

from a high degree of refining, which meant less colour, was that the use of such an invert-sugar enabled a brewer to use in the brewing of his pale ales a more highly kilned, and consequently a sounder, malt than could be done with a lower quality sugar.

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MEETING HELD THURSDAY, 14TH MAY, 1896.

Dr. W. L. HIEPE (President), in the Chair.

After the transaction of some business, the chair was taken by Mr. CHAS. HILL.

Dr. Hiepe then read the following paper :—

*Pure Beer.*

W. L. HIEPE, Ph.D., F.I.C., F.C.S.

My paper is not a purely scientific one, nor is it a practical one in the usual sense of the word, although in the course of it I shall have to refer frequently to both the science and practice of brewing. It deals, however, with a subject of great importance to brewers generally, namely, with the position taken up by a not inconsiderable section of the public in reference to the methods and materials employed in the manufacture of the beverage known as beer.

No doubt, all of you are acquainted with the material facts of the great change made by Mr. Gladstone's Act of 1880, whereby the duty, which until then was payable on the malt, was transferred to the finished article. This change was brought about, to a large extent, by the agitation of the agricultural population and their friends, who thought that, by abolishing the malt tax, considerable advantages would accrue both to themselves and to the British farmer generally. That these hopes were doomed to disappointment is now a well known fact, and this affords an instance of the impossibility of predicting the exact consequences of any great economical changes.

Mr. Gladstone's Act was a distinct compromise between the Excise authorities and the Trade. The tax taken off the malt was put on the beer, but the brewer had to pay actually more than was previously imposed upon the maltster, and, in consideration of this, he was to be allowed to use, besides malt, other materials, which could be employed as substitutes for it. In other words, the brewer was granted what is called "*the free mash-tun,*" in exchange for a slightly increased tax, and it is but fair that he should now insist that the understanding arrived at is adhered to. The effect of the free mash-tun was that the use of foreign malt and other materials increased by leaps and bounds, to the detriment, no doubt, of the interests of the British barley grower, and, instead of the latter benefiting by the change he is worse off than before.

In consequence of this a determined agitation was started some years ago, and has been repeated from year to year, to again change the Excise regulations, to take away the advantage obtained by the brewer in a fair bargain, and to put intolerable restrictions on his processes of manufacture. The alleged object is likewise to benefit the British farmer, but it is highly probable that the farmer would again be disappointed, and the effect of the proposed change, which it is impossible to foretell exactly, would certainly not be what is put forward by the would be friends of the farmers.

At the present juncture matters are more complicated than they were in 1880, because there is in alliance with the farmers the temperance interest.

The change proposed, and which was embodied in a Bill introduced into the House of Commons on March 25th, can be summed up as follows.

The name beer to be employed exclusively to that beverage which is brewed from malt and hops only, with the exception of 3 per cent. of sugar for priming. All brews containing sugar and other malt substitutes to be labelled by a different name. This is the main part of the Bill, and we must not enter into details.

You are of course aware that the Bill was withdrawn by Mr. Quilter on the suggestion of the Government, and a promise was given to appoint a Committee of Inquiry and to obtain expert evidence on the subject, and deal with it afterwards in accordance with the results of the inquiry. If such an inquiry is made, and

proper evidence is given before the members of the Committee, then the Trade has nothing to fear, but it is absolutely necessary that every step should be taken to obtain an impartial and authoritative inquiry, and meanwhile the more the subject is laid before the public in a clear and open manner the better it will be for the interests of the brewers.

The object of my paper will therefore be to consider the whole question of malt and hop substitutes from all possible points of view, and so to allow everybody to form an opinion as to how far the demands and alleged objects of the agitation are justifiable.

In Mr. Quilter's Bill a distinct definition of the word beer was adopted, but, as a matter of fact, I do not believe that such a definition, which could be upheld, for example, in a court of law, can be formed. At the same time it is generally understood by the public that beer is the product of the fermentation of a wort made from malt and flavoured with hops, but there is no doubt that the beer-drinking public do not insist on this, and all that they require is a pleasant, wholesome beverage of the kind they like, and they do not trouble very much about the materials used; indeed, I have come across quite a large number of people who, although they know that malt is used for brewing, had no idea what malt was or what it was made from. We must therefore now inquire whether a wholesome and pleasant drink, such as the public require, can be made only from barley malt and hops, or whether other substitutes can be used to produce the same article.

