

**Reports on the successful application of methylated spirit, under the provisions of the Act 18 & 19 Victoria, cap. 38., to various purposes in the arts, manufactures, and scientific research, in 1856 : addressed to the Commissioners of Inland Revenue.**

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# REPORTS

ON THE

SUCCESSFUL APPLICATION

OF

# METHYLATED SPIRIT,

UNDER THE PROVISIONS OF THE ACT

18 & 19 VICTORIA, CAP. 38.,

TO VARIOUS PURPOSES IN THE

Arts, Manufactures, and Scientific Research,

IN 1856 ;

ADDRESSED TO

THE COMMISSIONERS OF INLAND REVENUE.



LONDON :

PRINTED BY GEORGE E. EYRE AND WILLIAM SPOTTISWOODE,

PRINTERS TO THE QUEEN'S MOST EXCELLENT MAJESTY.

FOR HER MAJESTY'S STATIONERY OFFICE.

1856.



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# REPORT

ON THE

## SUPPLY OF SPIRIT OF WINE,

*FREE FROM DUTY,*

FOR USE IN THE

### Arts and Manufactures,

ADDRESSED TO

## THE CHAIRMAN OF INLAND REVENUE,

BY

PROFESSORS GRAHAM, HOFMANN, AND REDWOOD,

IN 1854 AND 1855.





# REPORT

## ON THE

### SUPPLY OF SPIRIT OF WINE FREE FROM DUTY FOR USE IN THE ARTS.

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SIR,—We have the honour to report on the practicability of supplying for commercial purposes, a mixed spirit free from duty, without injury to the revenue,—a subject proposed to us for investigation in your letter of March 25, in the following terms :—

“The attention of Government, has for some time been directed to the importance of allowing spirit of wine, free of duty, for use in the arts and manufactures. In order that such a privilege may be granted with safety to the revenue, it is absolutely necessary that means should be devised by which the spirit may first be rendered unfit for human consumption. It is also indispensable—1st. That spirit, after being thus treated, should still be so pure as to be generally available for the purposes to which it is to be applied in the arts or manufactures. 2nd. That it should not be capable of purification by any simple process of rectification or otherwise, so as to be made palatable by the addition of sweetening or flavouring ingredients.

“It is also highly desirable, that while the mixed spirit should be rendered as offensive as possible to the taste or smell, no decidedly poisonous properties should be communicated.

“Some preliminary inquiries have been made into this subject. Mr. Phillips, one of our surveying-general examiners, has suggested a substance to be mixed in certain proportions with spirit which would interfere very little with its use in the arts, while it would render it highly unpalatable although not unwholesome. Dr. Hofmann, as you are aware, has made a number of experiments on spirits mixed in the manner suggested, and obtained



very promising results. It is therefore desirable that the subject should be more fully investigated.

"With this view, your attention is directed to the points already indicated, viz :—

"Whether and by what means, spirit produced in the ordinary mode can be rendered so offensive to the taste or smell, as to make it unfit for human consumption as a beverage, without materially impairing it, either for the manufacture of ethers, or as a solvent of gum resins, or for any of the purposes in the arts to which it is usually applied ?

"Whether, and to what extent, the mixed spirit would resist any process for its purification, or might be so compounded as to make it palatable ?

"To what branches of the arts or manufactures it would be safe or desirable to limit the privilege of using such mixed spirit ?

"In what manner, under what superintendence, and with what precautions, the spirit should be mixed ?

"The Board will also be glad to receive any suggestions of a practical nature, although not falling within the scope of this commission, which may occur to you in the course of your investigation."

Of the volatile substances which first suggested themselves as proper to be added to alcohol, in order to obtain the object proposed, the greater number were soon eliminated as unsuitable upon a close consideration or actual trial of their properties.

Sulphide of ethyl, and volatile sulphur compounds analogous to it, communicate their repulsive taste and odour when they are added to alcohol, even in a proportion so minute as 1 to 100,000 ; and are not removed from the alcohol by rectification or filtration through charcoal. But the sulphide of ethyl was easily separated from the alcohol by means of distillation after the addition of a little alkali, which is conclusive against its use.

The neutral volatile oils or essences are too easily removed from alcohol by means of dilution with water and distillation. The same objection applies to ordinary ether and to the compound ethers of all classes ; the compound ethers being further readily decomposed by distillation with an alkali.



