THE

THEORY AND PRACTICE

OF

BREWING,

FROM

MALTED AND UNMALTED CORN,

AND FROM

POTATOS.

BY JOHN HAM.

ILLUSTRATED WITH PLATES.

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DIRECTIONS,

&c.

PRELIMINARY OBSERVATIONS.

THAT the different beverages which are the subject of public and domestic manufacture in this country may be greatly improved by the application of the discoveries which modern science has made, there cannot be a doubt; but the excise laws are perpetually interfering to check this progress; they tie up the hands of the manufacturer and paralyze his mind; it is in vain for him to strike out improvements in the

art he professes; he dares not practise them because they are not provided for by the existing laws, and even if he cannot discover that any of these laws oppose them, he fears to subject himself to the heavy fines and penalties to which, whether innocent or guilty, he may be exposed.

But as all manufacturers of fermentable liquors may still partially, and to a profit, avail themselves of the new views with which the Author hopes he has interspersed his present work, and as private families are wholly at liberty to adopt them without restraint, to these, and to the agriculturists, does he at present address himself, under the hope that the more enlightened time will arrive when freedom of trade will be granted to individuals as well as nations, and the public manufacturer be released from the narrow path to which he is now confined.

The present Work is not therefore to be considered as an additional Treatise to the many already extant on Brewing simply, or as giving directions for the process in the manner of a cookery-book, by a collection of *recipes* unaccompanied by the reasons of the operations; but it is principally intended to show many modes of economizing in, and of improving that art, and to point out the theory of it in general; in the course of which the Author hopes to give such hints on subjects connected with vinous liquors in general, as may lead others to apply the products of the vegetable kingdom to some new and useful purposes. He therefore ventures to say, that some part of the contents will be found interesting to all persons whomsoever—whether engaged in the cultivation of the soil or in working up its different products for the supply of the wants of life. The country gentleman and

farmer, as well as the resident of cities and towns, will, he trusts, have cause to acknowledge that he has collected information from it which he could not otherwise obtain at so small a cost.

GENERAL DESCRIPTION

OF THE

PROCESS OF BREWING.

This may be divided into four principal parts. 1. The Mashing; 2. Boiling; 3. Cooling; 4. Fermenting.

1.—*Mashing.*

The mash-tub is generally a round wooden vessel, furnished with a moveable or false bottom pierced with small holes, and fixed above the real bottom so as to leave the space of three quarters or an inch vacancy between each. The false bottom is generally in three, or more parts, according to the size of the mash-tub, for the conveniency of more readily taking out and cleaning it after every brewing, and its use is to cause the liquor to drain off from the malt in all

parts at once, and to prevent the cock or tap from choaking; this false bottom, when not of iron, is fastened to the real bottom by screws or wedges, to prevent its floating, and when the tub is thus prepared, a certain quantity of hot water at the proper temperature is put into it in the first place: (although the large public brewers reverse this plan by adding the malt first, and then causing the water to run underneath, or between the two bottoms, and thence to ascend through the holes in the false bottom, by which they are completely cleared from all obstructions; and as the malt floats on the top of the water it is the more easily mixed therewith.) Next, the ground malt is added, and gradually stirred about with a sort of oar until completely wetted, care being taken that all the clots or balls are broken in pieces, otherwise the malt within them would remain dry, and of course yield nothing to the water. This stirring process is called *the mashing*, and is in general continued no longer than sufficient to cause all the ground malt to be completely wetted, by the *least* quantity of water necessary for that purpose, so that *the mash* forms a thick mass; a little ground malt (reserved for

that purpose) is then strewed upon the surface of the mass, to confine the heat in some degree, and a cover is besides generally put over the mash-tub. The infusion is then allowed to rest for about three hours, reckoning from the commencement of the mashing. *The wort* (being the water now impregnated with the soluble part of the malt) is then allowed to drain slowly from the malt, through a cock or tap placed in the lowest part of the mash-tub, and generally underneath its real bottom, into a vessel or tub called the *underback*. When it is nearly drained off (or even whilst draining) hot water should be continually sprinkled over the surface of the malt in the mash-tub, until the wort at the cock begins to exhibit some perceptible degree of weakness, which it will not do until a great portion of the wort which the malt retains is driven downwards, and out of the cock, by the superincumbent water thrown over the surface, which takes the place of the wort that would otherwise be absorbed and retained by the malt like a sponge: in this operation, care should be taken to sprinkle equally the whole surface of the malt in the mash-tub, that the water may descend gra-

dually through the entire mass, and by this plan (not often practised by the larger public breweries) the whole of the extract from the malt is concentrated into a smaller bulk of wort than by repeated mashings, which are by no means required with good malt, as that will generally yield the whole of its most valuable matter to the first mash, and the art of the brewer is then to separate it from the malt with the least possible quantity of water; but as there is no certainty that the water, thus poured or sprinkled over the surface of the malt, will penetrate the whole of the interstices, so as to drive the wort before it throughout all parts of the mass, a second mashing is necessary, where large quantities of malt are used, as soon as the wort at the cock is apparently weakened, (and the mode of ascertaining this by instruments will hereafter be explained) principally for the purpose of lightening the malt, and opening those interstices which may have been closed by the weight of the water percolating through it. The wort drawn off from this second infusion makes, of course, a weaker liquor, and the malt will now be completely exhausted by a repetition of sprinkling over

the surface, until the wort from the cock underneath becomes little else than water. At the first mash, allowance must be made in the heat of the water for the cooling of the mixture, for the temperature of infusion must neither be too high nor too low, and the proper degree will be given in the particular directions which will follow. The quantity of wort drawn from the malt is regulated by the sort of ale or beer intended to be made; but for the stronger sorts of ale, care is taken that no part of the draining from the mash, inferior in strength to the first running, be mixed therewith; but by the method here recommended of sprinkling over the surface of the malt with water, a quantity of wort not very much exceeding the bulk of the water used for the first mash, and of an average strength, nearly equal to that of the first running, can be drawn off. The quantity of the second wort (where a second mash is employed) also varies according to the sort of beer intended to be made; but, as every advantage is obtained by the method here recommended of concentrating the extract of the malt into its least possible space, by the operations in the mash-tub alone, any part

of the wort, if not sufficiently weak, can be made so at all times by an addition of water, and thus better beer can be made than by repeated mashings, as will appear from the reasons to be given in the sequel. The malt, after being thus exhausted of its goodness, is called *grains*, consisting of the husks of the barley and a part of its gluten and vegetable principle, not soluble. These infusions of warm water with malt are named, as already expressed, " worts," being transparent brown colored liquors, with a rich fullness in the mouth, and a smell well known ; they contain, of course, a part of the solid portion of the malt in solution, but are much sweeter than that portion, as it exists in the grain, occasioned by the action of the hot water on it, which appears to have the quality of increasing the sweetness of malt, and also of all sorts of unmalted corn, when infused at a proper temperature, and of then rendering the extract soluble in cold water. To measure the quantum of this sweetness, or rather fermentable matter, an instrument called a " Saccharometer" is in general use among the public brewers, and ought to be so in private families: the use and construction

of it will be explained as we proceed. The saccharine matter may be reduced to a dry state by evaporation, and has been sold under the name of extract of malt, but it attracts moisture very greedily from the atmosphere; and if dissolved in a larger proportion, will commence fermentation of its own accord, and in warm weather will readily run into acidity. It differs from sugar in not being susceptible of crystallization, and by containing starch, mucilage, and a proportion of gluten, the starch however being considerably altered in its general qualities, and converted into the substance known by the name of starch sugar. The proportion of the starch sugar is generally most abundant in the first runnings from the malt, for when two or three subsequent mashings are employed, the water dissolves, with this saccharine matter, a portion of mucilage and gluten, which causes the wort therefrom to turn acid much quicker than the first wort. The mode of brewing here recommended will avoid this additional extraction, and consequent tendency to acidity in the future beer; and although the total extract from the malt is rather lessened thereby, little is left behind but what is

likely to injure the keeping quality of the beer and to render it thinner and harsher to to the taste; and if brewers were in general aware of this effect they would pause before they attempted to extract the *utmost possible quantity* of soluble matter from the malt. Still it is much to be regretted that the excise laws so interfere to fetter trade, for if brewers were permitted to use the first wort only for the manufacture of beer, and to employ the remaining part of the soluble matter from the malt, either for the purpose of making spirits or vinegar, an immediate improvement would generally take place in the quality of the beer throughout the whole country; a combination of these different trades, and that of the starch-maker, in one (or a free interchange of their surplus products) divested of all vexatious excise regulations, further than what may be necessary for the security of the revenue, would in many instances be greatly to the benefit of the nation.

2.—*Boiling.*

When strong ales and table-beer are to be made, the first wort, or draining from

the mash-tub, is conveyed to the boiler alone, and unmixed with any part of the subsequent mash or drainings, where it is boiled with the hops, generally for one hour, and as violently as possible so that it does not run over the boiler. This boiling evaporates merely the watery part of the wort, and increases its density, or specific gravity, (or in common language, its strength) very considerably; but that is not generally the principal object of it, except for very strong ales, as it is employed to extract the quality of the hop. During the ebullition a great number of white flakes separate from the wort, and float about in it (the separation being partly occasioned by the oleaginous or astringent principle of the hop) and these flakes are either deposited at the bottom of the coolers, or amongst the hops when the wort is separated therefrom by straining, which is generally done by running the whole contents of the boiler into a vessel perforated with small holes in its bottom, called the *hop-back*, and as the wort drains off from the hops it is conveyed into the *coolers*. These hops, when they have ceased to drain, are again put into the boiler with the whole of

the remaining wort which has now been drawn off from the mash-tub, and boiled with it for a space of time longer or shorter according to the sort of beer intended to be made, when it is ready to be strained again, and to undergo the cooling process. It must be observed, that the hops after they have apparently drained dry, still retain a considerable portion of the wort, which may be separated from them in the same manner as it is expelled from the malt—merely by sprinkling water over their surface, (which may now be employed cold:) the water drives the wort before it and takes its place amidst the interstices of the hops. The second boiling increases in specific gravity (or strength) not only in the same manner as the first, by the evaporation, but also by the quantity of the rich wort retained, and conveyed into it by the hops from the first boiling, as the sprinkling of the hops above-mentioned is never to be employed until the brewing is concluded. The wort should not remain long separated from the malt before it is put into the boiler, as the heat, at which it drains from the mash, is such as to promote acidity very fast; and this tendency is immediately

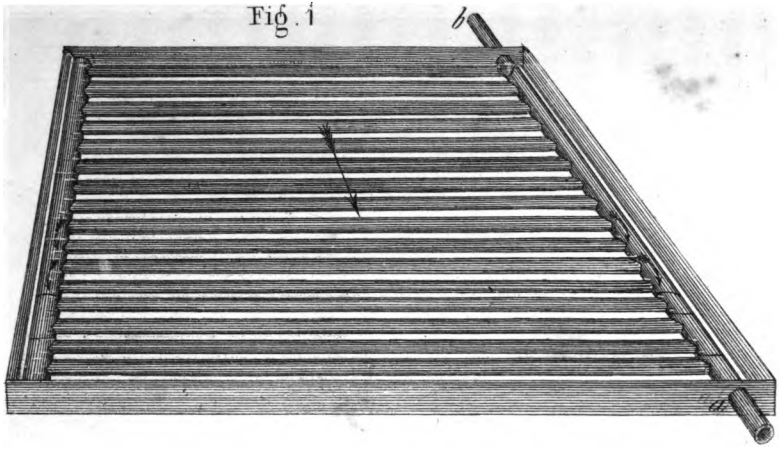
prevented by raising it to the boiling point, at which temperature all vegetable juices are safe from the acetous change. When therefore the wort has to remain for some time in the underback, a few of the hops intended to be boiled with it should be mixed with the wort.

3.—*Cooling*.