The history of the development of the manufacture of fermented liquors is sadly incomplete. We know only that in the earliest times such liquors were produced from all sorts of materials, principally the saccharine juices of fruits and trees, honey, &c. Later on, the transformation of starch into fermentable substances was discovered and made use of, and from that time we may say that beer proper was known.

The source of the starch and the manner of transformation would of course differ according to climatic conditions, but there is no doubt that in the temperate zones the cereals claimed the most attention, and a process of malting and brewing was gradually developed by experience. Experience seemed to show that barley, of the cereals grown in the temperate climates, was most suitable for the process.

then in use, and it has remained the only material, until by progress of scientific researches into the chemistry of brewing and the introduction of cereals from other countries, it was partly replaced by substitutes. To obtain the bitter flavour of the beer various plants have been used at times, but the hops as used now seem to have been selected as the most suitable at a very early period.

We have thus seen that there is nothing in the history of brewing as far as we have it to justify the assumption that barley and hops only should be used, and we must now deal with the question from different points of view.

It is necessary at this point for us to get some distinct idea as to the qualities necessary to render a material suitable for brewing beer. It goes without saying that the material must be one which is in no way injurious to health. It must, moreover, be of such a kind as to yield, when properly treated during the brewing process, a wort of certain qualities, namely :—

- I. It must contain a certain amount of fermentable saccharine matter.
- II. It must contain a sufficiency of certain types of nitrogenous substances to feed the yeast during fermentation and produce a healthy reproduction of the same.
- III. It must contain certain types of carbohydrates, which escape the primary fermentation, but which ferment in the cask and thus give to the beer an agreeable effervescence, usually called condition.
- IV. It must contain certain bodies not fermentable by yeast, partly of nitrogenous and partly of carbohydrate nature, which remain in the finished article and impart to it flavour and palate fulness and a certain amount of nutriment.
- V. It must be free from such bodies which, being of an unstable character, pass out of solution easily, making the beer turbid, or impair its soundness.
- VI. It must be obtainable at a reasonable price.

Doubtless, an ideal barley malt would fulfil all these conditions, excepting perhaps the last, but unfortunately such perfect malt is a rather scarce article, and nearly all the malt in the market, especially that of English barley, is more or less defective in respect to one or more

of the above points. But I do not want to put the whole blame on the maltster or on the English farmer. Both are certainly not perfect, and I hope that great improvement will soon come about as well in the production of barley on English soil as also in the making of malt from it; but, taking into account the climatic conditions of these islands, the production of a malt which could be used alone for brewing the light, young, brilliant, and sparkling beer, such as is now demanded by the public, is almost beyond our hopes.

The above qualifications of a good wort refer only to those of its constituents which are derived from malt or malt substitutes. It must, however, possess other qualities, due to the bitter used for flavouring, but I prefer to leave the consideration of this part of the question to a later stage.

We may take it, then, that any material which will, under proper treatment, yield a wort conforming with the above tests, can be used for making beer without impairing its qualities, and must therefore be a legitimate substitute for malt.

I need hardly say here that, when I speak of malt substitutes, I mean partial substitutes only. The presence of some malted grain, containing diastase to convert the starch, is, of course, necessary, and, so far, no other cereal has been found which, from every point of view, is so suitable as barley. But this does not prove that, if another cereal was found which could be malted with the same facility as barley, malt made from this could not be substituted for barley malt.

The malt substitutes can be conveniently divided into two classes—

1. Starchy materials.
2. Saccharine materials.

To the former all the different prepared and raw grains belong, such as rice and maize, and to the latter all kinds of sugar.

We must here briefly enter into the chemical changes occurring during the preparation of the malt and wort. During the growing stage on the malting floors there is formed in the grain a substance called diastase, which has the capacity of converting gelatinised starch into fermentable sugars, and other carbohydrates of a less fermentable nature. During the malting process, moreover, the starch is modified so as to be easily gelatinised at the temperatures used for mashing, which are limited by the fact that diastase is destroyed at 168° F. The nitrogenous constituents of the barley are also considerably

altered, a large part of them being removed and another being rendered soluble. When the malt is mashed, viz., mixed with water at a suitable temperature, the diastase transforms the starch into fermentable sugar, and other substances which ferment either with difficulty or not at all; besides this, nitrogenous substances are dissolved, and in this way we get a wort which has the properties given under I, II, III, and IV (*vide supra*).

