A

PRACTICAL TREATISE

ON

BREWING,

WITH THE MODE OF USING THE

THERMOMETER AND SACCHAROMETER,

CHIEFLY DESIGNED FOR

PRIVATE FAMILIES.

BY

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PRACTICAL TREATISE,

&c. &c.

The object of the present work is to supply some sound practical directions for assisting private families in brewing their own beer.

The Author has himself found the want of such directions, more especially as to the use of the Thermometer and Saccharometer; two instruments which he considers absolutely necessary to ensure precision in the results.

By a proper application of those instruments, and a judicious choice of Malt and Hops, he is satisfied a considerable saving may be effected; and his own experience justifies him in stating, that by the method he recommends, the same quantity of ale, of a superior flavour, and more generally esteemed, may be produced from six bushels of malt, than by the usual plan

of proceeding can be obtained from eight bushels.

There can be no doubt that good beer has often been brewed without a thermometer and saccharometer, but it is equally certain, that there is scarcely a family which has not been frequently obliged to submit to the disappointment and inconvenience arising from constant failures; and it is to avoid the risk of these failures, and to introduce certainty into the operations, rather than to rely upon guess, that the author has drawn up the following rules.

The subject is divided into sections, in which each part of the process is treated in its natural order, beginning, first, with an account of the Instruments, and of the Utensils necessary for brewing, and the most convenient mode of arranging them in the brew-house, and of keeping them clean and in order: secondly, with a description of the qualities of the Materials used in

brewing, and herein more especially as to Water, Malt, and Hops, so as to make a proper choice of those articles: lastly, with practical directions for ensuring the production of good beer through the different processes of Mashing, Boiling, Cooling, Fermenting, and Cellaring; pointing out the proper time for running the beer from the gyle-tuns into casks, and the proper management of it when in the cellar.

UTENSILS.

THE essential utensils are, first, a copper or boiler, for heating the water and boiling the worts; a mash-tub, in which the infusion of malt is to be made; an underback, or tub, into which the worts are drawn off from the mash-tub; flat shallow tubs, exposing a large surface,

with but little depth, called coolers, for cooling the worts after they are boiled; and a tub, in which the fermentation is to be carried on, usually called the fermenting-vat, or gyle-tun.

Where there is a regular brewhouse, the copper should be highest in point of elevation, so that the cock which empties it may be above the top of the mash-tub, and this latter vessel must be above the underback. The coolers are generally so placed, as to admit of the worts being conveyed into them after boiling, from the cock at the bottom of the boiler, by means of a shoot, or wooden trough, and the gyle-tuns are placed immediately underneath the coolers. It is, moreover, very convenient, that the cistern, or reservoir, from which the water is obtained, should be higher than the copper, so that by means of a pipe with a cock opening over the copper, it may be filled as wanted. When this is not the case, the

water may be conveyed into the under-back, from whence it may be pumped into the copper by means of a pump, which will be found also very convenient for pumping the worts into the copper after they have run from the mash-tub.

All these utensils should be carefully cleaned, and more especially when any long interval takes place between the brewings. In public breweries, they generally brush these vessels with lime and water, or whiting and water; the calcareous matter absorbing and neutralizing any acid that may be formed. Another very simple method of effecting the same purpose, is to rinse them well with water in which some alkali is dissolved; such as soda, or salt of tartar, or common pearl-ash, any of which will effectually destroy the acidity that may remain; and the salts that are formed being soluble, are easily washed away previously to a subse-

quent brewing, and will leave the utensils perfectly sweet and clean. The brewer cannot be too much on his guard against acidity, in every shape.

A guage will be found very useful, by which the contents of the underback, coolers, and copper, may be ascertained. This will perhaps be best effected, by having the depth of the underback and coolers marked in inches on a narrow white board, attached to one of the sides of these vessels, and ascertaining either by calculation, or by actual trial, how many gallons are contained in every inch of depth.

Both a saccharometer and thermometer may be had of Mr. Carey, mathematical instrument maker, 181, in the Strand, for a guinea, which will answer every purpose of the private brewer. Nevertheless, a second thermometer, with a tin guard, to use in the boiler, will be a desirable acquisition:—it may be bought for about five shillings.

WATER.

THERE have been various opinions respecting the choice of water for brewing, and it is by no means improbable, that some kinds of water may be more favourable than others for extracting from malt and hops their full powers and qualities. It is equally clear however, that a great deal of unfounded prejudice has existed upon this subject. For a long time it was supposed that the London porter owed its superiority to the use of Thames water, whereas London porter is now, I believe, all brewed from spring water, drawn from deep wells, which penetrate through the clay stratum that lies beneath the plain of London.

Every one is aware, that much better tea is made with spring water than with soft water. Quassia, gentian, and other bitters, yield their qualities exceedingly well to spring water. And, although there are some soils in which

acrospire, which pushes in an opposite direction to the rootlet, should not extend more than three-fourths of the length of the grain.

In choosing malt, the following directions may implicitly be relied on. Its grains should be large, clean, plump, and unshrivelled, yet specifically lighter than water. They should have a thin skin, should easily break, and shew a full, floury, mellow kernel, which, if drawn across a board, leaves a chalky trace. No part of the kernel should be hard, or horny, which it sometimes is at the end opposite the rootlet. The taste should be sweet and mellow, and partake of that flavour that is so well known to persons who have passed a brewhouse at the time of mashing, and at the same time should leave no impression of rawness on the palate. Its specific gravity being lighter than water, it floats upon it. Hence a good method is to take a small handful of

grains, and throw them into a bason of water. If they all swim on the surface, and on their sides, the grain is well malted; if they swim endways, it shews that part of the grain is not malted; and those that sink are perhaps little altered from their original state of barley. The colour of good malt is pale and bright. A bushel of good malt should weigh 40lbs. and upwards, which is about equivalent to the weight of three quarters of a bushel of the raw grain.