The mixed oils, procured from wood and various other organic substances by the agency of destructive distillation, promised better results. The liquid distilled from caoutchouc, and known as *Caoutchicene*, which is distinguished by a powerful and highly characteristic odour, has the advantage of being composed entirely of neutral hydrocarbons, and is therefore not liable to be acted upon by either acids or alkalies. These hydrocarbons are also of various degrees of volatility, some of them boiling at a lower and some at a higher point than alcohol itself, which must increase the difficulty of their separation from alcohol by the process of rectification. For experiments in mixing, caoutchicene was prepared by distilling caoutchouc in a glass retort by a heat gradually rising to redness. The oil was redistilled till its temperature of ebullition rose to  $250^{\circ}$  centigrade, and the portion which came over below that temperature, amounting to about three-fifths of the original distillate, was alone employed. The caoutchicene so prepared, when mixed with a large proportion of alcohol, evaporates completely in air, and when used as a solvent of resins, leaves on drying an inodorous varnish.

The proportion of caoutchicene, which it was found most advantageous to use, was one part to 400 parts of strong alcohol, or 0.25 per cent. of caoutchicene. The spirit used in all the experiments to be described, was of specific gravity 0.828. Such a mixed spirit becomes milky and opaque when diluted with water, but it is remarkable that the caoutchicene exhibits no disposition to separate as an oil and come to the top, even when allowed to stand at rest for many days. Nor was the oil removed from the diluted mixture by agitation with the solvents of caoutchicene, such as benzole and colza oil. Filtration of the diluted mixture through wood charcoal removes the oil in part, but the caoutchicene odour remains seemingly unreduced in intensity. This mixed spirit, when distilled with one-eighth of its weight of potash, still retained the taste and odour of caoutchicene unaltered. When distilled with the same proportion of sulphuric acid, the odour of the mixed spirit was slightly modified, but still remained very decided. The odour of caoutchicene was not removed from the mixed spirit by chlorine.

500 measures of this mixed spirit were diluted with 250 measures of water, which produced turbidity, and distilled by a water-bath. The distillate first collected, amounting to 166 measures, was of



specific gravity 0·869 ; it became turbid by water, had the rank odour of caoutchicene, and was quite unpotable. The second portion of the distillate, amounting to 380 measures, of sp. gr. 0·888, was less offensive, but its odour was still peculiar and disagreeable ; the taste of caoutchicene was also sensible and persistent. This distillate became milky with water, and the odour was then more repulsive. The third portion of the distillate, which contained all that remained of the alcohol, amounted to 62 measures of sp. gr. 0·955. It was turbid, from the more fixed oils having distilled over, and possessed the strong rank taste and odour of caoutchicene.

The second distillate, described above as amounting to 380 measures, of sp. 0·888, was again diluted with half its bulk of water, and distilled at 212°. The first portion of distillate, amounting to 166 measures, of sp. gr. 0·893, became very turbid with water, and had a highly decided odour and flavour of caoutchicene, becoming insupportable on the tongue after evaporation of the alcohol. The second portion of the distillate, amounting to 177 measures, of sp. gr. 0·930, was still decidedly marked by the odour of caoutchicene, particularly on dilution, when it became only slightly opalescent. This, which was the most highly purified portion of the distillate, was evidently a spirit which would not be saleable as a beverage.

In another experiment 500 measures of the mixed spirit containing caoutchicene were first distilled, and 420 measures drawn off. This distillate became turbid with water and had the offensive odour of caoutchicene. Mixed with half its bulk of water the liquid was redistilled and three fractions collected. The first distillate, amounting to 182 measures, of sp. gr. 0·875, became milky with water, and retained the repulsive odour and taste of caoutchicene in a striking degree of intensity. The second fraction, amounting to 297 measures, of sp. gr. 0·905, became opalescent with water, and had a distinct odour, not very unpleasant, and a taste allied to that of a minthy essential oil. The odour and taste became more highly marked on the addition of water. The third distillate, amounting to 288 measures, of density 0·987 and very aqueous, was offensive in taste and odour.

The second fraction above, which was the most highly purified portion of the liquid, was itself submitted to a new distillation, and brought over in three portions of sp. gr. 0·865, 0·866, and



0.905 respectively. All of them retained a decided taste and odour of caoutchicene.

These experiments show that much of the caoutchicene in the mixed spirit can be separated by repeated distillations, but that a portion adheres to the alcohol with considerable pertinacity. Enough of the caoutchicene appears to be retained in all circumstances to render the alcohol unpalatable as a beverage. On the other hand, the intense and disagreeable odour of spirit so mixed would considerably limit its applications. The odour would not be tolerated in dwelling-houses, nor in shops and warehouses frequented by the public, and the use of the mixed spirit would probably therefore be confined to manufactories.