The wort after boiling, and while still hot, is conveyed into large shallow vessels called *coolers*, placed in some airy situation to promote refrigeration as quickly as possible. In these coolers the wort should be only two or three inches thick. A variety of inventions, to produce the effect rapidly, have been published, and some adopted. 1. Coils of pipe immersed in a current of water, into which the wort enters boiling hot, and comes out at the opposite end sufficiently cold. This mode cannot be adopted but where there is an abundant supply of cold water; to economize which, (2.) coils of double pipe have been employed, the *interior* one containing the stream of hot wort and the *exterior* the current of cold water, and both *running in*

opposite directions, by which simple arrangement, almost a complete exchange of temperature takes place in equal bulks, the wort assuming that of the water, and the latter taking away nearly the whôle of the original difference of heat in the wort, bulk for bulk. These plans are objectionable on account of the impossibility of cleaning the pipes properly, and therefore, (3.) the common cooler has, in some instances, fans placed over it, which promotes the process by the motion of the air on the surface of the wort. 4. Another plan has been adopted by placing at the bottom of the cooler a bed of pipes in the form of a gridiron, as *Fig.* 1. The cold water is admitted at *a* and traverses the pipes in the direction of the arrows until it escapes at *b*. Meantime the wort ripples over the pipes in the direction of the large arrow, in a thin stream, and meets with a succession of pipes each colder than the preceding, until it reaches that into which the cold water is first admitted, and by running slowly over it is at last reduced nearly to the same temperature. The whole bed of pipes is made to lift perpendicularly, like the cover of a box, on union joints fixed to

Fig. 1



the transverse pipes *a b* within the cooler, thereby allowing every part of their surface, and that of the bottom of the cooler, to be perfectly cleaned. This ingenious contrivance, therefore, combines cleanliness and expedition with the same economy of water as is above stated. During the cooling process the wort still increases in specific gravity by evaporation, but the quantum of increase is in the inverse ratio of the rapidity of cooling; the diminution of quantity of the first wort, from the boiler to the cooler, is considerable, occasioned by the evaporation, the separation of the hops and of the wort which the hops retain, which is added to the second boiling, and contributes to increase the density of that, and also its bulk, at the expense of the first.

4.—*Fermenting*.

The wort from the cooler is, by the public brewers, let down into a deep round or square vessel, called *gyle-tun*, in which it is mixed with yeast or barm, for the purpose of promoting the fermentation. This yeast is formed and thrown off by beer

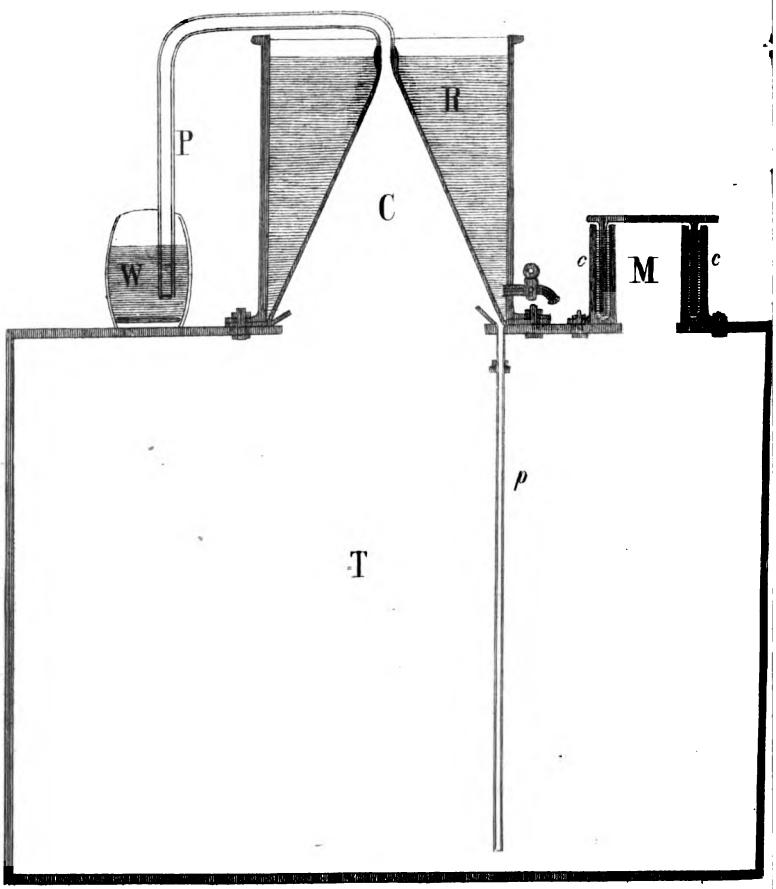
during its fermentation, which is an intestine motion (generally accompanied by increased temperature,) within the body of the fluid undergoing it, occasioned by the formation and tendency to escape of a gas, (the carbonic acid,) which is incessantly ascending towards the surface, and carrying with it a portion of the liquid, where it forms into bubbles; and if this liquid, like that of the juice of the apple or grape, be not sufficiently tenacious to retain the imprisoned gas, these bubbles immediately burst as they reach the surface, and thereby produce a constant hissing noise; but the fermentation of beer differs essentially from that of cider and wine, in the following respect:—wort, being a glutinous fluid, holds this gas so obstinately, that as every successive portion arrives at the surface, it forms, with the wort, tenacious bladders or bubbles, which are forced upwards by the constant accession of fresh supplies, until this frothy head becomes too heavy to support itself above a certain height, or rather the fluid part of the top of it has a constant tendency to drain off and descend; and the head, therefore, then breaks and falls in the same proportion as fresh sup-

plies arrive from underneath, which, for a considerable time, keeps it at the same height; but at last the intestine motion decreases, the temperature descends, the liquor has now become of less specific gravity, and acquired a vinous taste and spirituosity, which is solely produced by fermentation, as no spirit (alcohol) exists in any fluid that has not undergone this process. The beer is now drawn off from the gyle-tun into casks; this is called *cleansing:* in these casks the fermentation continues a few days, throwing off from the surface of the liquor a quantity of yeast, and permitting another portion to subside to the bottom, after which it becomes comparatively transparent, and is fit for use from the age of one month to twelve, or more, according to the taste of the consumers, or the custom of the place. As fermentation is a most delicate part of the art of brewing, and of preparing fermented liquors in general, we shall say more on the subject when we come to our particular directions for conducting the process, which, although apparently a spontaneous act of nature, still may be so regulated and controlled by art, as to produce

the effects desired. The quantity of carbonic acid gas thrown off by the fermenting process is so immense, that the malt alone, used in this country, produces sufficient in one year to fill a pipe four feet and half in diameter surrounding the whole globe of the earth; this, with the decomposition of vegetables, and all the other sources of its production, would contaminate the whole atmosphere, were there not means appointed by the Almighty Chemist to decompose it as fast as it is produced, among which the vegetable kingdom takes the most prominent part, as already explained, in the Treatises on Vegetable Chemistry; but the other modes employed by nature for its decomposition we are as yet unacquainted with.

This gas, being much heavier than atmospheric air, occupies the upper part, or apparently empty space, of the gyle-tun, in which neither flame nor life will exist for a moment. Candles are extinguished, and animals instantly killed, after being plunged therein; and it not only destroys life, but renders the heart and muscle of animals killed by it, insensible to the powerful action of the galvanic battery. This

Fig. 2



fermentation, (which is the only process in nature entitled to that term, notwithstanding chemists have added two others, having no phenomena in common with it,) is called the vinous, and can proceed without any contact whatever with the atmosphere, provided that means be taken to allow of the escape of the carbonic acid gas, which generally flows over and falls down the side of the gyle-tun, from its great specific gravity; this gas itself indeed forms a most complete cover to the liquid undergoing the process, and cuts off every communication between it and the atmospheric air. It has been supposed that the carbonic acid gas, in its escape, carries off with it much of the aroma and spirituosity of the liquor; and the following plan, (*Fig.* 2,) for preventing this supposed loss, has been the subject of a patent both in this country and France. *T* section of the fermenting tun, *C* a cone surrounded by cold water in the vessel *R*. This cone of course communicates with the fermenting tun, (which is made air tight,) and condenses whatever vapour may ascend into it, which again, in the liquid state, descends into the tun by the pipe *p*; *P* is a pipe terminating

about six inches below the surface of the water in *W*, intending to carry off the uncondensible carbonic acid gas, which is there supposed to deposit whatever condensible liquid it may still contain: *M* the man-hole rendered air-tight by the circular channel of water *c c*. We have certainly found that, in a very violent fermentation, and towards the latter part of the process, when a considerable quantity of alcohol was formed, the carbonic acid gas did absorb and bring over a fluid, which, on being condensed by causing the gas to pass through the worm of a small still, showed most decidedly the presence of a considerable quantity of alcohol, in a much greater proportion than that contained in the fermenting fluid, and of a very pure flavor; but no fermentation ought to be permitted to proceed with such rapidity, and if conducted properly, the loss of spirituous particles by means of the escape of the gas, is comparatively small; however, we are not prepared to say that the above or any similar apparatus is totally useless, as it is a matter of calculation whether the saving will be equivalent to the interest of the money expended in fitting it up; but there

is yet a more serious objection to its use in this country, especially amongst the distillers, who, if any, are the persons most likely to benefit by it. The fermentation of an extract from grain is so far different from that of the juices of fruits, as already mentioned, that it produces an intumescence and frothy head, in many instances exceeding the bulk of the liquid submitted to the process; this plan, requiring *air tight vessels*, and at the same time of a greater capacity than are generally in use, (for it will readily be understood that the head of froth must never be permitted to enter the cap or cone,) the alterations required would be great, for whenever it has at present a tendency to overflow the fermenting tun, a temporary receptacle is frequently made for it until it subsides. Now any pressure put on the gas, in its attempts to escape, as by the plan represented, would not only have a tendency to impede the fermenting process, but would also contribute to elevate the frothy head still higher, by preventing the bubbles from breaking and falling down towards the surface of the liquor so readily as at present. ' It is certainly very possible to avoid

this pressure, and to convey the whole of the carbonic acid gas, produced in a large distillery, through a worm pipe surrounded with cold water, and then employing this gas (after it has deposited as great a part of the liquid it held in solution as possible,) for impregnating soda water, and a variety of other liquors therewith, instead of using a much inferior gas (as far as aroma is concerned,) as at present, produced from carbonate of lime with sulphuric acid. A still more important use may however be made of it, by the property it possesses of preventing putrefaction. All animal substances immersed in an atmosphere of carbonic acid gas are secure from taint, in the hottest weather; if therefore it be received into reservoirs, or gas holders, similar to those employed for carburetted hydrogen, (and the absorbing powers of the water being limited, is therefore no objection,) a stock of fluid anti-septic is at once laid in, sufficient to preserve meat and fish sweet throughout the summer months: but here again obstacles are interposed by the excise laws which no *individual* would attempt removing.

Thermometer and Saccharometer.

Both these instruments are, or ought to be, used in brewing, as they form the brewer's rule and compass; the former is well known, and the latter is merely a hydrometer adjusted in its scale, so as to comprehend and indicate every possible variety of strength in malt liquors. The saccharometer in general use among brewers, merely denotes the difference of weight between a barrel of water (36 gallons old measure, or 36. 61 imperial gallons) and a barrel of wort; and it has been ignorantly presumed by some, that this indication expressed the real quantity of extractive matter contained therein, whereas nothing can be more erroneous, as the annexed table will show. As, however, *relative* specific gravity is all that is required to be known, the saccharometer thus constructed will just as correctly indicate the *proportionate strength* of worts, as if formed on any other scale, and its indications are readily made to express the

real quantity of solid fermentable matter in the wort, and also its specific gravity in the ordinary language, water being considered 1000, this is done in the table. Trials, with the solid extract of different kinds of malt and of corn, have been frequently made, to ascertain if the specific gravity is a true measure of its relative quantity, and the result has been, that the extract produced the same increase in the specific gravity of water when dissolved in it in the same proportion. The thermometer is a necessary appendage to the saccharometer, for as liquids vary in specific gravity according to temperature, and as the temperature of the wort, when the instrument is immersed in it, is not always the same, (and it would be very tedious to equalize it by heating or cooling the different parcels to the same degree) a table or scale accompanies the instrument, which corrects the indications by difference of temperature within a certain range. By means of the saccharometer, the quality of the malt made or supplied can be easily detected, when the brewings are conducted under similar circumstances.

TABLE I.—Equivalents.