The cause of shrivelling in malt is twofold. It sometimes arises from the barley being cut down while not yet ripe, in which case, there being a superfluous quantity of juices in proportion to the mealy matter, the kernel contracts. At other times it arises from the heat of the kiln being applied too suddenly to the malt in drying. The results will be similar. Good malt, when first removed from the kiln, is

hard and crisp under the teeth, but on cooling, it absorbs moisture from the atmosphere, sufficient to mellow it.

There is a kind of hardness, called flintiness, to be guarded against in selecting malt. It is caused by the barley not having been long enough in steep to effect a thorough penetration or soaking; or from the barley consisting of mixed samples; the grains being unequal in size, the smaller grains are moistened, and begin to grow before the larger ones, and the batch when dried on the kiln will consist partly of malt, and partly of grains that are little altered, which latter will be hard and gritty when chewed. When this flinty malt is exposed to the air, it does not absorb moisture, does not mellow, but remains as hard as ever. Malt of this kind, even if mixed with some good malt, produces beer of a raw and ill flavour, and does not keep sound; therefore, with these plain facts kept

in view regarding the qualities that the best malt should possess, and the opposite which the bad will present, the reader can scarcely fail in making a right selection.

COLOUR being an object with the consumers of malt liquor, it may not be amiss to point out the effect of colour produced from high dried malt. The more slowly the malt has been dried, and the lower the heat at which the drying has been effected, the paler its colour will be, and the greater quantity of saccharine matter it will contain. On the other hand, a quick heat will parch and brown the malt, and will replace the saccharine taste by one that is austere and sub-acid, deep in proportion to the degree of heat, and of its continuance, and the worts will be weak in proportion as they are brown. These positions once understood, it is easy to appreciate the effect of colour on the flavour and value of malt liquors.

est opponents of the acetous fermentation.

The fine flavoured and light coloured hops are pressed into sacks of comparatively fine cloth, called pockets, which weigh about $1\frac{1}{2}$ cwt. each, and are sold chiefly to the ale brewers. The strong flavoured ones are put into coarse bags that contain double the weight of the pockets; these are used principally by the porter and small beer brewers. The ale brewer seeks for peculiarity of flavour in his hops; but his judgment must vary with the taste of the consumers. With respect to taste there is no criterion; otherwise we should find few that could have a pleasure in either taking snuff, or using tobacco, in its various forms.

The difference of soil, together with climate, has undoubtedly a considerable influence in producing the difference of flavour perceivable in hops. Those grown on the stiff clays in Notting-

hamshire, and thence termed North Clay Hops, are ranker, and in some markets bear a higher price than Kent Hops, though not so high as Farnham Hops. The rankness of the North Clay Hops generally remains a considerable time; hence, they seem better adapted to strong keeping beers, than other kind of malt liquors. The flavour of the Worcestershire Hops has a grateful mildness, not to be met with in the other sorts.

The active qualities of the hops do not reside in the leaves themselves, but in a very fine yellow powder, which may be separated by beating and sifting. Dealers in the article value the hops in proportion to the quantity of this powder, which they call condition. If hops are very green, they have been gathered too young, and before the aroma has been fully matured; on the other hand, when they are brown, the defect arises from over-drying, or from

being too much ripened on the poles; whereby their aroma and bitterness are weakened.

The odour of good hops, especially when rubbed between the fingers, is very fragrant; and the hands are left clammy by the rubbing.

When a quantity of hops are kept in store, care should be taken to preserve them in a dry place, closely packed, and excluded from the air, as the aroma, from being very volatile, would, by exposure, soon evaporate.

MASHING.

The chief art in mashing, is to produce from the malt the greatest quantity of matter which is capable of adding to the flavour and strength of the beer; and this depends principally on the

temperature of the liquor employed in making the first mash; liquor being the technical word used by brewers to denote water. The old rule used to be, to let the liquor cool until you could see your face reflected from the surface; this, however, is a very uncertain guide. The thermometer removes all doubt. It is an instrument so constructed, that when the lower part, including the bulb, is immersed in the liquor, the mercury in the stem rises up to a certain height, and there remains stationary, indicating the degree of heat of the liquor. If the liquor is used too hot, the surface of each particle of malt will be converted into a paste, which will effectually prevent the water from penetrating to the interior, and dissolving the mucilage, and what is called the seccharine part of the malt, which means neither more nor less than the sugar, or sweet part, upon which the strength and weight of the wort, as

well as the future quality of the beer, in a great measure, depends. The heavier and the sweeter the wort, the better and stronger will be the beer. If the liquor be too cold, it will not dissolve so much of the saccharine matter; and in both these cases, great part of the virtue of the malt will remain unextracted in the grains, which will be found heavy, sweet to the taste, and slimy or pasty to the feel. In the first case, the malt, sometimes termed by the brewers the goods, will be what is called set, and very little wort will be obtained, the liquor remaining combined with the malt in the mash-tun, and what little does run will be thick and muddy. This is an error which admits of no remedy, and the brewing is spoilt. To avoid this, let the liquor be run into the mash-tun at a temperature of 174°, ascertained by the thermometer, which I have found by experience to be the very best temperature at which to make

