities, although a little more trouble than the temperator. There can be no fear of second fermentations, providing the gyle-tun be properly attended to; that is, not to allow the ferment to become too languid, so as the Ales may not be impregnated with yeast, which is the sole cause of second fermentations.

BOILING FERMENTATION.

It is very difficult to trace the cause of a boiling fermentation, but it is quite evident that it is more prevalent in summer than in winter. I attribute the cause to an over quantity of yeast, and not pitched low enough to combat against the atmospheric influences which the gyle-tun is subjected to in the summer. From my experience of boilers, the best course to adopt is (and I have proved it to be successful), whenever you have to deal with a boiling fermentation, take as many pounds of the best wheaten flour as there are barrels of Ale, and as many half pounds of salt; the flour and salt should be well mixed together in a tub with some of the Ales or

Porter, as the case may be. Having well mixed the ingredients, they should now be infused in the tun, and the gyle well roused; the Ale should in the meantime be cleansed, and the gyle continually stirred until the Ales are all out. You will find this remedy effectual.

SKIMMING THE FERMENTATION.

There are many brewers who adopt the method of skimming the tun, but I cannot see that any good can be derived from it. I consider it unnecessary trouble, and prefer cleansing in cask, rather than allowing the Ales to do the whole of their work in the tun. By the latter process the heat of the tun would run too high, and cause the Ales to drink thin and insipid, unless it is well attended to, and the temperator kept in the gyle to keep the heat down. I would not let the heat rise over 72°. There are also some air-tight squares in use for fermenting, but I do not see the utility of them, for after the fermentation has continued for about six hours, it is quite evident that the carbonic acid gas is too powerful over the gyle-tun to admit any air that would be detrimental to the fermentation, so that the tun covered with sacks for the first six hours would answer the same purpose as air-tight squares. During my experience I have not been able to discover anything superior to the old system of cleansing.

HOW TO USE OLD OR STALE BEER.

The London brewers cannot do well without old stale beer, that is the larger firms, as it is necessary for blending purposes, and they generally keep a good stock by them. Ales and Porter are pumped up altogether in large vats. This Stale Beer is blended with Porter, as it becomes matured much quicker with an addition of three or four gallons per barrel. The latter quantity depends on the strength of the acid in the Beer, therefore you must be guided by your own judgment as to the quantity to be used; but in the ordinary way, about three gallons per barrel would be sufficient. This should be used in Porter half an hour previous to cleansing. If you blend any Stale Beer with Ales, you should use none but what are perfectly bright, and not too acid. Dry and clear cold weather is the best time for mixing

INGREDIENTS USED FOR ADULTERATING BEER

There is no beverage so wholesome and invigorating as Beer, nor any so generally palatable. It may, indeed, be justly considered as our national drink, and therefore to give a good genuine article, brewed from the very best materials, is the right way for the tradesman to sustain his reputation and give satisfaction to his customers. Avoid therefore using those noxious ingredients which are illegal, and visited with heavy penalties. Cocculus Indicus is a drug very dangerous to use; it is a strong narcotic, and its use therefore cannot fail to be highly detrimental to health. Opium and tobacco are also used, but instead of those ingredients giving the Ales an agreeable flavour, it is quite the reverse, and whoever drinks such Ales feels the painful effects most acutely next morning. Green copperas (sulphate of iron) is much used in London, although not so injurious as the other ingredients mentioned. It is generally used by the publicans, and is technically called Heading. Sulphate of lime is also frequently put into the casks when they have done working. Sulphate of iron puts an artificial head on the Porter, which it would not otherwise have, the publicans having put so much water, Jamaica foots, and Spanish juice, in the Beer, which destroys all its natural head (froth), and the consequence is it does not suit the eye of the public; the quantity generally used is about a quarter of an ounce to the hogshead, diluted in water. By using any of these ingredients you may make yourself liable to a heavy penalty.

HOW TO MAKE RECENTLY BREWED ALE DRINK OLD.