The relative proportions of the substances thus dissolved in the wort will, of course, vary: they can, to some extent, be modified by the brewer at will, by using different kinds of malt, or by varying the treatment, especially in respect to the temperature and quantity of the water; and it is to a large extent by varying the proportions of these wort constituents that the different kinds of beer and ale are produced.

The question now to be considered is whether the different kinds of substitutes can be used to produce the same kind of wort.

The first kind of substitutes, made generally from some cereal other than barley, are not malted. They contain no diastase, and can therefore be used only when mashed together with malt, the diastase of the latter always being sufficient to transform a large amount of starch over and above that contained in it; the starch of maize, rice, &c., is chemically of the same composition as that of barley, and on transformation by diastase yields exactly the same products, and the brewer has the same control over these by regulating the temperatures, &c. But these unmalted grains are different in one respect; they contain the nitrogenous matter in the crude state, and nearly all insoluble, and by replacing part of the malt by them we no doubt reduce the quantity of nitrogenous matter in the wort. This, of course, limits the percentage of such matters which can be employed; but, as a rule, the nitrogenous matters obtained from the malt are largely in excess of the quantity required, and it is one of the great advantages which the brewer derives from the use of these materials, that he does decrease the quantity of dissolved nitrogenous matters in the wort, which, if the latter is made from barley malt alone, is often so much in excess that a large amount of trouble is caused by it.

We find, therefore, that the only point in which these farinaceous substitutes differ from the malt is one in which the difference is a

decided advantage to the brewer, and certainly no disadvantage to the consumer.

As regards the use of unprepared raw grain, the same may be said to a certain extent, but in the case of raw maize the oily and fatty matters of that grain present the possibility and risk that harsh and disagreeable flavours will be developed. At the same time, the ease with which these materials are converted, after having been gelatinised in a converter of the Billing's type, is a great temptation to use a very large percentage of them, but with an excessive percentage there is no doubt that not only the yeast suffers to some extent, but the flavour and fulness of the beer is considerably impaired.

In defending the use of these substitutes, I would draw the limit at a certain relative amount of them, which would be somewhere about 30 per cent. of the total grist.

Turning our attention to the other class of malt substitutes, viz., the saccharine materials, we find that they contain no starch, but ready-formed sugars. One class, namely, the commercial glucoses, are made from starch by means of dilute acid, and contain the transformation products of starch, viz., dextrose, maltose, dextrin, and some of the intermediate carbohydrates. These materials are also poor as regards nitrogenous constituents, and all I have said above in regard to this point holds good here also. At the same time, as we have here to deal with the starch already transformed, it is clear that the brewer has lost his control over that part of his extract. If the sugar is of a very fermentable character, he will find it necessary to so arrange the treatment of the starchy part of his goods as to provide for an extra amount of those bodies which are either unfermentable or are only fermentable with difficulty. If the brewer knows the composition of his sugar there would be no difficulty in doing this, and, from this point of view, the use of these sugars offers no objection.

The fact that the bulk of these sugars consists of glucose, instead of maltose, which we get from the starch in the mash-tun, is immaterial, since the products of the fermentation of maltose and glucose are identical, and, indeed, there seems little doubt that maltose is converted into glucose by the yeast prior to fermentation.

The other class of saccharine substitutes consists of such sugars as cane-sugar and invert-sugar. Cane-sugar is, I believe, used very

little, or, at least, only in small quantities, although the high extract which it yields, besides a clear gain of 5 per cent. on inversion in the round, offers a great temptation. The reason for this is, no doubt, the fact that, the yeast having to carry out the inversion, the start of the fermentation is to some extent delayed, and that may sometimes constitute a source of serious mischief.

Invert-sugars are, as you know, made from cane-sugar by inversion with acid or yeast, generally the former. They are almost entirely fermentable, but those made with acid, especially the darker coloured brands, contain some unfermentable substances, which contribute to the flavour and fulness of the resulting beer.

Commercial cane-sugar and invert-sugar are practically free from nitrogenous substances, and, being almost entirely fermentable, it is clear that the brewer should make the same provisions in arranging his mashing heats as in the case of glucose, viz., select them so as to obtain an extra amount of unfermentable substances to make up for the absence of these in the sugar.

We have thus demonstrated that all the kinds of malt substitutes which are in use yield practically the same final product as malt : that by judicious selection of these, and arrangement of his mashing heats, the brewer can compensate for any difference which would otherwise arise in the composition of his wort ; and, therefore, from a scientific point of view, no possible objection can be brought against the use of these materials.

I repeat, however, that there should be a certain limit, and when I put this at about 30 per cent., I mean that this should include grain and sugar, if both are used.