the first mash, being hot enough to extract the goodness from the malt, and never endangering its being set. It may be run into the mash-tun a few degrees above that heat, so as to allow for the cooling it will receive from the mash-tun itself. When cooled to 174°, let the malt which has been previously ground or bruised, be emptied into the liquor; and let it be well mixed and agitated as it is emptied out from the bushel or sack, so as to form a stiff mash; and let the agitation be continued until every portion of the malt is well saturated. The proper quantity of liquor at the same temperature is then to be added, and the mashing or agitation continued for 20 or 30 minutes, according to the quantity of malt used; after which, to prevent its cooling, the mash-tun must be covered with sacks, or other coarse covering, and left to repose for an hour-and-a-half. The malt should not be ground too fine, as

the powder thereby produced is more apt to set, and at all events, to clog and prevent the running off of the worts. Indeed, it is generally believed that the bruising of the malt is better than the grinding, and is the practice now universally adopted by all the professional brewers.

In grinding the malt, I should say, that if the malt-mill be so set, that no grain passes through unbroken, it is quite sufficient for brewing, and will allow the worts to run off more transparent than it can be from more finely ground malt, which is a very desirable object. The quantity of liquor to be used in mashing will be regulated by the quality and quantity of beer to be brewed; but as a guide in this respect, it will be necessary to state, that of malt newly dried from the kiln, and fresh ground or bruised, every imperial bushel will absorb and retain 6¼ gallons of liquor; whilst malt, which has been

allowed to mellow before grinding, by being exposed to the atmosphere, (which it always should be,) absorbs about 6 gallons.

Supposing that one quarter of malt, or 8 bushels, be the quantity employed, 48 gallons of liquor more than is wanted for the wort must be allowed for, as wasted by this absorption; and in addition to this waste, an extra quantity must be allowed for evaporation in boiling, cooling, and in fermenting, which will not be less than one-fifth of the whole; that is to say, if the quantity of beer, or as it is called by the brewers, the length, to be drawn from 8 bushels of malt, is intended to be two hogsheads, or 108 gallons, there must be about 22 gallons more liquor employed over and above the 48 gallons, which will necessarily remain in the grains; or in other words, 178 gallons of liquor will be required to produce 2 hogsheads of beer from 8 bushels

of malt. I prefer putting the malt into the liquor rather than adding the liquor to the malt; as the first plan admits of a more complete mixture of the malt and the liquor by agitation, so as to ensure the whole of the malt being wetted and saturated.

In brewing from one quarter of malt as described above, I use 80 or 85 gallons of liquor for the first mash, which yields about 32 or 37 gallons of wort. At the end of the hour-and-a-half, the cock or spigot may be opened, called technically setting the tap, that is, allowing the wort to run off from the mash-tun into the underback, taking care to let it run with a small stream at first, and to return the first gallon or two gently back again into the mash-tun, so as not to disturb the malt. As soon as the wort runs clear, the cock may be opened wider. It is a good proof that the mashing has been made at a proper temperature, when the wort

comes away transparent like sherry, and forms a white frothy head in the underback. If the froth is brown or red, it shews that the heat has been too high. The wort when it comes away, should be at a temperature from 145° to 150° by the thermometer. In the second mash the liquor should be laid on at a temperature of 184°, and the third mash at 194°; nothing is gained by a higher temperature, but the extraction of an ill flavour, arising from the solution of a bitter resinous principle in the malt. It may be observed here, that the malt being thoroughly saturated by the liquor of the first mash, you obtain worts from the subsequent mashes, very nearly equivalent to the liquor laid on, and this will enable the brewer to judge precisely of the quantity required. In Edinburgh the brewers make but one mash, and obtain all the remaining quantity of wort required, according to the length they mean to

draw, by sparges, or as we should term it, by sprinklings of water, successively spread over the top of the mash-tub, in such a way as not to disturb the malt. The liquor is poured on to a horizontal board, perforated with small holes, having a ledge round it, and being swung by a string from a point over the centre of the mash-tub, it can be carried successively over every part of the malt, which is sprinkled as if from the rose of a watering-pot. This is a very good method of obtaining the wort that has been left in the grains; for the cock being left running below, the liquor that is sprinkled over the top, by degrees, drives the wort out from the grains, and leaves them saturated with plain water, instead of wort, which, if left in the grains, would in private brewing be wholly lost.

In public breweries, where the brewing goes on from day to day, the grains, after all the worts have been drawn off,

are again washed with water, which takes up all that remains in the grains, and is made use of for the first mash of the next brewing, and called a return.

In all cases it is desirable to get the worts from the underback without loss of time, as the longer they remain there, the more danger there is of incipient fermentation and acidity, more especially in the latter or weaker worts; and in order to prevent this tendency to acidity, it is an excellent plan to put into the underback a part of the hops intended to be used: they may be contained in a bag, to prevent their mixing with the wort; and afterwards, when all the worts have been conveyed from the underback, the hops thus partly exhausted, may be boiled along with the last worts, and thus nothing is lost.