Some persons do not relish Ale till it has become old. In this the publican will find no difficulty, as it is very easy to be accomplished, provided he has a barrel or two of sour Beer; add two gallons of the latter, with a pound and a half of the best Hops well rubbed, and one pound of sugar candy dissolved in the Beer.

HOW TO RECOVER PRICKED OR ACID BEER.

This is commonly attempted to be done by the assistance of some alkaline ingredients. Those most commonly in use are salt of

wormwood, carbonate of soda, and chalk; but these, though they may partially correct the evil, never render the Beer so pleasant as it was before it became acid. The most effectual method of proceeding with Beer which has turned acid, is to wait till your time of brewing comes round, and it can then be worked off in the fermentation in small quantities, this being the only effectual remedy.

PURIFYING FOUL CASKS.

The casks should be well scalded or steamed, after which they may be well scrubbed with a good stiff brush, or they may be well scraped—either process will suffice—previous to using the solution that I recommend. Dilute six pounds of sulphuric acid in two gallons of water, or as much in proportion as you may require, which may be applied with a mop, after the casks have been well cleaned out. I have always found this to have the desired effect, and never knew it to fail.

TO IMPROVE THE FLAVOUR AND QUALITY OF ALES.

Use one pound of lump sugar and one pound of candy sugar, dissolve the same in one quart of water boiling hot, and let it remain until it is cold before using it. If you fine Ales down with isinglass, mix it altogether and put it in the barrel, well stirring at the same time. The above mentioned quantity will be sufficient for one barrel of Ale.

BOTTLING ALES.

In bottling Ales, it is most essential that the Ales should be perfectly clear and brilliant previous to bottling, so as to have the least possible sediment deposited in the bottles at the time of drawing the cork. The temperature of the store room for storing should be from 62° to 65° in the winter, which would materially assist the Beer in getting into condition, and causing it to be ready for consumption. The store room may be heated with gas, or with a stove, consuming coke for the purpose.

BOTTLING PORTER.

In bottling this class of Beer, the same remarks apply to it as to Ales. The heavier the gravity of the Porter, the sooner will it get into condition. There are some bottlers who flatten their Beer previous to bottling, by turning it into coolers, and then let it remain for twenty-four hours; they aver that it facilitates the condition of the Beer. Both Ales and Porter should certainly have vent some considerable time previous to bottling, because if the Ales or Porter should be at all frisky or turbid, it will be the means of causing it to settle down, and become bright and fit for bottling.

FININGS.

Ale or Porter when well brewed will generally fine itself; but for Porter, and even for Ales sometimes, owing to different causes, it is requisite to have recourse to finings. Many things are employed for this purpose by the brewers. The only legal article, however, is isinglass. The price varies according to quality, from 3/6 to 16/ per lb. The isinglass being in flat pieces, somewhat resembling a flat fish, should you at any time be in need of finings, and want to dissolve them quick, cut the isinglass in shreds, place them in a vessel, pour some boiling water upon it, and let it stand one hour; you then pour off the water, and add as much sour Beer as will cover the isinglass, and in two or three days it will be fit for use. It should be taken out of the tub and rubbed through a fine sieve; this being done, you should add as much Mild Ale as will make it a clear liquid, table Beer being quite good enough to prepare it. The quantity to be used per barrel must be regulated according to the degree of feculency in the Beer; a pint and a half would be quite sufficient for one barrel of thirty-six gallons. If the Beer is in a fit condition to receive the finings, it will become pure in about twelve hours. In order to know if the Beer is in a proper condition to receive the finings, draw off a glassfull of the Ale that is to be fined down—let it be a tall glass—put in a little of the finings, and shake it well up; then set it down to subside, and if the finings have the desired effect, you will observe in a few minutes the isinglass collecting the feculences of the Beer into large fleecy masses, which will begin to subside regularly to the bottom. If the Beer be not in a proper state, which it never is while any fermenta-

tion continues, or when any after fret occurs, as is sometimes the case, the bulk of the finings will soon be at the bottom, leaving the Beer still foul, except just at the top, where there will be a little transparency, perhaps an inch in depth, which will grow deeper in time, but will not readily extend to the whole. Fish skins, particularly sole, are frequently used for the same purpose, because cheaper than isinglass; but for a private brewer, the cost of the small quantity of isinglass requisite can hardly be an object.