Specific Gravity, Water being 1000.	Degrees per Common Saccharom.	Solid Extract in lbs. Avoir. per Impl. Gall.
1000	.0	.0
1	.4	.03
2	.7	.05
3	1.1	.08
4	1.5	.10
5	1.8	.13
6	2.2	.15
7	2.6	.18
8	2.9	.20
9	3.3	.23
1010	3.7	.26
11	4.0	.28
12	4.4	.31
13	4.8	.33
14	5.1	.36
15	5.5	.39
16	5.9	.41
17	6.2	.44
18	6.6	.46
19	7.0	.5
1020	7.3	.52
21	7.7	.54
22	8.0	.57
23	8.4	.59
24	8.8	.62
25	9.1	.64
26	9.5	.67
27	9.9	.7
28	10.2	.72
29	10.6	.75
1030	11.0	.77
31	11.4	.8
32	11.7	.83
33	12.1	.85
34	12.5	.88
35	12.8	.9
36	13.2	.93
37	13.6	.96
38	13.9	.98
39	14.3	1.0
1040	14.6	1.03
41	15.0	1.06
42	15.4	1.08
1043	15.7	1.11
44	16.1	1.14
45	16.5	1.16
46	16.8	1.19
47	17.2	1.21
48	17.6	1.24
49	18.0	1.27
1050	18.3	1.3
51	18.7	1.32
52	19.0	1.34
53	19.4	1.37
54	19.8	1.4
55	20.1	1.42
56	20.5	1.45
57	20.9	1.47
58	21.2	1.5
59	21.6	1.52
1060	22.0	1.55
61	22 3	1.58
62	22.7	1.6
63	23.0	1.63
64	23.4	1.66
65	23.8	1.68
66	24.1	1.7
67	24.5	1.73
68	24.9	1.76
69	25.3	1.78
1070	25.6	1.81
71	26.1	1.84
72	26.4	1.86
73	26.7	1.89
74	27.0	1.91
75	27.4	1.94
76	27.8	1.96
77	28.1	2.0
78	28.5	2.02
79	28.8	2.04
1080	29.2	2.06
85	31.0	2.19
90	33.0	2.32
95	34.8	2.45
1100	36.6	2.6

TABLE II.—Temperature.

Specific Gravity.	60°	62°	64°	66°	68°	70°	72°	74°	76°	78°	80°	Degrees of Thermometer.
1050	.0	.2	.4	.7	.9	1 .2	1 .4	1 .7	1 .9	2 .2	2 .5	
1060	.0	.2	.4	.7	.9	1 .2	1 .4	1 .7	2 .0	2 .3	2 .6	
1070	.0	.2	.5	.7	1 .0	1 .2	1 .5	1 .8	2 .1	2 .4	2 .7	
1080	.0	.2	.5	.7	1 .0	1 .3	1 .6	1 .9	2 .2	2 .5	2 .8	

Specific Gravity.	82°	84°	86°	88°	90°	92°	94°	96°	98°	100°	Degrees of Thermometer.
1050	2 .8	3 .1	3 .4	3 .8	4 .1	4 .5	4 .8	5 .2	5 .5	5 .9	
1060	2 .9	3 .2	3 .6	3 .9	4 .2	4 .6	4 .9	5 .3	5 .7	6 .1	
1070	3 .0	3 .3	3 .7	4 .0	4 .4	4 .7	5 .1	5 .5	5 .9	6 .3	
1080	3 .1	3 .4	3 .8	4 .1	4 .5	4 .9	5 .2	5 .6	6 .0	6 .4	

Note.—The two last figures only, of the four in the Specific Gravity column, are generally used by manufacturers.

Table I. almost explains itself. Thus, a specific gravity of 1019, (or 19 as it is expressed in common language) is equal to 7 pounds, or degrees, by the common saccharometer in use in breweries, and contains (5-10) half-a-pound of solid extract in an imperial gallon.

Table II. is the correction for temperature. As all worts are supposed to be at 60° of heat when the specific gravity is ascertained, what will be the specific gravity of a wort at 60°, which shows at 90°, a specific gravity of 50?

Against 1050 in Table 2, and underneath 90, is 4 1

The specific gravity at 60° 54 1

ON THE

MATERIALS FOR BREWING.

As we are desirous to go forward regularly with this subject, and to take it step by step, it will naturally commence with the different qualites of

Water.

We feel a diffidence in being obliged, in some degree, to dissent from received opinions on the qualities of this menstruum, when applied to brewing. There are two methods of producing the higher qualities of beer—the slow and the expeditious—the former in country situations principally, and the latter in the larger breweries of cities and towns, where the adoption of the plan of producing early ripeness, by hastening the fermentation, is become common, to the impoverishment of the

national beverage; and the distinguishing marks of the superiority of the British brewery to all others, are now nearly lost. We would therefore wish, if possible, to see it brought back in some measure to its original excellence, not by increasing the quantum of materials used, but by making the most of them, in conducting the fermentation much slower than it is at present the custom to do. For this purpose, we most decidedly prefer hard spring water, and particularly that from wells dug in a chalk soil, where it can be obtained, for reasons which will be given under the head 'Fermentation.' For, although before the introduction of the thermometer in brewing, the heats of the mashes were so injudiciously applied, that it was found soft water produced the greatest extract from the malt, yet from our present knowledge of the effects resulting from the variation of the heats, we can now oblige the hardest water to make an extract from the malt in equal quantity (if necessary) to that produced by rain or snow water, possessing besides the valuable property of checking the fermentative process. To those, therefore, who still

wish to hasten that process, so as to anticipate age to the impoverishment of the liquor, we would by no means recommend the use of hard water; for if the fermentation is to be conducted with expedition, hard water will be found inimical to its progress: but in all other cases, where a fulness on the palate is sought to be preserved after keeping the beer a considerable length of time, we invariably approve of the hardest and most transparent water that can be procured.

Malt.

Malting is a process so hedged up, and confined by law into a particular path, that it may be safely said the maltster has no field left for the exercise of his skill, and therefore the act of parliament regulating the manufacturer may be referred to as almost the only guide: but it may be as well to say something on the theory of the process. During the vegetation of seeds, whilst the future stem is advancing through the body of the grain, the substance thereof, by some hidden process in nature, becomes saccharine, and more soluble;

intended doubtless for the nourishment of the infant plant before it reaches the surface of the ground, which nourishment is afterwards supplied by the soil and atmosphere. Malting, therefore, is nothing but a forced vegetation, and the excellence of its management depends on advancing the vegetation to the point at which the saccharine matter becomes most abundant, and there stopping it. This point is generally considered to be attained when the acrospire, or future stem, has reached nearly to one end of the grain, whilst the roots form a short bushy knot at the other. If the acrospire (Plumula) has not reached this point, the grain is not supposed to be perfectly malted; and if it proceeds farther, and projects beyond the end, the saccharine principle is absorbed by it, and diminished very rapidly. This incipient vegetation is produced, first, by putting the corn into a cistern, and covering it with water, where it remains for a period fixed by law: the water is then drained off, and the wet corn (having imbibed a quantity of water, on the average amounting to 47 per cent. that is, every 100 pounds of barley will weigh 147 pounds wet,) is then

thrown out of the cistern on the floor, and formed into a rectangular heap, about 16 or 18 inches deep, and called the couch, where it remains for some hours, until a little heat is perceptible in the heap, when it is gradually spread thinner over the floor, and frequently turned, to prevent the vegetation proceeding with too great rapidity. If this turning on the floor be neglected, the roots run out to a great length, impoverishing the malt, but unfortunately, with ignorant people, increasing the maltster's profit, inasmuch as they tend to add to the measure of the malt by preventing the corns from touching each other in the bushel, when the roots are not well rubbed off by proper screening. Weight therefore becomes the only criterion, *with well-made malt*, to ascertain that a proper quantity is delivered, and nothing less than from 38 to 40 pounds ought to be considered equivalent to the imperial bushel, which will generally be of that weight when the malt is properly cleaned from its roots. When the vegetation has reached the proper period to be arrested in its progress, as explained above, the corn is then thrown on a kiln to be dried,

which is generally done by coke or coal that produces no smoke; and here the colour required is given to it—some beer requiring it very pale, and porter, on the contrary, quite brown

Some barleys will not continue their vegetation properly, throughout the whole process, without an additional wetting, which the law positively forbids until a period when it is almost useless, and therefore bad malts are frequently the consequence. Another cause of inferiority arises from malting barley grown on dissimilar soils, when it is impossible to keep the vegetative principle in simultaneous movement; and the consequence is, that a part of the corn is fully malted, when the remainder may be only partially so. A good maltster is, therefore, particular in not mixing together dissimilar samples of barley; and for this reason *ship* barley never makes good malt, being of course a mixture of a variety of sorts.

Barley by being converted into malt, generally increases two or three per cent. in bulk, (when not well screened) and loses at an average about one-fifth of its weight, or twenty per cent. Part of this loss of

weight may however be ascribed to the kiln drying, and consists of water which the barley would have lost had it been exposed to the same temperature.

A very simple method will in general ascertain the quality of malt sufficiently correct. Put a small quantity into a tumbler glass containing pump water, and the number of corns which *immediately* (after a slight stirring) fall to the bottom, will show the proportionate inferiority of the sample: if they should all float, the malt must be excellent; but if even a few sink, the sample should not be regarded as of bad quality, especially if they stand on one end at the bottom of the glass. This test however will not apply to the *blown* porter malts.

The wort drawn from the palest malt, it is well known, is more ready to ferment than that from the browner sorts; and malt may become what brewers term "foxed," either by careless stowing away in a damp situation, or by the dishonesty of the maltster in wetting it whilst throwing off from the kiln, in order to increase its measure, and make it appear plump and full: the smell, however, will soon

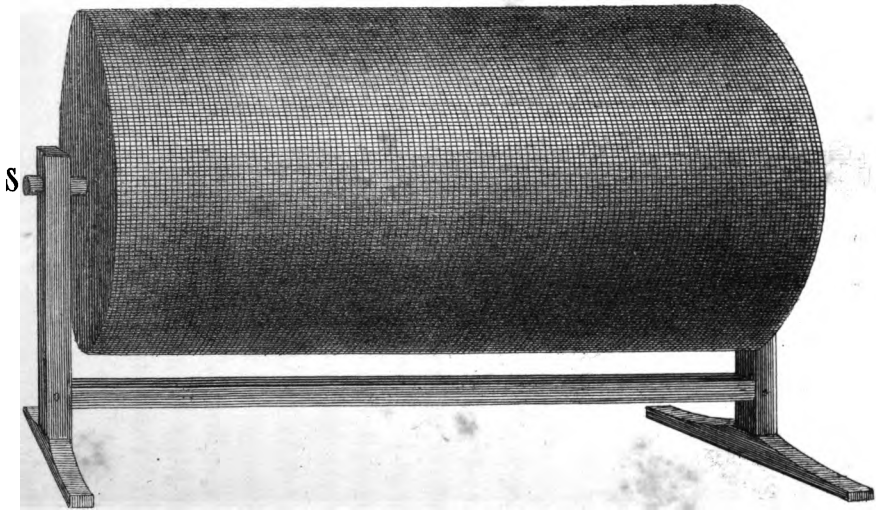
detect this injury. Wheat and rye make very superior malt, but few persons have ever given it a trial: those who once do it will always continue it in a proportion corresponding to its relative value to barley. Oats is too inferior a seed to bear a duty of two shillings and sixpence per bushel; and as every sort of corn, when malted, will pay the same amount of duty by measure, the following is the relative quantity of extract afforded by the four species named; viz.

Wheat, 36
Rye, 32
Barley, 25
Oats, 17

Thus it will be seen that nine bushels of wheat, ten of rye, and nineteen of oats, are respectively equal to thirteen of barley, and will produce equal quantities of beer of the same strength: the calculation, therefore, of the advantage or disadvantage of malting either of these species of corn, can at any time be ascertained from the market price.

From this description of the malting process, it may be seen, that it is in the power of any servant to make malt as

Fig. 3.



unproductive as he pleases, by wilful neglect or carelessness: it therefore appears rather surprising, that the inventive powers of the present age have not been applied to the improvement of this process, by the substitution of machinery, which is at all times free from obstinacy, idleness, or drunkenness; unless, indeed, the excise regulations have rendered it forbidden ground for the application of science. But it cannot be doubted that permission may be obtained to try any new plans (however much the necessity of *asking such permission* is to be deplored); and therefore, as it has been already stated, that malting is nothing but an artificial vegetation, which requires *motion* to regulate its course, there is every probability of the following plan succeeding. Let *Fig.* 3. be a cylinder in a horizontal position, with ends of wood, and side or circumference of wove wire, with the meshes not finer than necessary to prevent the smallest barley corn from falling through. The shaft *S* must be attached to some water or other power capable of keeping it in a continued, but very slow motion; the cylinder must now be filled about three quarters full of barley, either through

a door in one of the ends, or by a wire aperture opening in some part of the circumference; water must now be sprinkled over the cylinder until all the corn therein be equably wetted, which the revolving motion will soon accomplish, and the sprinkling, or wetting, continued at intervals, whenever the vegetating process may require it. This slow motion will be constantly exposing fresh surfaces of the corn to the atmosphere, and the vegetation checked or expedited according to the rate at which the cylinder revolves, which rate may be made capable of any adjustment; so that when once the proper degree is found, very little attention to it may afterwards be required, except in as far as the heat of the atmosphere undergoes sudden variations. The number of the cylinders employed must of course depend on the extent of the trade; and it is very possible to conduct the whole process in them, even to the drying of the malt when finished. A variety of other plans for accomplishing the same purpose may be proposed, and the present is only suggested for the purpose of directing the attention of maltsters and others to the subject.