Our attention had been particularly directed to wood-naphtha (crude pyroxylic or methylic spirit) as the substance to be added to alcohol, by the previous experiments of Mr. G. Phillips and of Dr. Hofmann on the use of that liquid. The application of crude wood-naphtha depends partly upon the empyreumatic oils which it contains, and partly upon the methylic spirit and other substances miscible with water, which constitute the mass of the liquid. It was necessary to examine separately the influence of these two classes of constituents, and first of the empyreumatic oils.

In one series of experiments, a specimen of the oils which had been separated from wood-spirit in the process of purifying that liquid, was used as the flavouring substance. Two per cent. of these oils were dissolved in spirits of wine. This mixed spirit had the strong characteristic odour of crude wood-naphtha, became milky when mixed with water, and was highly unpalatable.

When this mixed spirit without any addition was simply distilled by the heat of a water-bath, a small quantity of a dark-brown tarry matter was left behind in the retort, and the proportion of oils in the distilled spirit was greatly reduced. This mixed spirit appeared to be further purified when distilled from anhydrous sulphate of copper, from the potosulphate of iron, or from persulphate of iron. But none of these distillates was potable, and all became turbid with water. The flavour of the same mixed spirit was improved by distillation with one-eighth of its weight of sulphuric acid, but the liquid was still not potable. When the last distillate was again rectified from one-twentieth of its weight of potash, the rank odour of the oils



disappeared in a great measure, the odour now retained resembling that of benzole. An attempt was made to remove the odour last described, by diluting the liquid with water, and passing it in the state of vapour over animal charcoal, but the liquid still retained the benzole odour, and was precipitated by water.

The greatest amount of purification was obtained by distillation from potash or lime, the alkali keeping back the creosote; but the mixed spirit still retained the tarry smell of benzole, and was turbid with water. When the mixed spirit so far purified by means of alkali was diluted with water and again distilled, the first half of the new distillate was turbid with water, and even formed a layer of oil on the surface. But the second half of the distillate did not become turbid with water, showing that the benzole product comes off first. This last portion of the alcohol appearing to be restored to a fair degree of purity, it became doubtful whether much dependence could be placed upon the oils of wood-naphtha, for the purpose of mixing, apart from the methylic spirit of the naphtha. An experiment was made with pure benzole itself, mixed in the proportion of one part of benzole to ninety-nine parts of strong alcohol. A considerable portion of benzole was separated from this mixture by dilution with water, the benzole forming an oily film on the surface of the liquid. The liquid, however, continued milky and retained a strong odour of benzole. When this mixed spirit was diluted with three times its volume of water, and slowly rectified, the first half of the distillate contained much benzole, and became milky with water, while the second half of the distillate did not become turbid with water, and appeared to contain very little benzole. This result affords a very strong presumption that benzole is removable by rectification from alcohol when diluted with water.

Three additional and still more extensive series of experiments were made by means of different varieties of crude wood-naphtha, as this substance varies considerably in composition. Two of the varieties were procured from Messrs. Turnbull and Co., of Glasgow, one of which was described as "of full strength, but concentrated without destroying the oils;" the other described as taken "at an earlier stage of the process, half strength, and containing more oils than the last." The third material operated upon was a mixture of strong alcohol with five per cent. of crude naphtha, prepared at the laboratory of Inland Revenue by



Mr. Phillips. But after what has been already said it is unnecessary to enter into the details of those experiments, as the results were similar to the first series. The oils were, in a great measure, removed from the mixed spirit by simple distillation, or by distillation from potash, and the distilled spirit was chiefly characterized by the taste and comparatively mild odour of methylic spirit or pure wood-spirit. The specimens became as little offensive as alcohol mixed with Turnbull's purified wood-naphtha; and there appeared, therefore, to be no great advantage in using the crude naphtha for mixing in reference to a purer wood-spirit. The question reduced itself to the applicability of pure wood-naphtha for the object in view.

The wood-naphtha hereafter used for mixing with alcohol was of the comparatively pure quality in which it is supplied to the public by Messrs. Turnbull and Co., at the price of 8s. 6d. per gallon. This wood-naphtha was nearly colourless; it mixed with water without becoming turbid in the least degree, and contained no more than a small trace of the oils which give a rank and repulsive odour to many species of wood-naphtha. The odour of this purified wood-naphtha was not disagreeable, although well marked and characteristic, being due principally to methylic spirit. The specific gravity of this naphtha was 0.815, and its boiling point 151° F. When thoroughly dehydrated by being distilled three times from half its weight of anhydrous sulphate of copper, one gallon of the liquid gave by fractional distillation the following series of liquids, each amounting to about a pint:—