As soon as each wort is obtained, its weight, or strength, should be ascertained by the saccharometer. This is an instrument constructed like the

hydrometers used by excisemen for ascertaining the specific gravity of spirits. When used by the brewers, it is called a saccharometer, which means a measure of sweetness, and it is supposed to indicate the quantity of sweet or saccharine matter contained in the wort. This is not strictly true; because, not only the sugar, but the mucilage also of the malt, dissolved in the water, adds to the weight. Be this however as it may, it is found that the strength of the beer depends upon the specific gravity, or weight of the wort; and for all practical purposes, this point is ascertained with sufficent accuracy by the saccharometer. It consists of a bulb and stem, arranged so as to float perpendicularly in a fluid, and is so adjusted, by means of an equipoise, that more or less of the stem of the instrument projects above the surface, in exact proportion to the density of the fluid in which it swims. In common

water, at a temperature of 55°, the instrument sinks so that very little of the stem projects above the surface, and in this case the part where the surface of the fluid cuts the stem, is marked as Zero, or nought. It is the point from which the other distances on the stem are measured.

A barrel of water of 36 gallons, is said to weigh 360 pounds avoirdupois, and if a barrel of wort weighs 370 pounds, it is 10 pounds heavier. The saccharometer floating in this wort, would swim so that the surface of the fluid would cut the stem of the instrument at the part marked 10, and the brewers would call it a 10 pounds wort, and so of the other numbers.

The mode of ascertaining the average strength of the whole of the worts, is to multiply the quantity of each wort into its gravity, as shewn by the saccharometer; and then adding all these products together, and dividing by the

whole quantity, you obtain the average strength of the whole mixture. Thus, suppose the wort from the first mashing be 54 gallons, or $1\frac{1}{2}$ barrels, and its strength to be 30 pounds; and the next wort to be 72 gallons, or 2 barrels, at 20 pounds gravity; and the third to be 90 gallons, or $2\frac{1}{2}$ barrels, at 6 pounds gravity:—

Thus	$1\frac{1}{2}$	× 30	=	45
	2	× 20	=	40
	$2\frac{1}{2}$	× 6	=	15
	6 barrels.		6)	100
				16.6

or the average of the whole will be 16 and six tenths pounds per barrel, written decimally 16.6.

In the course of boiling, the worts will become stronger; because the water boils away, but not the sugar or sweet part of the wort. For this reason it will be well to try the strength

of the worts, both before and after boiling, as you will by that means know what increase of gravity is usually acquired during the boiling. The saccharometer will thus inform you what strength of beer you may expect from your malt, and will enable you in brewing to make two sorts of beer, of different strengths, by mixing the worts of different gravities according to the taste or fancy.

BOILING.

As soon as the wort from the first and second mash has done running, and a third mash is required, the liquor which had been heated ready in the boiler for this purpose, is run into the mash-tub. The boiler will then be ready to receive the first and second worts, in order that they may be boiled together with the hops. The worts are now to be pump-

ed up, or conveyed, from the under-back into the boiler, and the hops are to be added; the quantity of hops being regulated by the fancy of the brewer; and in some degree, by the length of time the beer is intended to be kept. In summer time, or warm weather, more hops are required, as they certainly tend to preserve the beer from becoming hard or acid, taking care not to use so large a quantity as to make the beer unpleasantly bitter. About $\frac{3}{4}$ lb. for every bushel of malt, will be found enough in cool weather; and in warmer weather, 1 lb. to $1\frac{1}{4}$ lbs. may be required. Care should be taken in boiling, to keep the temperature equal and moderate; for by violent boiling, a great portion of the aroma and volatile oil of the hops is lost along with the steam.

I have found it an excellent plan, not to put in all the hops at the time of boiling, but to reserve nearly half the quantity intended for the brewing, un-

til the beer is in the casks, and just before stopping down the casks. This plan not only prevents any after-fret taking place, but assists in clearing the beer; and the spirit already generated in the beer by fermentation, extracts from the hop the volatile and aromatic oils, which are often lost in boiling. In every case, it is advisable to infuse the hops in a sufficient quantity of boiling water, preparatory to their being boiled with the worts; for the water wets and saturates the hops better than the more viscid worts; and thus the flavour and essential parts of the hop are more effectually extracted, than if the hops are added to the worts in a dry state. Too much heat in the copper is apt to decompose some of the saccharine matter and starch of the malt, and is the cause of the burnt taste sometimes perceivable in beer. It is necessary too, occasionally, to keep stirring the worts while boiling, so as to pre-

vent them sticking to the bottom and burning. One of the mashing oars will effect this purpose.

In large public breweries, they have a rod called a rouser, attached to the machinery of the brewery, which continues in motion the whole time the worts are boiling; and is useful, moreover, in preventing the hops from plugging the cock while the worts are drawing off. The boiling must be continued until a flocculent matter begins to separate, and is seen swimming in the boiling wort. This matter is not discernible in the first part of the boiling, owing to its more intimate mixture; but in the process of boiling, it coagulates, and leaves the rest of the liquor perfectly transparent. This is called, technically, by the brewers, the breaking of the worts.

The length of time requisite for producing this change, varies with the strength of the wort, and no certain

rule can be given, but the boiling must be continued till this effect takes place: it is an indispensable criterion, and without it good beer cannot be brewed. Strong worts require from about half an hour to three quarters; and weaker ones from two hours to two and a half. During the boiling, samples should be taken out occasionally in a wooden bowl, or other convenient vessel, and left to repose for a few moments, when it will be seen whether the flocks subside, and leave the supernatant liquor quite transparent, which is the true criterion that the worts have been boiled enough. No good purpose is answered by suffering them to boil longer after this breaking or separation has completely taken effect, unless, indeed, it may be required to obtain a stronger wort; for as has been already observed, the longer the boiling is continued, the more the watery part evaporates, and the denser and heavier the

wort becomes; remembering, however, that this additional strength is only acquired by a diminution in the quantity of the beer. It is much better to produce the requisite strength, by not adding more than the due quantity of liquor in the first instance, rather than to remedy the mistake by long boiling.