Unmalted Corn.

Good beer, of an equal quality to that brewed from malt alone, has been frequently produced from a mixture of malted and unmalted corn; but that a portion of malt must be used is unavoidable, and *this* portion should be of the best sort; which, mixed with the proportions of unmalted corn indicated hereafter, and brewed as directed, will yield in many instances a larger quantity of wort, of equal strength, than can be drawn from a like number of bushels of malt.

Barley that has been malted seems to possess the power of *malting* a further quantity in the mash-tub; that is, a certain portion of it appears to act as a malt-ferment on raw grain, turning the whole sweet. This plan is applicable to any sort of corn, and even to wheat bran. From whatever sort is used, the beer appears not to be dissimilar in quality or taste. It is all equally pleasant and wholesome, and when brought to similar strengths, no one can discover, on its attaining a proper age, that it was not made from malt alone, when

judiciously managed. The grains too will be found to possess a greater degree of nutriment for pigs, &c. than those from malt, for this plain reason—a bushel of barley, when dried to the same degree as the malt which is generally sold, will be found to weigh ten pounds heavier. This extra weight must of course be left in the grains, after the usual quantity and strength of wort is drawn, as from malt alone; and if they are pressed closely into a tub or cask, they will keep good any reasonable length of time. When such a difference of price exists as three to four shillings per bushel, between the malt and the barley from which it is made, the possible saving by this mode of brewing is at once obvious and immediately realized.

Good malt thus employed, mixed with unmalted corn, and ground as will be directed, appears to have a peculiar action on the latter in the mash-tun, by breaking down the viscidity, or glutinous quality of it, (which at first seems to set the whole mass together like hasty pudding) so as to allow the wort at the proper time for draining, to run off freely, which at first is held so fast imprisoned as if the hot

water were mixed with starch: indeed, it is this latter principle, contained in all sorts of corn, which is rendered sweet and fluid by being mixed or in contact with a small proportion of malt. The flour of barley is certainly of more difficult solution than that of malt, and requires the constant guide of the thermometer, and more mechanical agitation in the mash tub, and the variation of a few degrees of heat is not so unimportant, as if all malt were used; still the proper mode of management is easily acquired, with the assistance of the thermometer, for without this instrument the process of brewing in no case can be conducted correctly, and we therefore mean to speak its definitive language in all our subsequent instructions.

Potatos.

On so novel a subject as the introduction of potatos in brewing, it will be necessary for us to preface it with some observations on the utility of this root, which in an agricultural, a manufacturing, and even in a national point of view, is not by any means duly appreciated.

In saying this, we know that we shall be opposed to the opinions of one class of persons; viz. the owners of land, who in general are disposed to discourage the extended cultivation of the potato, under the impression that it would proportionally impoverish the soil.

That, on a partial view of the question, this may occasionally be the case, is probable; but, take it more comprehensively, and the following reasons will serve to show that all the different species of corn impoverish the soil much more than the potato, *in proportion to the quantity of food produced.*

As our explanation of these reasons may be considered by many as too abstrusely philosophical, we address ourselves only to those, in this particular case, who will take the trouble of expanding their minds so as to embrace the question generally. Observation enables us to pronounce decidedly, that an acre or any other measure of potatos will sustain animal life longer than the same surface of any other known vegetable cultivated. It further teaches us that the whole of this extra nourishment cannot be drawn from the soil, as its fer-

tility is by no means lessened in the same proportion. The proof of these two propositions it is certainly difficult to bring to mathematical demonstration; but in all such complicated cases as this, we have one equally to be relied on; viz. universal experience.

Let the question be put in another shape. We will suppose a certain quantity of land, of precisely equal fertility throughout every part of it, to be divided into equal portions; one of these portions shall be cultivated with potatos for seven successive years, and the other with the various succession of crops at present in use. Let as many animals, as nearly as possible of the same kind, be fed by the produce of these two portions, as they will conveniently sustain; and let care be taken that the whole of the manure produced by each set of animals be returned over each portion of the land which is feeding them, we will then venture to say that the number of animals, at the end of the seven years, which have been fed from the potato ground, (at all times taking *condition* into consideration) will so greatly exceed that from the other portion, as amply to repay,

and with a large surplus of value, the expenses of manure in bringing the potato ground again to the same state of fertility as the other part, (provided that it has been impoverished) or, which amounts to the same thing, the potato ground, in five years, will have produced much more food than the other in seven.

After all, we may be told, "This is mere assertion and you give no proof." If there were not thousands of difficulties of giving other proofs, in such cases, but those of general experience, these questions would long since have been decided; but although an appeal to Ireland may be satisfactorily made in favor of our assertion, we do not stand in need of its assistance, but we will proceed to take another view of the same subject.

Referring to our statement, which will follow, of the comparative produce of land in potatos and grain, we only now ask for an admission that an acre of potatos will produce more food or nutriment (that is, that it will sustain in the same *condition*, a greater number of human beings, or animals of the brute creation) than an acre of any known vegetable production, whether

of corn, roots, or plants, or any mixture of the same, *without impoverishing the soil in proportion to the excess of such food*—if this be granted, the potato has drawn nutriment from some source independent of the soil—the conclusion is inevitable. Here is an extra quantity of food produced, and that extra quantity does not come totally from the soil, as from the supposition it is not impoverished in the same degree: from whence then does it come? The reply is ready—*from the air of the atmosphere.* Here then is a source of manure, or "maintenance" very little thought of, and frequently disregarded altogether: but we are told the atmosphere is surrounding every possible variety of crop, and why does it not afford the same support to all? We reply, that nature's laboratory, which is incessantly at work in decomposing the air that flows over our fields, and assimilating its various principles for the support of animals—which attracts therefrom those portions that are fitted for the supply of the farinaceous and saccharine parts of plants, together with the moisture which the air contains—we say that nature's laboratory, for all these purposes, is to be found in the

multitude and the extended surface of the *leaves* these plants throw out. These leaves are incessantly occupied in snatching from the air which glides over them all those portions from which food is formed: and why should this be thought surprising, when all nature is moving in a circle?—when the principles of animals and vegetables are decomposing and recombining, to form the like again, in constant succession and eternal rotation? Is there not a tendency in all bodies on the surface of the globe, to return to their original elements—air, water, and earth? (We speak in popular language, and purposely avoid subdividing them further into oxygen, hydrogen, nitrogen, and carbon.) It is obvious to common undertandings, that the two latter are again destined to form afresh other bodies, but the first principle, air, is disregarded, because invisible: it nevertheless performs as important a part in renewing the animal and vegetable kingdoms as the other two. We would also ask what becomes of the apparently solid substance of a large body of manure, when sufficiently decomposed for use? All that it has lost in weight cannot be water: then

the steam which flies from it into the atmosphere is not simply water in a state of vapour? No, it contains another and most important principle, already mentioned under the head 'Fermentation,' formerly called 'fixed air,' (carbonic acid gas,) which is received into the atmosphere to be conveyed by the winds to the leaves of plants, and by them to be again converted into their solid and liquid substances; and in this manner the farmer loses a great part of his manure, because 'it takes to itself wings, to fly away' to strange lands. Thus it appears that the quantity of nutriment plants draw from the soil is small in proportion to that which they apply for to a messenger that would pass over them without benefit, and convey its riches to their neighbours, were it not for the mouths with which they are furnished in the shape of leaves; and of course, the more these mouths are multiplied, the greater the consumption of the food conveyed by the air, which in their absence passes on its journey to fertilize those portions of the earth where these plants are more numerous. The different species of corn not being furnished with them in such

abundance as roots, of course depend more on the soil for support, and therefore exhaust it more in proportion to the food they yield. Amongst all the varieties of vegetables which abound with these *air traps*, the potato is by far the most useful and valuable, as applicable for the benefit of man; and whatever obstructions may be placed in the way of its extended cultivation, there is yet a sufficient quantity of land in the British isles out of the control of its enemies, even if the present restrictive system among landowners should continue. We have thought it proper to say thus much on the *cultivation* of the potato, trusting that the landowners of Great Britain will see that it is futile to make these objections, and their interest to abandon them.

This root contains, intermixed with its fibrous part, a juice which is not pleasant to the taste, (although a great detergent, or substitute for soap) and also a large quantity of fecula, or starchy matter, a great part of it in no degree inferior to the finest arrow-root. It is this fecula alone which constitutes the value of the potato in brewing; and the method of extracting and using it

for this purpose will be explained in due course. The quantity of fecula contained in different varieties of the potato varies greatly. We have now before us a statement of the comparative produce of no less than forty-seven different sorts, but in consequence of the want of a nomenclature of the potato tribe, it will be impossible for us to affix names to each sort, which can be recognized, or understood generally. The following are a few of the known sorts, with their respective produce in fecula, but this quantity will of course vary in different seasons, although the relative proportion may still be correct.

The Champion yields	18lbs.	of dry fecula	per 112lbs.
The Oxnoble yields	25lbs.	ditto	ditto.
The Kidney yields	18½lbs.	ditto	ditto.

The average produce, of the forty-seven sorts, is however 20½ pounds of fecula per cwt. and this quantity may always be expected by a proper selection of the sample, or of the seed from whence it is grown.

We can now ascertain the astonishing difference in the produce of an acre of land when planted with potatos or with corn, and we will include this calculation in the

following table, supposing the land to be of medium quality.

Produce per Acre.		1.	2.	3.	4.	5.
Sorts.	Lbs. Avoirdupois.	Whole Produce in dry Food, including Husks.	Whole Produce in Starch, Gluten, & Sugar.	Difference in Columns 1 & 2.	Extractive Matter for Brewing.	Solid Matter left after Brewing.
Potatos	17920	4180	4031	149	2200	1980
Wheat	1500	1350	1289	61	900	450
Barley	1500	1350	1242	108	750	600
Oats	1480	1332	990	342	629	703

The foregoing Table first expresses the gross weight of the average produce which in Column 1. is reduced to a perfectly dry state, as even corn, when fit for grinding, contains moisture. Column 2. is the total quantity of nutriment afforded by each sort, supposing that to reside exclusively in the three principles, starch, gluten, and sugar, according to the analysis of Sir H. Davy and other chemists. Column 3. the quantity of matter presumed to contain no nutriment. Column 4. the solid fermentable matter capable of being drawn from each sort by the brewing process. Column 5. the quantity left in the shape of grains, &c. as food for cattle.

N. B. In this statement the native juice of the potato is totally omitted, (being washed away in the preparation of the fecula) although it contains in solution 80 pounds of solid matter in every ton of potatos, and no doubt forms part of their nutriment when eaten in the ordinary way.

Thus it will be seen that, if an acre of barley will produce 750 measures of any sort of beer or fermented liquor, the same quantity of land with wheat will yield 900

of the same measures, and with potatos no less than 2200, or three times the produce from the barley.

Although we have no intention of recommending the use of the potato fecula *alone* for the purpose of brewing, still, whatever may be the proportion of its mixture with grain, the statement herein given, of its relative value, will not in the least be affected thereby.

That the potato has not been cultivated even more extensively than is at present the case, is in consequence of the ignorance of a method of preserving it, and of the new uses to which it may be applied, one of which it is my present object to point out. In France the whole nation is alive to it, and many extensive distilleries, and some breweries, are already established, to work from potatos alone; but, in this case, the potato flour is sweetened by a chemical process, which it would be foreign to our present purpose to describe.

It is singular that the flour which may be extracted from an acre of potatos, is double in weight to the whole quantity of wheat which can be grown on the same land, including its fine flour, coarse flour,

and bran; and this potato flour is far superior to the best wheaten, for every culinary or other purpose except that of making bread, in which the principle called *gluten* so abundantly exists, and to which, from its tenacity, bread owes its lightness; still, a proportion of the potato flour, or fecula, may with advantage be introduced therein, without injury to this quality.