From the brewer's point of view, we have only to inquire whether the use of these materials offers any advantage, without damaging the interests of the consumers.

We have already seen that the differences in the wort produced with malt substitutes from one produced without them all tend to make the former better and sounder ; at the same time, the use of these materials requires nothing in the shape of any extra plant or apparatus. Another advantage is the fact that the substitutes are, as a rule, free from colour, and in this way the brewer not only obtains a more complete control over the colour of his beers, but he can use better cured malts than he could use without them.



These reasons alone might induce the brewer to adopt the use of substitutes; but there is a still more potent reason, viz., the fact that they are decidedly cheaper than malt. If you take malt giving an extract of 90 lbs. per quarter, at 35s. a quarter, you have 4·67*d.* as the price of a pound of extract. Maize giving an extract of 105 lbs., and costing 33s., comes to 3·77*d.* per lb., and sugar yielding 72 lbs. per 2 cwt., and costing £12 per ton, comes to 4*d.* a pound. From this we can calculate the saving on substituting a certain amount of grain and sugar. If we assume that 15 per cent. of the above maize are used with 15 per cent. of sugar and 70 per cent. of malt, then the cost of the material for 100 barrels of beer at a gravity of 20 lbs. would be £37 0*s.* 9*d.*, whilst if the malt alone was used it would be £38 19*s.* 4*d.*, or a saving of £1 18*s.* 7*d.* per 100 barrels, equal to 4·6*d.* per barrel. In these calculations I have not taken the most favourable figures; malt at 35s. can be obtained, which gives more than 90 lbs., and maize and sugars giving the above extracts can be bought at lower prices; but even the result as given above shows that the saving is large enough to give the brewer an extra inducement to use these materials, although it is not anything like as large as one would imagine from the statements contained in some of the papers, where the desire of the writers to do harm to the trade only causes them to expose their ignorance and to make statements utterly at variance with facts.

We have so far seen that, as regards the brewer, the use of malt substitutes is justified on scientific as well as on economic considerations. But how is the beer-drinking public affected?

All that the public can ask for is, that under the name of beer or ale, &c., a beverage is supplied which is free from injurious substances, and is possessed of such qualities as are by custom associated with the names.

The beverage should be brilliant, sparkling, of good and agreeable flavour, and should contain a certain amount of alcohol and nourishing matters. There can be no doubt that under the name of beer much is sold which does not come up to all the requirements as given above, but, in nearly every case, this is not caused by the use of substitutes, or adulterants as they are called, but by the use of inferior malt or hops, or by faulty manipulation. With materials, including substitutes, of fair quality and rational mashing, the

brewer can turn out an article which should be satisfactory in every respect, and give the public no cause for complaint. Let us now briefly consider the legal aspect of the case.

The Act of 1880 was one which partook much of the nature of a compromise. Not only was the duty taken off the malt and put on the beer, but it was, at the same time, increased to a considerable extent, and has been increased since, first by putting an extra 3*d.* per barrel, and again, later on, indirectly, by lowering the standard gravity by 2 degrees. In consideration of this increase, the brewer was to have the advantage of perfect freedom of choice as to the materials from which he made his beer. In this manner the use of certain materials has been legalised, as it were, and has been continued and increased with the knowledge and sanction of the excise authorities. This, alone, would show and prove to most people of average intelligence that there could be nothing very noxious in them, but, in spite of that, the so-called temperance party are clamouring for the prohibition of their use, and speak about them as if they were nothing less than poisons. We have already seen that these substitutes are not only harmless but certainly improve the beer, and, under the circumstances, it would certainly not be acting fairly to deprive the brewer of the right which he has been paying for during nearly 20 years. The Bill, as introduced into the House of Commons, provided that the words beer, ale, porter, and stout should be legal for such beverages as were brewed solely from barley, hops, water, and yeast, allowing 3 per cent. of sugar for priming and the use of hardening materials. Quite apart from the unfairness of such a law, it seems almost impossible to provide a sufficient supervision without great inconvenience and vexatious interference, especially as it is impossible to judge by analysis or other means whether or not the finished article was made from malt only. The Bill does not state whether the beverages which are not allowed to be called "beer" should continue to pay "beer" duty, and, in any case, the cost of collecting the duty would be enormously increased. It refers, also, to hops, and we will briefly inquire into the use of hop substitutes. There can be no doubt that the hop flower was used at a very early period for flavouring the beer; indeed, we find that some time in the earlier centuries the use of hops was prohibited by law, because it was said to be injurious. Still, during the hundreds of

years that beer has been brewed it has been found that hops are the best fitted for the special purpose. What object do we require the hops to fulfil in brewing? They serve to help the precipitation of certain nitrogenous matters during boiling; they act as an antiseptic and preservative, and this increases the soundness of the beer; they give to the beer an agreeable flavour and a certain bitterness; they act mechanically as a filter-bed, and help to separate the sludge from the wort; and, finally, in the process known as dry hopping, they facilitate clarification and conditioning.