When the worts have been sufficiently boiled, they are to be run off into the coolers, taking care previously to damp the fire, by opening the fire-place door, which admits a current of air over the top of the fire; or if the fire be fierce, either take it out entirely, or cover it with fresh coal or cinders, so that the bottom of the copper may take no injury.

Before turning the cock to let the wort into the coolers, a birch broom is frequently thrust down into the boiler, and fixed before the opening, in order to stop the hops running into the coolers along with the worts. To make this

separation more effectual, a bag of horse-hair is placed at the end of the trough next the coolers, which allows the wort to run, but retains the hops. The bag being afterwards suspended over the coolers, all the retained wort drains through the hop-leaves, and thus no loss is sustained.

The saccharometer will now come into use again, to ascertain the density of the worts after boiling, and after the infusion of the hops. If only one kind of beer is to be brewed, the worts may be mixed, so as to form an average strength, which will be indicated by the degree at which the saccharometer floats. If two kinds of beer are intended to be brewed, the worts of different strengths must be kept separate, and the quantity and strength of each ascertained, mixing the stronger and weaker worts together in such proportions as may suit the intention of the brewer.

As some guide in this matter, I would observe, that the worts used for the strongest ale that is brewed, seldom exceed 40 lbs. per barrel. The worts for Edinburgh and Burton ales, of the best quality, are generally about 36 lbs. per barrel. An excellent ale is made from 30 and 28 lbs. per barrel. London Porter is made from worts of about 22 lbs. per barrel. Brown stout from 24 lbs; and good family table beer from worts of 18 lbs. per barrel. The London table beer is from worts of about 15 lbs. per barrel; and small beer for work-houses, is sometimes brewed from worts of not more than 6 lbs. per barrel.

I subjoin a table, stating the density of worts usually employed for different kinds of beer.

	Density of Worts in lbs. per barrel.
Burton Ale . .	40
Edinburgh Ale.	36
Brown Stout. .	24
London Porter .	22
Table Beer. . .	18

	Density of Worts in lbs. per barrel.
London Small Beer . . .	15
Work-House Small Beer	6

These are the extremes; and the brewer will so proportion the strength of his worts, according as œconomy or his palate may direct.

Before quitting this part of the subject, I must advert to another calculation which may be effected by means of the saccharometer, and which will be found exceedingly useful in determining the quality and goodness of the malt that has been used, and it is one I never omit to make, and to record. Thus, suppose the whole quantity of fermentable wort obtained be $4\frac{1}{2}$ barrels, at 20 lbs. gravity; $4\frac{1}{2}$ multiplied by 20 is equal to 90. This sum may be considered as the amount of quantity and

strength produced; and if this sum be divided by the number of quarters of malt used, it affords a basis by which the excellence of the malt used in different brewings may be compared. Thus, suppose this 90 be obtained from 10 bushels of malt, or $1\frac{1}{4}$ quarters; then 90 divided by $1\frac{1}{4}$ gives 72, which according to the results usually obtained, would indicate that the malt was of inferior quality.

Qrs. 1,25) 90,00 (72
87,5

2,50

I say of inferior quality, because I have obtained by this calculation as high a number as 87, and seldom less than 74. Generally, good malt weighing 40 lbs. per bushel, and well made, should yield from 80 to 82 lbs. per quarter, of fermentable matter. In the extracts from my brewing book, in-

stances will be seen of the mode of making this calculation, when worts of different qualities and quantity are used; and it is a calculation which enables you at all times to discover in what manner you have been treated by your maltster, and will be a guide for the future selection of malt. This mode of calculating the comparative merit of the malt, is adopted by most, if not all the public brewers, and gives a result, which, although quite arbitrary and technical, is a language generally understood in the trade.

COOLING.

When the wort is decidedly broken, and the liquor become quite transparent, it is to be run off from the boiler, into coolers, and the more rapidly it

can be cooled the better. It is here, that the public brewer has the great advantage over the private practitioner. He not only possesses extensive floors over which he can thinly spread his wort, so as to expose a great quantity of surface, but he generally also has a command of cold spring water, that he can convey through pipes, so contrived to branch in various directions amongst the worts, that they are cooled down to the required temperature in a very short time. The stratum of worts in the coolers should be as thin as your apparatus will admit.

In brewhouses they seldom allow the worts to be deeper than from two to three inches whilst cooling, but the private brewer has seldom such convenience of apparatus.

The time of cooling should not exceed twelve hours, for there is always danger of the worts running into acid fermentation whilst at a high tempe-

rature, and therefore the thinner they can be spread, and the sooner they can be cooled, the better. The worts are liable also, if cooled slowly, to another kind of souring, called foxing, which sometimes takes place in the coolers, and is accompanied by a disagreeable flavour and smell, with mouldy spots interspersed.

Hence, in hot weather, brewing is a critical operation, and private families should refrain from brewing in summer if possible. The object however is, that the worts be cooled down to a temperature which will ensure a healthy fermentation, neither too tumultous and rapid, nor too languid.

When the temperature of the atmosphere is at about 50°, which is perhaps the best heat for brewing, worts of ordinary strength should not be cooled lower than 68° or 70°. If the weather is warm, they may be cooled still lower; and in hot weather, as low as possible;

the coolest time of the twenty-four hours, being an hour before sunrise; but no prudent person would willingly brew when the temperature of the air is as high as 60°. It should also be noted, that weak worts will more easily ferment than stronger ones, and large masses of wort are more apt to run into violent fermentation, than smaller quantities.