It is to this fecula that the cereals, potatos, and all vegetables owe the principal part of their nourishment, (whether in this shape or in that of sugar, as these two principles scarcely differ by chemical analysis) and those that contain the greatest quantity, are most sought after for the use of man.

As the fecula can be readily converted into sugar, and as sugar is the only basis of the vinous fermentation, it is not at all necessary to make use, for this purpose, of those vegetables or roots whose immediate principles consist of sugar, or in which that substance is ready formed in the native juice, such as that of carrots, parsnips, beet root, &c. &c. Indeed the saccharine juice of these roots is always mixed so

much with other principles, which add a variety of nauseous tastes to it, and thereby injure its quality, that a pure sweet is much more easily obtainable from the fecula in question, than from almost any substance in nature; for, as it is insoluble in cold water, every foreign substance can be readily washed away, before it is submitted to the sweetening process.

The potato in its entire state is a perishable root, and no method has hitherto been discovered for preserving it, even for a single year; but, let the vegetable principle be once destroyed by the process I am about to point out, and the fecula, which would have thereby disappeared to form the nutriment of the future infant plant, is now secured for any purpose—the potato is thus as it were rendered indestructible. Unfortunately, on account of the excise laws of this country, the purposes to which it is capable of being applied are in a great degree prohibited, as neither the public breweries nor the distilleries can use it—the latter certainly are allowed so to do under particular circumstances, such as renders the boon of no use to them. In progress of

time it is to be hoped, that the government of this country will see and remedy the national loss that is sustained by these laws interfering, to fetter and stifle almost every new use to which the vegetable kingdom may be applied in the manufacture of fermented liquors; when that time arrives the agriculturist may reckon on great encouragement in the extended cultivation of this root, even in the interior parts of the country, for whilst its most valuable part can be so concentrated in the manner to be described, not only may the potato be said to be rendered capable of being transmitted to the most distant parts, at a comparatively small rate for carriage, but the quantity of manure left behind, in the shape of its fibrous part, which is separated in this mode of manufacture, and which may be either employed directly on the land, or after it has passed through the body of any sort of stock, will be an ample substitute for that quantity which is supposed to be contained in the straw of the corn crops, and the want of which in the potato crop has been a handle for many objectors to its extended cultivation.

Hops.

Before we proceed in the instructions for the management of the different materials we have enumerated, as applicable to brewing, we must say a few words on this essential article.

A great variety in the sorts of hops is grown in England, and each of them produces a different flavor in the beer, which can however be more easily distinguished when new, than after it has acquired some age. The sorts which bear the highest price in one part of the kingdom are rejected in another, and it would appear that, in the greater number of cases, an imaginary value is stamped on them, according to the prejudice which reigns in particular places, and although the different growths, under skilful hands, have each its specific quality, and may be applied to uses where another kind may be improper, yet with ignorant operators, advantage cannot be taken thereof.

In the western part of England, the *Farnham,* and what are called *country hops,*

(growing in the same neighbourhood,) are preferred by those who brew their own beer; in the eastern parts the Kent and Sussex; and these latter, mixed with the Worcester, are used by the inhabitants of the north western parts of England, for keeping beers and ales; but for those intended for present drinking, the Worcester alone is used in these parts, as the mildness of their flavor particularly suits them for it.

Lately, hops of an excellent quality, and fit for any purpose to which they may be applied, have been grown near Taunton; they are cultivated after the Farnham method, and partake of their fine quality, with a greater degree of *strength*. They are successfully cultivated also at Milborne, St. Andrew, in Dorsetshire, and at Whimple, in Devonshire; in each of which places the quality appears only to vary in proportion to the skill with which they are managed, and they bid fair to root out a prejudice which has for so many years given the preference to a district possessing no local peculiarities or extraneous advantages.

PRACTICAL

DIRECTIONS FOR BREWING.

BEFORE we proceed, we must define properly the object we have in view. Let it then be considered that *strength* in beer, or the increase of its quantity of alcohol, is a very remote consideration, and that its excellence ought to, and does, depend on its nutritive qualities, above those of every other common beverage. To secure these it is absolutely necessary that the fermentation be checked at the earliest period at which it becomes sufficiently palatable for drinking; for the extract of malt or corn, which enters into the composition of beer, is, as it were, the very essence of nutriment, and consists of a certain quantity of saccharine matter, united to a large portion of a fine mucilage and fecula, and it is this which is so essential to the production of a good malt liquor.

During the course of the fermentation, the wort, as already stated, is constantly undergoing a reduction in weight, so that when arrived at its extreme length, (as in the distillery) the same wort, which was at first considerably heavier than water, will, at the conclusion of the process, be about the same weight, or very little more; the consequence is, that the sugar being first attacked, all the nutritious part of the wort, is at length decomposed, and in its place remains little else than ardent spirit—thus, in proportion as we approach the extreme of fermentation, is malt liquor deteriorated, and the operation cannot in our climate be conducted too slowly. When therefore palatable beer can be produced, containing a small quantity of alcohol, united to a large portion of the fecula or mucilage, we are then conveying food under the shape of a beverage, and it may not unaptly be compared to mixing *raw spirit* with a quantity of *soup* before we permit it to be drank.

Let it then be kept in mind that every particle of *spirit* formed in beer by the fermenting process, beyond the quantity really necessary, as now explained, is at the

expense of the real nutritive or valuable substance.

A mixture of malted and unmalted corn and fecula, when judiciously managed, and the wort drawn under the directions to be found in the subsequent part of the work, produces a liquid containing an abundant sweetness for every purpose to which it may be applied.

A very general prejudice seems to exist against the public brewers, under the idea that they add a variety of drugs to their beer, as it has commonly a very different taste to the home brewed sorts. Now, without insisting much on the impossibility of their adding any other ingredient than malt and hops, whilst watched so strictly by the excise, and on the absurdity of the attempt when exposed to such heavy penalties, the case may be explained without resorting to imaginary substitutes for these articles, (drugs which can never be used with any profit even if permitted) by explaining in what manner the process followed by the public brewers differs from that of private ones. The former having large mash-tubs, which so effectually preserve the heat as to allow little to escape,

in proportion to the mass, are enabled to mash at a much lower degree than when the tub is very small—this alone gives a different flavor to the wort. Secondly, the fermentation is conducted in the public breweries in such manner as will produce speedy ripeness, in order to obtain quick returns; it therefore proceeds to a greater extent, and in much less time, than it can possibly do in small masses; and as the flavor of the hop is only partially incorporated, the beer scarcely ever keeps so well as that brewed by private families.

As we mean to proceed in describing the process of domestic brewing, on a small scale, from the different materials already specified, until we have brought all the worts into the coolers, ready for the fermentation, we shall begin with

1.—*Mashing with Malt, for Beer.*

Malt, 4 bushels,
Hops, 3 pounds,
Quantity of water required for the first mash 40 imperial gallons.

After the mash-tub is prepared with its

false bottom, as described in the General Observations, let the above quantity of water be put into it at the boiling heat, and agitated with the mashing oar until the heat descends to 190° by the thermometer; (Fahrenheits) then add the malt, stirring it well until every part of it be free from clots, and completely wetted, which may be accomplished in ten minutes; when finished cover the mash-tub with sacks, or any thing conveniently at hand, and let it stand two hours and a half in that state; meantime, fill the boiler to about three quarters full with water, and make it boil by the expiration of this period, when the cock underneath the mash-tub must be turned in such manner that the wort may run off from the malt slowly, and in a small stream; at the same time commence sprinkling *boiling water* over the surface of the malt in the mash-tub, as fast as the wort runs off below, so as to keep the malt fully immersed in the water, but still not more than just sufficient to do it. Continue this sprinkling (as gently and softly as possible on the surface) until the wort below has amounted to 30 gallons, when the cock must be stopped; and, in domes-

tic brewings, no further mashing will be necessary, from the small quantity of malt used, which will not be so closely pressed together as to prevent the water from having access to every part, differently to the case in the larger masses of the public breweries. The mash-tub must now be covered as before, and the boiler is supposed empty, or must be made so, to give room for the wort, which is waiting to be boiled with the hops. The boiler is presumed to be of a capacity sufficient to do it without the risk of running over during the ebullition—that is, it must contain at least 45 gallons. Now get the wort into it, and add the hops thereto, making it boil with as much expedition as possible, and keeping it boiling as rapidly as it can be done with safety, for the space of one hour; at the expiration of this time set the cock of the mash-tub again running slowly as before, and then remove the wort from the boiler, passing it through a hair sieve into any shallow tubs or vessels exposed in an airy situation for cooling it—in these vessels the wort should not be above three or four inches deep in mild weather, and if of less depth so much the better. As soon

as this is accomplished, put the second wort into the boiler as fast as it runs from the mash-tub, adding the hops to it which have been separated by the sieve from the first wort, or boiling, and commence sprinkling cold water, if necessary, (according to the quantity and quality of the beer intended to be made) over the mash, until the wort for the table-beer has been drawn off, which however should not generally be less in quantity than that of the first boiling, (30 gallons) and this will be more than sufficient to expel all the wort from the malt. This second boiling must be strained from the hops as the first, and in order to dislodge the portion of the wort absorbed by the hops, cold water may be sprinkled over them in the strainer, as directed in the mash, and time allowed for them to drain properly into the cooling vessels. It is usual to let the second wort remain in the boiler until the coolers are emptied of the first; and that, in winter, is generally ready for fermenting in a few hours.

As the local situation of all brewing offices, in private houses, differs so much in temperature, the only method of ascer-

taining correctly the proper heat of the water for the first mash, is, to observe particularly that the heat of the wort, as it issues from the tap below, should be between 145° and 150°, and the heat for mashing, in any subsequent brewings, may then be corrected accordingly.

We have said nothing about grinding the malt, as that is generally done by the maltster, and no particular instructions need be given him for it.

2.—*Mashing with Malt, for Porter.*

Malt, 1½ bushels porter-brown,
Ditto, 2½ ditto, common amber,
Hops, 4 pounds,
Water, 40 gallons for first mash.

The peculiar flavor of porter is given by the brown malt, and it requires no other material or ingredient whatever, different from other sorts of beer. The brown or porter-malt is dried, or rather roasted, until the interior of the corn becomes almost of a light chocolate colour, and has the flavor

more of coffee than of malt. In consequence of this high heat in the preparation, the heat for the mashing must be proportionately reduced, and here the thermometer is particularly required. As this is a liquor never attempted to be brewed by private families, on account, probably, of the difficulty of obtaining porter-malt, which is scarcely ever sold by retail, we shall proceed to point out a simple mode of preparing it. Let the malt, required to be browned, be sent to a baker's, requesting him at his first leisure to heat his oven to the same temperature as for bread, and then to put the malt into it, which should not be in a quantity more than sufficient to cover the bottom above three inches—at the end of half an hour the door of the oven should be removed, and the malt stirred up from the bottom; and be afterwards occasionally inspected, until, on breaking some corns, the interior be found of a chocolate colour, when it must be taken out, and sent to the maltster to be ground, and it is then fit for use; but much more so if it lies exposed to the air, in its ground state, a week or more before it is used.

Previous to mashing, the water must be

brought down, *in the mash-tub*, to 170° before the malt is added to it, and therefore, if the heat be reduced by cold water, (to save time) care must be taken that the whole quantity be not increased above 40 gallons. Proceed in the mashing precisely as directed before for beer, and then leave the tub covered up as closely as possible for two hours and a half, when the tap may be set running, and the malt sprinkled over with *boiling water*, following the directions already given through the whole process, with this variation only;—viz. that the second wort must be boiled as violently as possible for three hours, but the quantity of wort, drawn from the two mashes, must be the same as for beer (60 gallons.) As, however, there will not be two qualities of porter required in general, these two boilings will be mixed together, when sufficiently cold, and they will not amount in quantity to so much as the ale and table-beer taken together, on account of the extra time of boiling the second wort of the porter, which will, and is intended to, lessen it considerably; at the same time that it is allowed to extract a greater portion of the astringent quality of the hop.

3.—*Mashing, with a mixture of Malt and Corn.*

The following mixture will make one hogshead of strong beer, and one hogshead of mild ale, or table-beer; and so in proportion for any greater or less quantity:—

Malt, 3 bushels,
Barley, 3 ditto,
Oats, 4 ditto,
Hops, 7 pounds,
Water, 90 gallons for first mash.