A good many substances have been introduced at one time or another to serve as hop substitutes, but without doubt the hop flower is so far the only thing that will give all the effects above stated. We may get the bitterness or some of the other effects with some of these materials, but in none of them are all the qualities of hops to be found. Besides this, it seems to be the fact that certain substances have been used to give the bitterness, these substances being certainly injurious to the human body. I say, and without fear of contradiction, that such injurious substances are not used now by any brewer. The fact that the Somerset House authorities report that out of many thousand samples of beer analysed not one was found to contain noxious poisons or other adulterants proves my statement. This authoritative statement is very conveniently ignored by the temperance party, and in spite of it they have much to say on the admitted prevalence of adulteration of beer with injurious substances. But I would say that I also consider that the other substitutes which are not noxious should not be used, simply because they have not the full effect of the hops, and I am convinced that I cannot be far wrong if I say that no respectable brewer uses them at present. There might have been some excuse for their use in such years as 1882, but at the present time, when hops are so cheap, I would not defend it.

The general public have therefore, I believe, very little reason to find fault with the brewers for using such malt substitutes, always provided that these are themselves of fair quality. It goes without saying, that as there are good and bad malts so there are good and bad substitutes, and although I believe a beer brewed partially from good malt and substitutes is far better than one brewed from bad malt alone, still, one brewed from bad malt and bad substitutes

would certainly be objectionable. On the other hand, it is clear that a brewer who has been using bad malt for the sake of economy (I believe there are still some who believe in such false economy) could by the small decrease in cost caused through the use of substitutes, employ better materials and still effect some saving.

It is a generally accepted fact that beers, during the last 20 years, have slowly but decidedly decreased in gravity. It does not seem clear what is the exact course of events, viz., whether a taste for lighter beers has developed in the public, compelling the brewers to follow it, or whether the brewers began to brew a lighter beer and, as it were, educated the public. I believe that both processes went on at the same time, and that the taste of the public has received an impulse in the direction of lighter beers by increased facilities of travelling and the increased importation of Continental beers of the Lager type. At all events it is certain that beers are lighter now than they were, and it is also certain that if it were not for the use of substitutes the brewing of these light young beers, which are brewed to-day and drunk to-morrow, would be impossible.

How is it then with the case of the British farmers, who are at the bottom of the agitation? Well, if they are well advised, they will leave matters as they are. It is a delusion doomed to certain disappointment, if they believe that the passing of Mr. Quilter's Bill would bring the brewer back to the exclusive use of English malt; that would be impossible with the present character of the beers. Instead of maize, rice, and sugar, all of which are at present imported, in all probability larger proportions of foreign malt would be used, to the detriment of the British farmer. There could be only one way to mend matters from the farmer's point of view, and that would be the application of a heavy import duty on foreign malt, together with the prohibition of substitutes.

This I need hardly say, is beyond the pale of possibilities, and although we must own that the farmer is a great sufferer through the course of events, there does not seem to be any means of helping him. On the other hand, it is a fact that he has been a partial gainer by the change of 1880, because, since the malt is free from tax, it pays now to grow barley on land which formerly could not be used for that purpose, and he can sell barley for malting, which formerly could only be used for feeding purposes. It is, however

only fair to say that through the large increase of the use of substitutes this gain has to a large extent been lost again. We have now seen, Gentlemen, that, view the question from which point you may, the use of substitutes for malt with certain limits is always to be justified, and is even advantageous to the brewer and the public.

Opposition such as has been attempted in the Pure Beer Bill can only arise either from gross ignorance or from a desire to damage the trade, and in reality both causes are probably present. In face of the evidence I have laid before you, I can only appeal again to you and the whole of the Trade to spare no effort to have the matter examined in a fair spirit, and have it finally settled in the only way that is possible under the circumstances, viz., in favour of the continuance of the *status quo*.

No notes were taken of the discussion which followed this paper.