BREWING TABLE BEER.

This class of Beer is generally made from the third mash, and the gravity of course is not very high, and the extract not of the best quality. This Beer is vulgarly termed bomb-clink at Burton, and usually served to the working men on the firm. To improve the quality of this Beer, add 10 lbs. of the best Jamaica sugar to the barrel. This should be done in the copper, and boiled fifteen minutes before turning out into the hop-back; but the wort should be boiled one hour and three-quarters before infusing the sugar, making in all two hours. Having the wort in the hop-back, it should now be turned into the cooler, and passed through the refrigerator into the gyle-tun, at a temperature of 68° thermometer in the tun; add 1 lb. of yeast to each barrel of Ale, and well rouse it. The gyle should now be covered, to prevent the gas escaping; the heat should rise to 78° by thermometer; it should then be cleansed in the usual way.

BREWING WITH PART SUGAR.

There are a variety of ways in using sugar. Some brewers dissolve it in the mash-tun, and others in the underback, and run it into the gyle-tun without boiling it; while others pump it into the copper, and boil it with the worts the same length of time as the extract from the Malt, allowing about 200 lbs. weight to be equal to one quarter of Malt. I do to a certain extent approve of the sugar being boiled with the Malt wort, for I think it is most essential that the sugar should receive its share of the properties of the Hops, as well as the extract from the Malt. The Hops certainly have a tendency to keep the Beer sound and good, besides imparting to it a most agreeable aromatic flavour; but thirty minutes I consider quite long enough for boiling sugar.

SACCHAROMETER.

The use of the saccharometer is to show the gravity or increased weight of the wort or liquid intended to be tried, in the proportion of pounds and half pounds to the barrel, the barrel of water weighing 360 lbs. It is adjusted at a temperature of 60°, and if the wort is at that temperature, the instrument will give an exact indication of its gravity; but as it generally happens that the wort is at a much higher temperature, the following table of corrections is given, which will show the number of pounds to be added to the indication of the saccharometer, at any temperature up to 150°.

EXAMPLE I.—Nearly fill the trial jar with wort, or liquor to be tried; immerse the saccharometer, and note also the point at which the mercury remains stationary. Suppose the saccharometer indicates 8, and the thermometer 60°, as the instrument is adjusted at 60°, no correction will be required; therefore 8 will be the true gravity of the wort, and that added to 360 lbs., gives 368 lbs. as its weight per barrel.

EXAMPLE II.—Suppose the saccharometer indicates 9, and the thermometer stands at 90°; under temperature 90°, in the first line of the table, will be found $1\frac{1}{4}$, which added to 9 will be $10\frac{1}{4}$, the true gravity; and that added to 360 will be $370\frac{1}{4}$ lbs., the true weight of the wort per barrel.

EXAMPLE III.—Suppose the saccharometer indicates 42, and the thermometer 140°; under 140° on the fifth line is $6\frac{1}{2}$, which added to 42 gives $48\frac{1}{2}$, the true gravity; and that added to 360 will be $408\frac{1}{2}$ lbs., the true weight per barrel.

TABLE FOR CORRECTIONS OF TEMPERATURE.