It will be first necessary to say a few words on the subject of grinding this mixed *grist*, or mash.

Where there is the liberty of choice, malt ground, or rather bruised, by smooth rollers, is much the better for this mode of brewing. The oats and barley must be sent to a common grist-mill, with particular directions that the oats be ground as fine as possible, and the barley cracked as a common steel mill grinds malt, *but considerably smaller*, although, if too fine or floury, the wort will not drain off well. As it is impossible to give any precise directions

with respect to the proper size of grinding the barley, that must be left in some measure to experience, which will soon indicate it. It must neither be as fine as meal, nor as coarse as malt is generally ground, but between both.

Prepare the mash-tub as before directed, with its false bottom, and let the water into it at such heat that it may soon be reduced to 170° in mild weather, or 175° in cold, as it is always better to keep it up above the required temperature in the mash-tub, that it may have time to warm the tub thoroughly. At the above degree of heat add the malt alone, and stir it well, until every ball or clot is broken, and it is completely wetted; then the oats and barley may be thrown in, and the whole well mashed and stirred together, for the space of a quarter of an hour or twenty minutes, or until it is completely wetted and saturated, and all the clots broken. Now cover the tub well to retain the heat, and at the end of two hours and half from the commencement of mashing, run off the wort into the underback, upon some or all of the hops intended to be used. The heat of the wort, as it drains from the tap, should be

140°, and if in the first brewing, it be above or below that degree, the heat of the mash must be corrected in the next, as the alteration of temperature is dependent on the local situation of the brewing-place, and therefore no degree can be given which is suitable to all situations. As this wort is to remain some time in the underback, which is unavoidable, unless there is the conveniency of two boilers, the hops must be mixed and stirred into the wort, to preserve it from injury.

For the second mash, when the wort of the first is well drained off, (which should be done in a *very small* stream, so as to require three quarters of an hour, or more, to do it completely,) put *boiling water* again to the corn in the mash-tub, but not more than sufficient to allow the whole of the grain being stirred or mixed up therewith; and this quantity cannot be exactly defined, as it depends on the draining from the first mash being more or less complete. This stirring must be employed every time any fresh quantity of water is put with the corn; that is, what is called every *mash*, must be a complete *mashing*—unlike brewing with malt alone, where, after the first mash, it is

directed to sprinkle water repeatedly over the grain, and to allow it to trickle through the whole mass, without moving it about with the mashing-stick the second time—here it must be so moved about *every time hot water* is added.

This being the second mash, it must remain in the tub one hour from the time the hot water is put to it, or from the commencement of the mashing, which should continue for about ten minutes or a quarter of an hour. After the expiration of this hour, let the wort again run off slowly as before, so that the whole shall be three quarters of an hour in doing it.

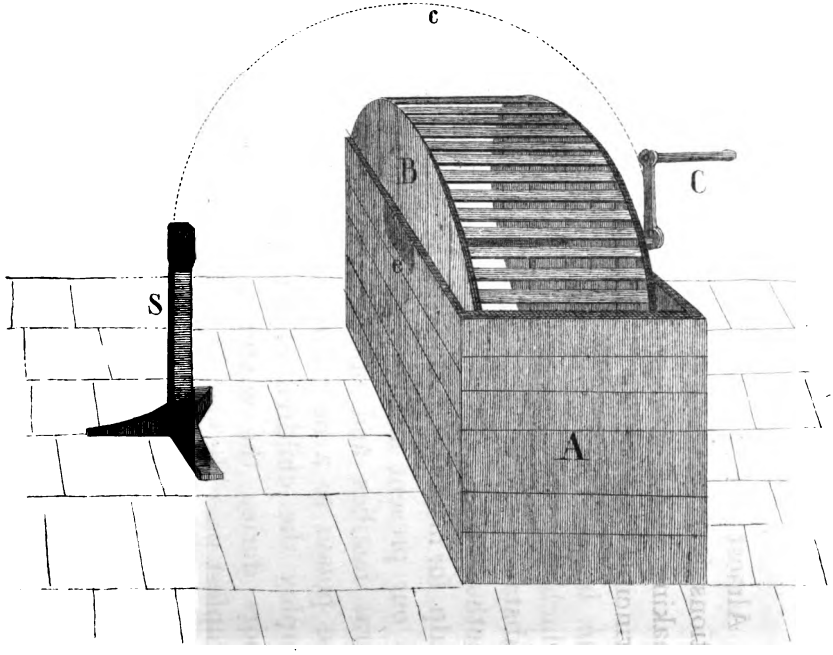
Then mash for the third time with boiling water, precisely as for the second, allowing it to remain also one hour at rest. If the table-beer be intended to be as good as possible, put no more water with this mash than just sufficient to allow the grains to be moved or stirred up with it, and when run off, the quantity absorbed by them can be expelled by sprinkling water over its surface, as directed in the case of malt alone.

The third mashing must empty the boiler of all the water that was previously put

into it, which is then prepared to receive the first and second wort mixed together, already waiting in tubs to be boiled. This, with the whole of the hops, must now be put into the boiler, and boiled as violently as possible for two hours, when it is to be run through the hop-strainer, as before, into the cooling vessels. One hour before this boiling is finished the tap must be opened for the third mash, now in the mash-tub, to be drained off slowly into the underback, ready to be removed into the boiler as soon as the first boiling is emptied therefrom; and the whole of the hops is to be returned into it; at which time, or before, if opportunity offers, the grains in the mash-tub may be sprinkled over with cold water, to make up the quantity of wort required, and this second wort must be boiled also for two hours.

We have thus brought the corn wort through the necessary operations into the coolers; and before we proceed, it will be better to conduct the potato-wort to the same point; as the instructions for the subsequent operations will, with few variations, be applicable generally, and can be comprised under one head.

Fig. 4.



4.—*Directions for preparing and using the flour or fecula of the Potato for Brewing.*

Almost every family in country situations is acquainted with the method of making starch from potatos. It is this principle, as already stated, which forms the basis of every variety of beer, and which is easily converted into a saccharine substance. Now, although there are many methods proposed to grind the potatos into pulp, for manufactories in a large way, still, as our present motive is to teach agricultural families and others, how to apply the potato to a new use, and thereby to employ the children of the poor within doors during the winter months, in the simplest possible manner, we shall at present confine ourselves within these limits.

The only machine required in the method now proposed, for preparing the flour of potatos, is for the purpose of washing them, as the usual mode of doing it by a broom is tedious. In *Fig.* 4, A is the trough containing water, B a cylinder revolving in it by the handle C. This

cylinder is made like a cage, with strips of wood, leaving intervals of about three quarters of an inch, to prevent the potatos from escaping, whilst a free access is allowed with the water, which fills it to about one third of its diameter. Potatos are to be put into it, in any quantity not exceeding half its content, and the handle turned, keeping it revolving until the potatos are quite clean, when the handle C is moved in the curve *c*, which turns the cylinder out of the trough, and by resting its handle on the support S, the potatos are discharged out of it by a door made in any part of the circumference: *e* is a moveable joint, which turns with the cylinder out of the trough, but still retains the other end of the axis.

The difficulty of finding employment suitable for children of all ages, not only in parish workhouses, but in all places, whether town or village, is confessedly very great; and although part of their time ought to be employed in receiving some sort of education, still, as this is very much neglected, even where there are public schools, and notwithstanding every exertion that can be made, a great part

of the time of a labourer's family will be wasted during the winter months; we are very desirous to make this time available for giving the children habits of industry, whilst they are adding a trifle to their parents' weekly wages; and, for this purpose, the potato offers resources to young and old, male and female, of almost every age beyond infancy. But, to take advantage of this offer, some previous attention to the subject will be required by the clergy, churchwardens, overseers, and influential gentlemen in all places, merely to set the machine in motion, which will then proceed of its own accord, and sweet will be the feelings of those who may have thus lent a helping hand to teach their poorer neighbours that the spare time of all their families may most easily be converted to some profit, as the truest charity is that which enables the poor to be independent of it. Amongst agricultural labourers the manufacture of the fecula of the potato is pretty generally known, nor will they require to be supplied with the raw material, —all they want is an immediate market for the produce; this (until the article becomes in general use, which in all probability

would soon be the case,) ought to be afforded them, at first, by the overseers purchasing it at a price at which they may just reimburse themselves by the sale of the flour, or fecula, to bakers, or for the purpose of domestic brewing, in the manner to be pointed out; as both these channels of disposing of it will soon be opened, after the first few trials.

For workhouses in towns and villages, a stock of potatos ought to be laid in at the time of harvesting them, and manufactured into flour during the winter, by the inmates, under the superintendence of the master or mistress. In a national view, this manufacture would, if generally introduced, produce important benefits; and we trust that we have been sufficiently explicit to shew the probability of it, in having said so much on the cultivation of the potato, and pointed out the cause of its limited growth being the want of a market, and also a method, now submitted to the public, to secure its most valuable part from any future change, however long it might be kept.

To proceed—After the washing, the next operation is the reduction of the clean

unpared potatos to a pulp, by furnishing children with a common tin grater for the purpose, and the quantity which can be thus prepared in a day, by each child, is much greater than may at first be expected. The potato flour, intermixed with the pulp, is thus secure from every change, at all seasons of the year, as it is now completely indestructible—the vegetable principle of the potato being destroyed; and if the pulp become putrid, rots, or in any respect decomposes, the starchy matter, or fecula, is incapable of change, and may at any time be separated and purified by the following operation, which however is intended to take place as soon as the pulp is ready.

Fill a tub or trough nearly full of water, and put a hair sieve therein, with its bottom about four or five inches *below* the surface of the water; that is, the sieve must be filled to that depth with water, and it must rest on two parallel pieces of wood, fixed across the tub or trough, to support it in the water at the depth mentioned. Now put the pulp into the sieve, until it rises to the surface of the water therein, and stir it about, frequently lifting the

sieve above the surface of the water to drain, and then immersing it again as low as the supports will admit, and stirring about the pulp in it by the hands, or by a piece of flat board; after repeating this operation five or six times, the whole of the flour will be washed out, and fall to the bottom of the tub or trough, which should be rather deep, that the agitation of the surface of the water may have no effect in stirring up the fecula, or starchy matter at the bottom; and it should have a hole in the side, at the surface of the water, always kept open, to let off the quantity which will accumulate, into another tub, so as to keep the first always at the same level.

The pulp now in the sieve must be emptied out, and reserved for feeding pigs, horses, or any sort of cattle—if for the former, it should be mixed up with boiling water, and given to them when sufficiently cold.

After continuing this operation until the trough or tub is half full of the potato flour, the water therein will have assumed a red colour; this must be drained off when the fecula shall have completely sub-

sided, and left it clear; and the fecula must then be mixed up with a tub full of fresh water, by stirring it up well with a spade or shovel, for it will lay so dead and heavy at the bottom, that scarcely any thing but an iron tool will have any effect upon it. After allowing it to subside, the water must again be drained off; and if the flour is required to be particularly white this washing operation must be repeated, otherwise it is in this state immediately fit for use in brewing; but if for keeping, or conveyance to any distance, it must be dried, and the following is proposed as one of the best methods of doing it. Let the wet flour be put into small thin bags of any sort, so as to fill them not above half or three quarters; then the mouths must be tied, and the bags suspended around the large fire-places generally found in cottages, and occasionally have their contents shaken, so as to bring the internal parts of the flour towards the sides of the bags, thereby exposing fresh surfaces to the heat. This mode prevents dust and dirt of all kinds from mixing with the flour, and dries it very gradually, which must always be done at a low degree of heat. A baker's oven,

after the bread is taken out, will generally dry a quantity of the flour effectually during the night, and for this purpose the door should be left open, but in no case should the drying heat exced 130° at first, but it may be gradually augmented to even 230°, or more.

For using this potato flour in brewing, take of

Malt	1	bushel,
Barley	1	bushel,
* Wet Potato Flour	36	pounds,
Hops	2½	pounds,

Water for first mash 30 gallons.

Previous to commencing the brewing operations, let the above quantity of wet potato flour be mixed with the barley by hand, as intimately as possible; then put the water into the mash-tub, and when it has been reduced to 180° of heat, (for as

* Or just in the state in which the water has spontaneously drained from it as much as possible; and if the flour be dry, 24 pounds of it should be previously wetted, and properly mixed with cold water, until it is of one uniform consistence, without knobs or balls, which will then be equivalent to the above quantity of wet.

already stated, the water should always be lowered to the proper temperature in the mash-tub) add the malt, and stir it well in the manner before directed. When sufficiently broken and saturated, add the mixture of barley and potato flour, and continue the mashing precisely as directed in the last section; the mash must remain as long, and all the subsequent operations be performed in the same manner, without any variation, except in as far as *quantity* is concerned, the present being reduced to give the operator an opportunity of learning the manipulation, before he ventures upon a larger, which must be founded on the same proportions.