1st distillate	of sp. gr.	0.8067	; boiling point	143.6°F.
2nd	"	0.8047	"	143.3° "
3rd	"	0.8031	"	146.5° "
4th	"	0.8028	"	146.5° "
5th	"	0.8016	"	148° "
6th	"	0.8008	"	150° "
7th	"	0.8009	"	151° "
8th	"	0.8015	"	151° "

Fractions 1 and 2 distilled again together from anhydrous sulphate of copper, retained the low boiling point 143.5°, and had the mean density 0.8057, which is a liquid possessing the lowest boiling point that has been assigned to methylic spirit, but with a somewhat higher specific gravity, the specific gravity of pure



methylic spirit being about 0.800. None of the fractional portions appear to be a single substance. The methylic spirit is probably accompanied in the earlier fractions with acetone of sp. gr. 0.792 and boiling at  $132.8^{\circ}$ , and acetate of methyl of sp. gr. 0.908 and boiling at  $144^{\circ}$ ; while some third liquid, of which the nature is unknown, must be present to impart the high boiling point combined with a low specific gravity which distinguishes the latter fractions of the distillate.

The presence of five per cent. of this purified wood-naphtha in strong alcohol is easily recognized by its taste and odour, and is more than sufficient to render spirit unsaleable as a beverage, as has been ascertained upon good authority. At the same time the odour of the mixed spirit on evaporating in air is by no means offensive. In solvent power such a mixed spirit is indistinguishable from pure alcohol; and varnishes made by means of it dry readily and acquire no odour or peculiar character from the menstruum. Farther, no practicable means of separating the methylic spirit again and recovering the spirit of wine in a state of purity and suitable as a beverage, appear to exist; while the substance which destroys the potability of the mixed spirit, without impairing its value for many useful purposes, is not itself poisonous or unwholesome, wood-naphtha, as is well known, having been used to some extent in medicine. The purified wood-naphtha, appears indeed to be singularly well adapted for the preparation of a mixed spirit such as the Government desires to supply duty-free to manufacturers. At the same time a mixed spirit containing ten per cent. of the purified wood-naphtha appears to be preferable to a five per cent. mixture, from the greater facility of recognizing the wood-naphtha in the larger proportion, particularly when disguised by the presence of other volatile and odorous substances. A ten per cent. mixture might therefore be issued in the first instance, and the proportion of wood-naphtha be reduced at a later period if it was found that the change could be made with safety to the revenue. It is accordingly a ten per cent. mixture which we have had tested for the various useful applications of alcohol, because if this mixture was found to meet the requirements of trade, the suitability for the same purposes of any mixture containing a less proportion of wood-naphtha might be safely assumed.



Although wood-naphtha (methylic spirit) and alcohol are of unequal volatility, there being a difference of about thirty degrees between their boiling points, yet no sensible separation of these liquids can be effected by distillation. Both the five and ten per cent. mixtures described were submitted to fractional distillation; but wood-naphtha was found in all the fractions. Even the last eighth portion of the five per cent. mixture, which was not distilled over, but was left behind in the retort, contained abundance of wood-naphtha, the more volatile constituent. In another experiment, to be described in the sequel, rectification repeated several times failed equally to eliminate the smallest portion of pure methylic spirit from the mixed spirit. The reason of this is, that alcohol which boils at the higher temperature has a denser vapour than methylic spirit, in the proportion of 1.600 to 1.125. The less volume of alcohol vapour which distils over at the boiling point of the mixed spirit is compensated for by the greater weight of that vapour, so that the proportion between the constituents of the mixed spirit appears to be little if at all disturbed during the progress of the distillation.

The similarity in chemical constitution of methylic spirit and spirit of wine, both being alcohols, is attended with a remarkable analogy in properties between the two substances, which appears to render their separation by chemical means also a problem of great, if not insuperable, difficulty.

Methylic spirit forms a solid crystalline compound with chloride of calcium,—a property which is taken advantage of in purifying methylic spirit, for scientific purposes, from the other liquids by which it is accompanied in wood-naphtha. Our mixed spirit being first carefully dehydrated by means of sulphate of copper, and reduced to a specific gravity of 0.801, was then mixed with chloride of calcium, in excess, so as to form a thin paste, and distilled by a water-bath heat. Methylic spirit was easily discernible by its odour in the distillate which came over; so that the presence of ordinary alcohol in a large relative proportion appears to prevent the combination of methylic alcohol with chloride of calcium, or to decompose such a compound when formed: for ordinary alcohol, as well as methylic alcohol, has a considerable affinity for the salt in question. When water was subsequently added to the chloride of calcium nearly dry in the retort, and the heat renewed, a liquid came over which possessed a



peculiar and disagreeable odour, but appeared to be chiefly composed of ordinary alcohol. This liquid should have been methylic spirit if the experiment of separation had been successful.