FERMENTATION.

As soon as the worts are cooled down to the proper degree of temperature, they are to be run off from the coolers, into the fermenting tuns, usually called the gyle-tuns. If only one kind of beer is brewed, one vessel or gyle-tun, if it be large enough to contain all the worts, will be better than dividing it into two gyle-tuns; always remember-

ing that there must be plenty of room in the tun over and above what is necessary merely to hold the liquor, for the expansion that takes place during the fermentation, and for the head of yeast that rises on the top of the fluid.

Where two kinds of beer are brewed, as ale and table beer, two fermenting vats are of course indispensable. Worts when left at these temperatures, will soon begin to ferment without any addition of yeast; and it has been the practice lately in some families, to run the worts at even a higher temperature at once into the casks in the cellar.

I understand that in this way, very good beer has been produced, but I cannot speak of it from my own experience. My method is in all cases to add yeast sufficient to produce a vigorous and healthy fermentation. This adding of the yeast, and setting the wort to work, is called in the technical language of the brewer, pitching. Now

the best temperature at which to pitch the wort, will in some measure depend upon the quantity or volume to be fermented. For where large masses of wort are undergoing fermentation, the temperature rises as much as from 10° to 15° during the process; and it is desirable that in no case the heat of the fermenting wort should exceed 80°, nor should it, if possible, fall short of 74°. Quantities varying from 100 to 150 gallons, will not rise during the operation more than five or six degrees; and as the mass usually contained in the fermenting vats of private families, seldom exceeds this quantity, I consider that pitching at 70°, will generally ensure the fermenting worts rising to 74°. In hot weather, the temperature will rise higher, because the fermentation will be more violent, and the wort must be pitched at a proportionally lower heat to avoid this evil.

The flavour as well as soundness of

the beer is promoted, by bringing it to a heat from 74° to 80°. If it rises higher than 80°, there is danger of vinegar forming along with the spirit; and on the other hand, if the wort is pitched at too low a heat, there is risk of the yeast not taking readily nor sufficiently, the fermentation languishes, and the beer afterwards has a heavy taste, and does not become fine, which always endangers its eventually turning sour.

The quantity of yeast should be proportionate to the gravity of the wort. It should be so thick as barely to retain the liquid state. It is best to add the yeast by weight; from $1\frac{3}{4}$ to 2 lbs. is sufficient for every barrel of wort of great strength; and from $1\frac{1}{2}$ to $1\frac{3}{4}$ lbs. for worts of less gravity.

The selection of yeast in brewing must not be slighted; and care should be taken that it be free from all unpleasant flavour.

After the yeast has been put to the

wort, there will be seen in about from 7 to 10 hours, a frothy ring leaving the sides of the tun, and proceeding towards the centre: this is succeeded by more, till the whole surface is covered with a thin creaming froth: at this time a hissing noise is heard, owing to the breaking of air bubbles on the surface, and there is a small increase of volume caused by the extrication of carbonic acid gas. The froth continues rising, till at length it forms uneven elevations resembling rocks.

When the head of yeast seems disposed to fall back into the liquor, it should be skimmed off, and the skimming repeated every 8 or 12 hours. After the first skimming, a small quantity of salt and wheaten flour, (to be first well mixed with a little of the wort,) say 2 lbs. of flour and $\frac{1}{2}$ lb. of salt may be added for every four barrels of beer; these will improve the flavour, give energy to the fermenta-

tion, and by the action of the salt upon the mucilaginous matter of the malt, will assist its early spontaneous fining, so much to be desired in beer that is intended to be kept for any length of time.

At this period the saccharometer will be found a most essential instrument. Its use has been already shewn in ascertaining the gravity of the different worts. It will now be applied to determine the degree in which the worts become lighter during the progress of fermentation. It is by fermentation that the worts are converted into a spirituous liquor; and as the spirit forms, the liquid becomes lighter, or is attenuated, and the attenuation will be greater in proportion to the quantity of spirit produced, which quantity will in like manner depend upon the amount of saccharine matter dissolved and diffused through the wort. The saccharometer determines all these points, and is therefore an instrument of the first

importance to the brewer, enabling him to conduct his operations with a precision, which would be hopeless without its assistance.

The worts while working, should be examined every twelve hours, by the saccharometer and thermometer, and the attenuation as well as the heat, should be noted down. Thus supposing you have a wort, which previously to its being fermented, showed a gravity of 30 lbs. per barrel, and afterwards when examined again shewed only 27½. This would denote that one twelfth part of the sweet matter of the malt is changed from the nature of sugar into that of spirit.

Worts of about 20lbs. per barrel gravity, may be attenuated until they shew but 4 lbs. per barrel, or even 3lbs. per barrel, provided the beer is not intended for long keeping. The taste and strength of beer are mainly influenced by the degree to which this attenuation is carried.

If the fermentation be continued till the beer becomes nearly of the same gravity as water, its sweetness will in a great measure disappear, and the beverage will resemble what is called strong beer, and which is so much approved of in North Wiltshire. If on the contrary the fermentation is stopped, whilst a considerable sweetness still remains, it will be more of the nature of a mild ale. The brewer will therefore be guided in this, by the kind of beverage that his employer requires.