Whilst the last boiling, in any of the foregoing operations, is going forward, get all the grains out of the mash-tub, and tread them hard into any kind of vessel; clean the tub, and it is then ready to receive the wort for mixing the yeast or barm with it.

This last boiling must of course be strained from the hops, into the cooling vessels, after it has boiled for the time directed, and the hops sprinkled with water in the manner already explained.

5.—*Fermentation.*

This has already been stated to be by far the most important part of the process of brewing; that is to say, that however well all the previous operations may have been conducted, the effect of them may be neutralized by the injudicious management of the fermentation, and it cannot be accurately commenced without the assistance of the thermometer; but we must here notice, that all expressions in common language, with respect to the state of beer when supposed to be fit for use, are most vague and indefinite, without the aid of the saccharometer, which will speak a plain and explicit language. Although therefore we cannot but recommend its use, and bear witness to its great utility, yet we almost despair of success in introducing it generally, until the pertinacity of the great bulk of mankind, in rejecting the assistance of every thing designated by the formidable word *scientific*, has been conquered; which we trust the Society for the Diffusion of Useful Knowledge will in some degree accomplish. Those instru-

ments, which we wish to recommend, are so extremely simple in their use, that even a school boy may in ten minutes learn it; the misfortune, therefore, of merely conveying an air of science with them ought not to be sufficient for their condemnation. We will however boldly affirm, that the art of conducting the fermentation of any liquid, will make no great step towards perfection until they become general, even in private hands; and such conviction will, we hope, plead our apology for saying so much on the subject, there being no vinous liquor, prepared in this country, in which the fermentation can be permitted to go its extreme length, as in wines from grapes, without deteriorating the quality of it. There is always in beer, cider, British wines, &c. a certain degree, beyond which the fermentation must not be allowed to proceed, in order to produce the liquid in its greatest perfection, and this degree, when once ascertained, the saccharometer will register.

The mash-tub, as now prepared, is to receive the wort of the first boiling, or strong beer; and another tub should be got ready for the table-beer.

The wort, during the summer months, may be put into each, at the lowest heat obtainable in the space of six hours, as it should not be kept longer in the coolers; in October and March at about 70°, (supposing the fermenting tubs, each not exceeding 100 gallons) and, during a frost, even at 80°; with a pint of good or thick, and a quart of light or thin yeast, per hogshead; but it must be observed that the yeast should be previously mixed with a gallon or two of the wort, at a much higher heat, (say about 100°) especially in the winter season; and that after the whole of the wort and yeast is put together in the tub, it should *then* not be lower than the heats mentioned. A sufficient space should be allowed in the tub for the head to rise, without running over.

The wort must remain in these tubs for two or three days, according to the season of the year, until a decided yeasty head be formed; or until it be reduced by the fermentation not lower than to one-half of its original specific gravity; the beer should then be drawn off, as fine as possible, into casks, without moving the head, which will be left behind to be mixed up with the

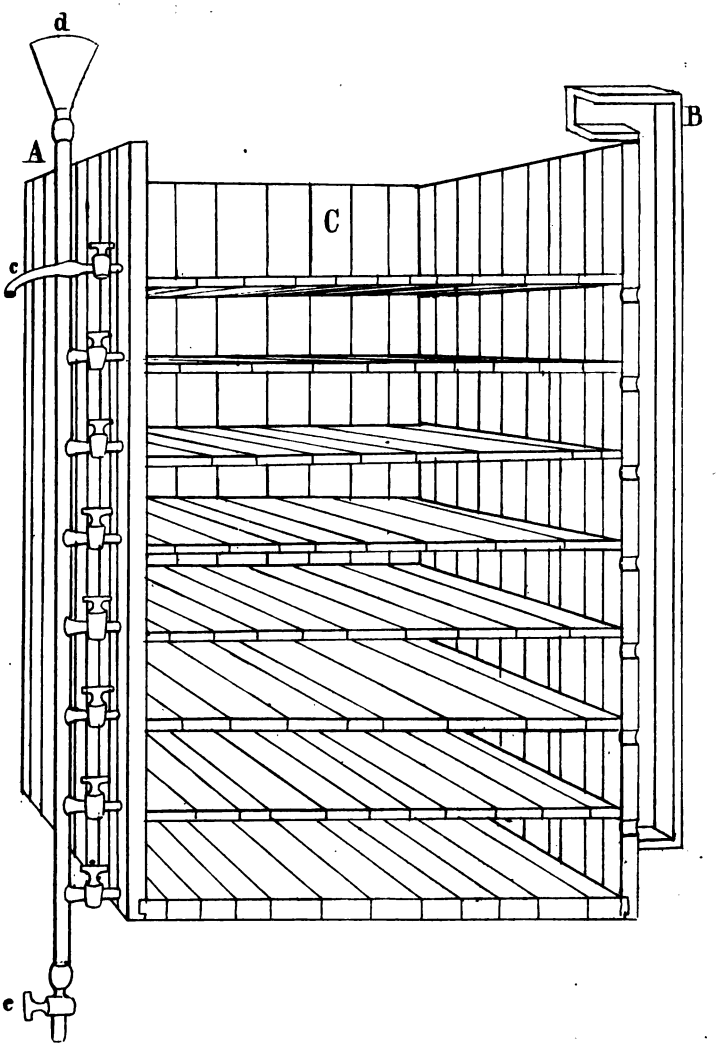
bottoms or lees; as both, whilst fresh, form good yeast. The casks must be occasionally filled up with the same beer, and when the working is finished, which in this mode of fermenting will be but little in the casks, they should be bunged up close, and a small hole be bored, at the side of the bung-hole, to prevent accidents, until the cask of beer becomes fine and fit for tapping, when the hole may be quite closed with a peg.

A different mode of fermenting is pursued in the government victualling offices, which we consider very far superior to the above, (for all wort not exceeding the specific gravity of 1060;) or to any plan hitherto adopted by private or public brewers, where expedition is not required; as the fermentation is thereby checked, and the beer the more readily becomes fine. The wort is merely fermented in the coolers, and when sufficiently fine, which is the case in winter (their only brewing season) in a few days, it is then drawn off directly into the casks, bunged up immediately, and sent on shipboard. The advantage of this mode of checking the too great progress of the fermentation, would be particularly felt in the

summer; but, in that case it is necessary to cover the coolers closely over, to prevent the access of the warm air of the atmosphere, which has no injurious effect below a certain temperature. This covering would, however, be attended with much trouble and expense, and therefore a series of coolers, or rather shallow vessels, one over the other, so that the bottom of every one may form the cover of that immediately under it, might, with advantage, be substituted.

Fig. 5, is a plan proposed for this purpose, consisting of a cistern or case, about eight feet high and five feet square, divided into compartments of eight inches deep. A is the pipe for charging all the chambers with the fermenting wort, and B a shoot or trunk communicating, with small holes in the upper part of each of them through which the yeast will be discharged into the superior open receptacle C of the fermenting case: *c* is a cock for drawing off the beer which subsides from the yeast, and which is put into the funnel *d* as fast as it forms, and allowed again to run into the different chambers by opening all the cocks, which must again be closed when done: *e*,

Fig. 5.



a cock by which the chambers may be all drawn off. It will doubtlessly be asked, "How are the different compartments to be cleaned out?" To which we reply, That the whole front of the case may be made to take off, and to be again replaced at any time, so as to be closed sufficiently tight by means of screws. The public brewer will also say, that the beer will be liable to the taste denominated "*yeast-bitten*," in consequence of the yeast having so large a surface to rest on; but this effect never takes place, except in beer undergoing a violent fermentation at a considerable heat, both of which effects this plan is suggested for the especial purpose of preventing (effects which invariably impoverish the liquor and hasten its destruction,) and also to promote a more complete union with the bitter of the hop residing in the yeast, by interposing some slight difficulty to its escape.

Two cases, or receptacles of this kind will be required, that the beer may be transferred from one to the other when the fermentation has ceased. The first may then be cleaned out, and the beer allowed to remain in the other until it becomes fine,

which will take place in a few days, even in the summer months—indeed it is only during the warm weather that the utility of the proposed plan will be sensible, as there is no difficulty in producing sound and transparent beer in the winter months, whereas, during the summer, when a pleasant, mild malt liquor of moderate strength is mostly required, it can be seldom obtained.

It is to be regretted that no unexceptionable method of incorporating the flavor of the hop with beer has yet been discovered; indeed the difficulties are numerous; the first loss is in the deposition found in the coolers, for the loss by evaporation, during the boiling, we consider as nothing. This consists of a valuable part, separated by the action of boiling; and the next, and most important, is that carried off by the yeast, and totally lost to the beer; for the bubbles of carbonic acid gas, as they pass upwards through the fermenting wort, appear to have a strong attraction for the bitter of the hop, which they separate therefrom, notwithstanding the union produced by the boiling process, and carry to the top amongst the froth, where it would be quite lost to the

beer, if it were not for the head breaking as fast as it forms, and thereby descending to the wort below; but here the incorporation is again prevented, because, as fast as the bitter part of this frothy head begins to touch the surface, a part of it is instantly forced upwards again, by the constantly ascending current of carbonic acid gas; so that the bitter of the hop does but partially unite with the beer, until the tumultuary part of the fermentation is over, when it is almost too late to assist the union. On the other hand, if the beer is immediately put into casks from the coolers, to be fermented there, which is done generally in country situations, the union is in some degree promoted, by constantly filling up the casks with the portion which works over; but unless that is frequently, and unintermittently attended to, the loss of the flavor by this plan is even greater than by fermenting it previously in gyle-tuns, where the head, as it forms and subsides, does partially return the bitter of the hop to the body of the wort.

There are many plans proposed to enable casks of beer, whilst working, *to keep themselves filled up;* but if the efficacy of any of

them be put to the test of extracting the bitterness from the yeast, they will generally be found to fail. The hop seems, as it were, to be an intruder in beer, and every part of the process of brewing appears to have a constant tendency to oppose its union, and to separate and disengage it from the wort; our attention should therefore be particularly directed to counteract this *propensity*, and to secure an intimate and early union between these *enemies*, for which purpose we submit the following observations :—

The fermentation of all liquors can scarcely be conducted too slowly, and, in the case of beer, although the wort containing the extract for the malt and hop, does not readily ferment without the addition of yeast, still it will commence, and continue the operation, and in a much more complete manner, without any such assistance ; but then there is some risk in warm weather, that when left to ferment of itself, it may acquire an unpleasant taste and smell, technically called " foxed." In the brewings of private families then, where speedy ripeness is not so much required, and which is purchased by the public

brewers at the expense of the finer portions of the malt and hops; and indeed to all brewers, private or public, who can wait patiently for *time* to supply the place of *yeast*, we give this advice—*Let no yeast be ever used*, but proceed according to the following plan:—

When a cask of beer is half empty, (if perfectly sound, and free from any acidity) draw it off into a clean cask of the same size, and fill up this latter with the wort from the coolers, as soon as it arrives at the temperature of 70°, remembering, at all times, to leave a small vent-hole in the casks, to allow of the escape of the carbonic acid gas, as it gradually forms. By this method of conducting the fermentation, (which will still proceed, but with great slowness) it will be found, that all the flavor of the malt and hop will thus be effectually preserved, in place of permitting the latter to escape intermixed with the yeast, to be transferred to our bread, which we could well dispense with there; for, notwithstanding the same quantity of that singular substance may be separated from the beer, (in equal reductions of specific gravity) by any method of fermentation, it must make

a vast difference in the flavor of the beer, and be attended with much greater economy, when we compel it to subside to the bottom of the cask, and there gradually to impart the fine essential oil of the hop to the superincumbent beer, in place of permitting it to flow over the bung-hole, with its precious cargo, never again to return; for its restoration, by occasionally filling up the cask with the same, whilst it is working, is but of little consequence, when this very light oil can borrow a vehicle (the carbonic acid gas) the next moment, to effect its escape again. By the slow method here recommended, the fermentation is scarcely perceptible, and, as no head of froth or yeast forms on the surface, the flavor of the hop is constantly intermixed with the whole body of the wort, and slowly forms with it an intimate and complete union. The mucilaginous part too, which, by the rapid mode, is separated in the form of yeast, and which, in proportion to its early separation, takes from the beer that fullness on the palate which is so desirable, is here retained in the wort, gradually to impart it; and when that is accomplished, as far as possible, it subsides

to the bottom, and there forms a substance for the beer to "feed on," until, at last, every part of the flavor contained in it is given to the beer; and this deposit, which then becomes what is called "lees," is quite tasteless. These lees are therefore nothing more than what would have been *yeast* by the rapid mode of fermentation; and the difference consists in this, that, whereas in the latter case they separate from the beer surcharged with the fine essential oil, and high flavor, both of the hop and malt; in the former, all these flavors are retained and incorporated therewith: but the public brewer must not adopt this plan in large casks, and indeed if he were to dispense with vats altogether and use no casks larger than wine pipes, his beer would always prove of superior quality, and by the method of slow fermentation, here recommended, that *certainty* in the manufacture would be acquired which has always been so great a desideratum. In the town of Dorchester, the fermentation of the beer is so sluggish, that the attenuation (reduction of gravity) in the gyle-tun seldom proceeds beyond one-fourth, or one-fifth of its original gravity, and then

the fermentation apparently ceases, but goes on slowly in casks; to this want of action (proceeding probably from the hard quality of the spring water in that town, which runs through beds of chalk) may be attributed the excellence of some of its beer, according to the doctrine of slow fermentation herein recommended, although in this case, at some sacrifice of the fine bitter of the hop, which is separated, and lost, in the yeasty head of the gyle-tun.