	TEMPERATURE.									
	60°	70°	80°	90°	100°	110°	120°	130°	140°	150°
lbs.										
1. 0 to 10	0	$\frac{1}{2}$	$\frac{3}{4}$	$1\frac{1}{4}$	2	$2\frac{3}{4}$	$3\frac{1}{2}$	$4\frac{1}{4}$	$5\frac{1}{4}$	$6\frac{1}{4}$
2. 10 „ 20	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	$2\frac{1}{4}$	3	$3\frac{3}{4}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$
3. 20 „ 30	0	$\frac{1}{2}$	1	$1\frac{1}{2}$	$2\frac{1}{4}$	3	4	$4\frac{3}{4}$	$5\frac{3}{4}$	7
4. 30 „ 40	0	$\frac{1}{2}$	1	$1\frac{3}{4}$	$2\frac{1}{2}$	$3\frac{1}{4}$	4	$5\frac{1}{4}$	$6\frac{1}{4}$	$7\frac{1}{4}$
5. 40 „ 50	0	$\frac{1}{2}$	$1\frac{1}{4}$	$1\frac{3}{4}$	$2\frac{1}{2}$	$3\frac{1}{2}$	$4\frac{1}{2}$	$5\frac{1}{2}$	$6\frac{1}{2}$	$7\frac{3}{4}$

By following the rules here laid down in the Table for Correction of Temperature, the operator can at all times brew a uniform article, which is preferable to following that uncertain system of adding so many barrels of water to the quarter of Malt during the process of brewing, no matter whether the materials be good or bad, and must have the usual quantity of barrels from the brew. The consequence is, the articles would be sometimes 3 or 4 lbs. heavier, and at other times it would be the reverse, probably 3 or 4 lbs. less, according to the quality of the materials used; hence arises complaints from the consumer, which is very easily avoided by the brewer understanding the Table of Weights and Heats. The temperature is specified in the first line of the table. You will perceive that if the heat of the worts be 150° by thermometer, and weigh 30 lbs., and when the heat has been reduced to 60° by thermometer, the gravity will have increased 7 lbs., making the actual strength 37 lbs. per barrel; this latter gravity can be reduced by the addition of boiling water, which is preferable to raw wort, to bring the worts to the desired gravity.

STORING AND VATTING ALES.

In many parts of England it is usual to store the Ales away in large vats, more so, perhaps, in Wiltshire, Somerset and Dorset, than in any other counties, and remain in the vats a year and a half or two years, which is a long time for capital to lie dormant. The London brewers pursue a different course, and have their returns once a month, whereby the capital is being continually at work. In reference to vatting Ales there are differences of opinion. I am decidedly averse to vatting Ales, particularly so in large quantities. Ales should not be vatted in larger vats than what you can well fill at one brewing, and also it should have gone through a good process of fermentation and in no way should the latter be languid, and great attention ought to be paid to the cleansing, so that the Ales before pumping them into the vat should be perfectly free of the least particle of yeast; in fact, my advice to every brewer is, and I am sure the brewer would in the course of time appreciate my recommendation, to adopt the Burton system, that is, after having cleansed the Ales run them into racking squares, and let them remain for twelve hours to allow the impurities in the Ales

to deposit in the squares before pumping into the vat, for if there be the least quantity of yeast left in the Ales, it is very probable a second fermentation will take place, sooner or later, and is most likely to occur when thunder is in the atmosphere. There is no preventive for the evil, and the whole vat is sure to go to the bad. My object for being in favour of small vats for storing is this; that a vat containing two or three hundred barrels of Ale contains such a large amount of sediment that whenever the atmospheric changes take place, the whole vat of Ale becomes in a turbid state, and the consequence is it will take a considerable time before it is fit for racking, and probably before it has settled down fit for racking there would be another change, and up it goes again; these are my reasons for being averse to vatting Ales. There are no Ales vatted at Burton, save those that are returned, having gone off a little acid. See the advantage you have in storing away in casks; the amount of labour it saves; no further racking; always ready to be sent to the customer; and if the Ales should happen, through atmospheric influences, to become a little cloudy, the Ales take no time worth mentioning before they are all right again: but you cannot say so of a large vat, which will take a fortnight or three weeks to settle down into its proper state.

FINIS.

James & Co., Printers, 12a, Well Street, Cripplegate.