But it may be well to remark, that the further the attenuation is carried, the more risk will there be of the beer becoming hard; and that on the contrary, if too much sweetness be allowed to remain, the beer will probably be heavy and mawkish, and not possess that clear and spirituous flavour, nor the exhilarating qualities, that are expected in good malt liquor. As a rule for a mild but lively and cheerful beve-

rage, I usually carry the attenuation to about two-thirds or three-fourths of the original gravity. Thus a wort of 30lbs. gravity, I should allow to ferment, until the saccharometer shewed that it had attenuated down to 10lbs. or 7lbs. preferring the latter, if it were required for more immediate drinking.

A wort of 20lbs. which gives an excellent table beer for the use of a family, I generally ferment as low as 5lbs. or, if I want it to come round early for use, even to 3lbs. per barrel. It may also be remembered, that if the attenuation is carried down to zero, so as to indicate that the beer is of the same gravity as water, it will not follow that all the saccharine matter is converted into spirit. There may still be sweet and mucilage enough left for the beer to feed upon. For the beer is a compound of spirit and mucilaginous fluid, the first causing it to be lighter than water, and the latter rendering it hea-

vier, so that between the two there may result a liquor so combined, as to produce a beer of an average gravity that shall not exceed that of water.

The time of fermentation before the due degree of attenuation is produced, will vary according to the state of the atmosphere, the strength of the yeast, and the temperature of the wort. I have known it completed in three days, and sometimes in not less than twelve. Suffice it to say, that when the brewer has by experience ascertained the degree of attenuation, which produces the beer most agreeable to the palate of his employer, at that point let him interrupt the progress of fermentation. This is effected by running the beer off from the gyle-tuns, into the barrels in the cellar, and this in the technical language of the brewer is called cleansing.

CLEANSING.

If the fermentation has been well conducted, and has continued healthy up to the moment of cleansing, the beer will have cleared itself from the greater portion of its yeast. Any yeast that may remain on the surface, should be skimmed off before the beer is conveyed into the casks; and still more care should be taken that the beer shall be suffered to run off so quietly from the gyle-tuns, as not to mix up the dregs that have by this time subsided to the bottom. This would be carrying matter into the casks that could have no other effect than endangering fresh fermentation, and moreover of spoiling the brilliancy and flavour of the beer. The casks in the cellar must be repeatedly filled up, so as to enable the beer to throw off any remaining portion of

yeast that may be generated during the fermentation which will still continue in the cask; for this yeast falling back into the beer, might be the cause of after-fretting, and endangering the beer becoming hard.

This process is facilitated, by using a tube of tin, about three inches in diameter, which is tapered at the end, and fits neatly and tightly into the bung hole of the cask. The tube rises about four inches above the bung hole, and is kept full. On one side, a horizontal tube, (likewise of tin,) is fitted and soldered to it, which conveys the yeast over the side of the cask, whence it falls into a vessel placed to receive it. There is a horizontal cover over the upright part, by opening which, the extra beer can be added from time to time, so as to keep the tube and cask always completely full, and this effectually promotes the discharge of any remaining yeast.

As soon as all symptons of active fer-

mentation have subsided, the casks may be bunged down, leaving only the vent peg partially closed. Previously however to closing the bung, that portion of the hops, which in the section on boiling, I recommended to be reserved, should now be added proportionably to each cask. They will be found to contribute the delightful smell, and fine flavour of the hop, much more perfectly than those hops which have undergone a long boiling, and they will equally contribute to the preservation of the beer, and prevent any after-fretting that might arise.

When the fixed air ceases to generate, the vent peg may be driven firmly, and afterwards occasionally opened, for a few minutes, so as to allow any accumulation of it to escape. Too much of this gas, would prevent the spontaneous final cleansing of the beer, at the same time, that a moderate portion adds much to its briskness and flavour.

It is not every one that has the command of a good cellar for keeping beer. The temperature should be as uniform as possible, and somewhere between 50° and 60° of Fahrenheit, and never exceeding the latter limit, if it can be avoided.

I have now described all the processes essential for brewing good beer, and can honestly say, that by following the same rules, I have succeeded in producing a beer that has given universal satisfaction. I feel assured that any person, however little he may have known of the theory of brewing, will not fail (attending strictly to the instructions herein given,) to produce a sound wholesome and palatable beer, beyond his most sanguine expectations. I would further add, that although in these instructions I have confined myself to brewing from malt and hops alone, I have found very great advantage in adding to the worts a certain portion

of sugar. The public brewer is not allowed to make use of this material, but it is not prohibited in private brewing, and it gives both strength and flavour to the beer.

I generally add the sugar in the boiler, about twenty-minutes before the worts are ready to be run off into the coolers. By the use of sugar, I do not mean to supersede the necessity of malt, which is essential for giving the accustomed flavour; indeed I rarely use it in greater quantity, than in the proportion of about a pound to every bushel of malt, or in table beer of nearly 2 lbs. to every bushel of malt. But for giving extra strength, at but little comparative extra cost, it is a most useful ingredient.

Before taking leave, I would again advert to the absolute necessity, of the strictest attention to cleanliness in the brewhouse, and all the utensils used in the process. The casks are seldom sufficiently cleaned, or cleared from the

acid that attaches itself to the sides, and is deposited between the seams of the staves. There is no effectual way of cleaning the casks, without taking out the heads, and well scrubbing the sides with a stiff birch broom. The mode of taking out the heads and replacing them, is very easily learnt, by once seeing a cooper perform the operation. The only implements requisite, are a hammer, and a tool called by the coopers a side-driver, which is a piece of bent iron applied to the hoops, to receive the stroke of the hammer whilst loosening or tightening the hoops; they may be got at any ironmonger's at the expense of a few shillings.