CONCLUDING OBSERVATIONS.

It may sometimes happen, in brewing from unmalted corn, that the first wort does not run off so fine as from malt alone, but that is of no consequence—it will be equally fine after the operations of boiling and fermenting. The first wort, as fast as it drains from the mash-tub, should be mixed with the whole, or greater part of the hops intended to be used, as this will secure it from injury until ready for boilng.

Should utensils be scarce, or a longer time required for cooling, as in mild weather, the last wort for the table beer may remain, without injury, in the boiler all

night, provided it be closely covered, and kept as nearly as possible at the boiling heat; and this alone will give the table beer a deeper color, which will generally be considered an advantage.

There seems to be a *racy* principle in the pale and amber malts, which only high heats in the mashes will extract, and although, by the employment of them, the quantity of fermentable matter in the wort may in some degree be lessened, we decidedly advise it, *when malt alone is employed,* for all beers intended for present drinking, but not those for keeping.

A greater dependence can be placed on the quality of the future beer if brewed before the winter commences, or in the month of October; for the cold gradually coming on, it prevents the fermentation from proceeding too rapidly, and enables the beer to sustain the heat of the ensuing summer with very little change; therefore, all beers intended for keeping should be brewed near the conclusion of the year, and those for present drinking at any time except the months of June, July, and August, in which it is nearly impossible to produce good beer.

Fining.

This is done generally by the aid of isinglass, which is prepared for the purpose in the following manner. When divided into shreds it is digested with stale beer for a day or two, until it is softened and partially dissolved; in this state, with a clean broom or wisp, it is beat up for a considerable time into a froth, and when no knob or ball remains it is fit to be put into the beer, in the proportion of about an ounce of dry isinglass per hogshead. This is all that need be done, and it requires no stirring, for when added in the state of froth, it swims on the surface of the beer at first, and will gradually descend through the whole mass, carrying all the feculencies down with it, and leaving the beer perfectly transparent. At the same time it must be acknowledged that isinglass has a tendency to flatten and impoverish it, and it seems to produce this effect by uniting with the vegetable principle called "tannin," which gives the racy and slightly rough taste to beer, and, by taking away this principle, leaves the beer much more monotonous in its flavor; indeed it is sup-

posed to be this union which gives to isinglass the property of fining liquors, and that it is inoperative where "tannin" does not exist: if this be the fact, that principle can be artificially added to liquors which are to be fined with isinglass, which would prevent the injurious effect above stated, and also render the fining more certain: indeed it is very probable that a judicious admixture of *bark* with beer and other fermented liquors, would greatly improve them.

We can see no reason why the same improved mode of filtering as is at present in use among the sugar refiners may not be applied to beer; the only care necessary would be to prevent access with the atmospheric air during the operation, and by this mode the *cleansing*, or separation of the yeast, may take place in the midst of the most violent fermentation of the gyle-tun, at any desirable degree of the saccharometer, and the beer be rendered instantly and completely fine.

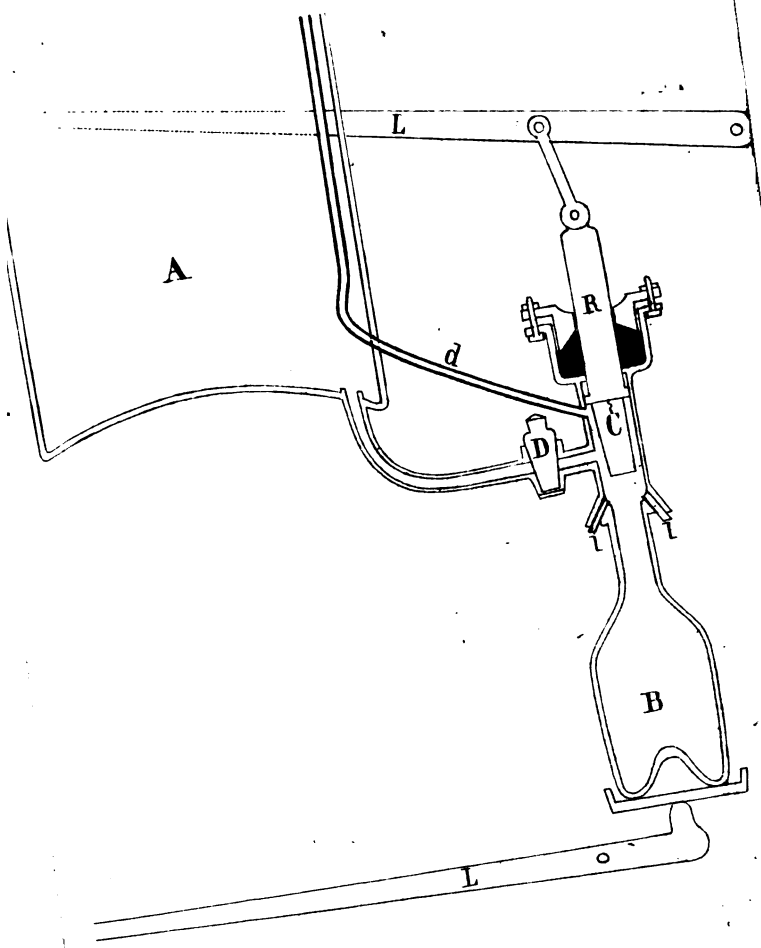
Bottling.

So many circumstances affect the proper

time, and state of the beer for bottling, that it is almost impossible to define them. Beer should never be put into bottles until the fermentation has become extremely slow, and that is seldom the case much under the age of one year: it however depends greatly on the attenuation (reduction of gravity) which the beer has undergone; for if it has fermented rapidly, and the specific gravity brought down so low as 1010 to 1015, there is little danger of its acquiring too great a force in the bottles, in any climate. The only true guide is however to examine the beer frequently by the saccharometer, and if in the course of any one month there may appear to be scarcely any change in the specific gravity, (supposing the heat of it not below 50) it may be safely bottled, which however should generally be done in the spring, that the increasing heat of the days may bring it "up in bottle" by the summer; for it is most difficult to produce this effect in a daily decreasing temperature, and we have seen beer quite brisk in bottle during the warm months which has produced scarcely any "head" in the ensuing winter, so powerfully does temperature affect it. This

effervescing quality is so very uncertain, and so extremely difficult to keep up to a certain standard—neither too much to endanger the bottle, nor too little to please the consumer—and requires so much nicety in the management, that we are rather surprised that no method has yet been adopted to charge beer and other vinous liquors with carbonic acid gas, in the same manner as is now commonly done with ginger beer and soda water; the advantages of it would be great, as a due degree of effervescence could always be given to it to a certainty, at a few hours notice, rendering it unnecessary to keep any stocks of evervescing bottled liquors, and removing, almost totally, the risk of breakages in consequence of the too great accumulation of carbonic acid gas. Another advantage would be obtained in the transparency of the liquor when fully charged with the gas, which is never the case in the common mode of bottling; for, as no fermentation can take place without a deposition of lee, and disengagement of gas, so the converse is also true, that no such disengagement can ever happen without a deposition in the bottle sufficient to render

Fig 6.



the brightest liquor turbid on the least agitation.

Perhaps the cause of the non-adoption of the proposed plan arises from the difficulty of filling and corking the bottles under such a heavy pressure, without the production of a great quantity of froth; we therefore suggest a method of obviating it, in hopes it will some day be executed and improved on. In *Fig.* 6. A is a vessel containing the beer (or other vinous liquid) charged artificially with carbonic acid gas, in the same manner as soda water. B the bottle to which it is to be transferred; R a rod moving through an air-tight stuffing box, having a short cork-screw for retaining the cork C at the end of it. L L' two levers, the one for forcing the cork into the bottle, when full, and the other to press the bottle tightly, whilst filling, against a collar of leather *l l*. The mode of operation will be thus—the lever L is first pressed down below *l l* to allow the cork to be fixed to it, and then drawn up to the place represented; the bottle is now placed on its stand, and forced up tightly against the collar of leather, (the top of the neck being formed conical for that purpose) the cock

D is then opened, which allows the liquor above to run into the bottle, whilst the air therein is expelled into the receiver through the pipe *d*. When the bottle is full, and the froth has all ascended through this pipe, the cock D is closed, and the lever L is pressed down, by which the cork is forced into the neck of the bottle, which is then removed from its stand, and disengaged from the screw by giving the bottle a few turns. All the bottles should be filled previously with carbonic acid gas when used, to prevent, as much as possible, the atmospheric air from entering the receiver A; for if the common air does find its way into it in any considerable quantity, such as a bottle full on every one that is filled with the liquor, the receiver must be frequently discharged of the air that thus enters, and thereby much of the gas will escape at the same time. The bottles can be easily filled with gas, from the gas-holder employed to charge the vessel A, in the same manner as if they were to be filled with a liquid (as the gas is so much heavier than the common air) by a long-nosed cock descending some way into the bottle, but as it might then be difficult to

ascertain when the bottle is full, it may be filled with water first, and the carbonic acid gas allowed to enter by inverting the bottle over the spout of the cock above mentioned, which in this case must be turned upwards, and the gas would then enter as the water ran out; the bottle is then to be immediately removed, and filled with the liquor. The pressure, of course, will gradually decrease in the vessel A, and must be restored by keeping the charging pump frequently going.

The following table contains the *strength*, or specific gravity of the wort from which the superior sorts of Scotch ale are manufactured, and also the specific gravity of the ale when the fermentation is completed :—

Sp. Gra. of Wort.	Sp. Gra. of Ale.	Sp. Gra. of Wort.	Sp. Gra. of Ale.	Sp. Gra. of Wort.	Sp. Gra. of Ale.
120	35	116	29	102	21
111	31	111	27	106	26
104	25	103	27	107	31
111	26	104	32	106	30
107	25	117	28	72	28
108	30	106	30	104	27
82	15	105	22	93	20
106	38	112	27	90	12
			34	120	34

These specific gravities are inserted in the language of the new saccharometers used by the excise; and it is only necessary to prefix 1 or 10 to each to express them in the common method.

It is to be observed that the wort, from which these ales were made, can scarcely ever be brought to the specific gravities mentioned, but by boiling it for some length of time.

We insert another table, showing, from actual experiment, the weight per bushel (imperial measure) of different samples of malt, and the relative solid extract in pounds avoirdupois.

Wt. of Malt, per Imperial Bushel.	Solid Extract from a Bushel of Malt in lbs. Avoirdupois.	Wt. of Malt, per Imperial Bushel.	Solid Extract from a Bushel of Malt in lbs. Avoirdupois.
37.7	23.5	39.2	25.9
37.7	23.3	40.5	24.6
37.7	21.7	40.3	25.3
39.6	23.5	40.3	25.3
39.6	23.0	43.2	26.1
41.8	25.7	43.5	25.6
36.0	22.8	42.3	25.3
36.8	23.5	40.0	25.1
36.5	25.6	40.0	25.5