For the purpose of trying gravities by the saccharometer, I have found the advantage of a tin cylindrical vessel, which may be called an assay jar, 10 inches high and 2 inches diameter, containing about an imperial pint, with a handle at the side, and the bottom pro-

jecting an inch all round for the purpose of making it stand firm. When this is filled with wort, it may be conveyed to any room away from the brewhouse, where there is perhaps more light, and the degrees upon the saccharometer are more easily seen.

By these means there is less risk of breaking the saccharometer, an accident that might easily happen if the observation were made in the brewhouse amidst the hurry of brewing; moreover when this vessel, charged with wort, is placed nearly up to its brim in a pail of cold water, the wort is soon cooled down to the temperature of 55°, which is the proper heat according to the construction of the saccharometer for ascertaining the gravities of worts. Fluids as they cool become heavier, and therefore, if the saccharometer is used in a wort that is hotter than 55°, an allowance must be made for the difference.

A scale for making this allowance is sold along with the saccharometer, but by cooling the liquid down to 55°, the instrument shews the gravity at once without further trouble.

I have said nothing about the fining of beer, because I have never found the necessity of using any; and fining by isinglass or any other artificial means, always produces flatness in the beer, and a tendency to become hard, unless it is drunk almost immediately. If the fermentation is carried to the proper length in the gyle-tun according to the rules laid down, and the dregs and yeast not mixed up with the beer after the fermentation is completed, the beer will be almost fine before it goes down into the cellar, and at all events will after a short repose there become perfectly transparent, which is the best guarantee for its becoming a sound keeping beer, without undergoing further change.

I subjoin an extract from my brew-

ing book, as a specimen of the mode in which the particulars of each brewing may be registered, in a tabular form, and which will serve also as a short practical manual for conducting the process of brewing, from the commencement to its completion.

No. 1.

3 *Sept.* 1834.

12 Bushels of Pale Malt.

12 Pounds of Kent Hops.

For 240 Gallons of Table Beer, or 4 Hhds. of 60 Gallons each.

Mash.	Liquor, Gallons.	Heat of Liquor.	Mashed minutes.	Stood minutes.	Wort, Gallons.	Gravity of Worts.	Boiled minutes.	Worts after boiling.	Gravity after boiling.	Produce per Quarter.
1	152	174°	30	120	80	24	80	250	17.1	79 lbs.
2	65	184°	20	90	65	18				
3	125	194°	20	98	125	7.5	120			
4	25	cold sparged.			25	5				
	367				295	14		250	17.1	79 lbs.

Average gravity of Worts before boiling :—

80 × 24 = 1920
65 × 18 = 1170
125 × 7.5= 937.5
25 × 5 = 125

295 gal.) 4152.5 (14 average gravity.

Produce per Quarter.

250 gallons, = 7 barrels nearly.
7 barrels, at a gravity of 17.1.

17.1
7

12 bushels, or 1.5 qrs.) 119.7 (79 lbs. per qr.

20 lbs. of Sugar were added towards the end of the boiling, which increased the average gravity to 20 lbs. per barrel nearly.

Pitched at 67°.

14 lbs. of yeast.

FERMENTATION.

Sept.	Heat.	Gravity.	Atmosphere.
3, at 10 P.M. . .	67°	20	44°
4, — 8 P.M. . .	71°	14.5	48°
5, — 8 P.M. . .	74°	9.5	47°
6, — 8 P.M. . .	72°	6	47°
7, — 4 A.M. . .	64°	4.7	41°

Cleansed at 4.7, having skimmed twice and added 2 lbs. of Flour and 8 oz. of Salt: produced 240 gallons of beer.

No. 2. — 20 Bushels of Pale Malt. — For 4 Hhds. of 60 Gallons each of Table Ale, or 240 Gallons.

23 *Oct.* 1834. — 20 Pounds of Kent Hops.

Mash.	Liquor, Gallons.	Heat of Liquor.	Mashed minutes.	Stood minutes.	Wort, Gallons.	Gravity of Worts.	Boiled minutes.	Worts after boiling.	Gravity after boiling.	Produce per Quarter.
1	190	174°	40	110	70	36	70			
2	65	184°	18	90	65	34				
3	108	194°	20	120	120	18	90	255	28	78 lb.
4	40	cold sparged.			40	14				
5	22	cold sparged.			22	6				
	425				317	24		255	28	78 lb.

Average gravity of Worts before boiling:—

70	×	36	= 2520
65	×	34	= 2210
120	×	18	= 2160
40	×	14	= 560
22	×	6	= 132
317		)	7582 (24 nearly average gr.

Produce per Quarter.

255 gallons, or 7 barrels, multiplied by 28 average gravity, gives 196.

20 bushels, or 2.5 qrs.) 196 (78 lbs. per qr.

20 lbs. of Sugar added at the end of the boiling, increased the average gravity to 31 lbs. nearly per barrel.

Pitched at 68°.
17 lbs. of yeast.

FERMENTATION.

	Heat.	Gravity.	Atmosphere.
Oct. 23, at 8 P.M. . .	68°	31	47°
24, — do. . .	73°	26	44°
25, — do. . .	74°	23	44°
26, — do. . .	71°	20.5	47°
27, — do. . .	68°	18.2	45°
28, — do. . .	63°	17	45°
30, — do. . .	58°	14.7	44°
1 Nov. do. . .	57°	13	48°
3 — 4 A.M. . .	54°	12.5	41°

Cleansed at 12.5 gravity.
Produce 244 gallons of Beer.
The Fermentation too slow.

Wm. Davy, Printer, Gilbert-street, Grosvenor-square.