The attempt was also made to purify the alcohol of our mixed spirit from its accompanying methylic spirit, by passing the vapour of the two liquids through a long glass tube containing fragments of chloride of calcium, which was kept at a temperature of  $212^{\circ}$  during the experiment. No absorption, however, of the methylic spirit by the chloride of calcium occurred, but the salt remained unaltered, and the alcohol distilled over and condensed with its original proportion of methylic spirit.

Several experiments were also made on the oxidation of the mixed spirit by means of various proportions of the mixture of bichromate of potash and sulphuric acid, with the view of oxidising and removing the methylic spirit; but without success. The oxidation products were acetic acid and formic acid, accompanied by much aldehyde, and indicated the decomposition of the alcohol as well as of the methylic spirit.

Sulphuric acid is very useful for discovering the presence of common alcohol when mixed with wood-spirit, from the ready production of ordinary sulphuric ether. But for the converse problem of separating a small proportion of wood spirit from a large proportion of alcohol, sulphuric acid appeared to be wholly inapplicable.

Oxalic acid employed to etherise the mixed spirit seemed at first to promise better results, as the methylic oxalic ether appeared to form more easily than the corresponding ethylic ether. After the cohobation of the dehydrated mixed spirit with oxalic acid for several hours, the liquid which came over on distilling was alcohol with the proportion of methylic spirit apparently considerably reduced. This alcohol always contained portions of the oxalic ethers, and was liable to become acid from the gradual decomposition of these ethers. The flavour of the methylic spirit, which is at first covered by the rum-like flavour of these ethers, would no doubt come out with time, and prove, as usual, highly disagreeable. No economical process for the purification of the mixed spirit could, we believe, be founded on the action of oxalic acid.

The conclusion from much investigation is, that the removal of wood-naphtha from the ten per cent. mixed spirit, and the



restoration of its potability by any simple and economical process is a most unlikely occurrence. We apprehend no danger whatever to the revenue from this source. The mixture of spirits of wine with ten per cent of purified wood naphtha or methylic spirit, which we recommend, may be designated *methyated spirit* for convenience.

The quantity of wood naphtha which can be commanded appears to be amply sufficient for the new contemplated application of that substance. We are indebted to Mr. John Turnbull for his valuable opinion on this point. "My calculation regarding wood-spirit," that gentleman states, "is a produce of two gallons and a half from a ton of average dry wood, and the production of the United Kingdom amounts annually to 66,000 gallons. This I take as the proceeds of nineteen manufacturers of pyroligneous acid; although you must receive it as a rough guess, still I believe it is not very far from the truth." Much wood-naphtha is also attracted to this country from the continent, owing to the high price which that liquid obtains here as a substitute for alcohol.

We have been favoured with the opinion of Mr. G. Smith, of Whitechapel, one of the most extensive London distillers, on the application of our methyated spirit as a beverage. He pronounces the methyated spirit to be quite unfit for the use of the rectifier. He believes that publicans would never use such a spirit for mixing with their liquors, even in a small proportion. A mixture of gin with one-eighth part of the methyated spirit was found to be nauseous and unpalatable. In gin mixed with one sixteenth of methyated spirit, the flavour of the latter was still very strongly marked. In gin with one part of methyated spirit in thirty-two, the flavour of the methylic spirit became faint, but it was still perceptible in a mixture of one to sixty-four. The largest proportion of the methyated spirit which it was thought a publican might venture upon adding to his gin was one in thirty-two. Now, the saving to him would be the same fraction of the spirit duty, or proportion of 6s. 2d. per gallon, the duty on spirits of the strength of gin—that is, a profit of 2½d. per gallon. So small a profit would be no compensation for the deterioration in the quality of the gin. The disagreeable odour of the methylic spirit is brought out strongly on mixing the gin with hot water.



The consumption of sweetened and highly flavoured cordials appears to be greatly inferior to that of gin; a publican in large business, who may retail 1,200 gallons of gin per month, not disposing of more than ten or twelve gallons of cordials in the same time. The substances chiefly used in flavouring cordials are carraways, cloves, and aniseed. The methylated spirit could not be used for any of these liquors. Indeed, from their being generally made use of to give an extempore flavour to gin at the option of the customer, more than usual attention must be paid to their own purity of flavour.

The flavour of brandy is too delicate to be tampered with, by the addition of the smallest proportion of methylated spirit. The addition of the latter substance to whisky would require to be guarded against, from the predilection of the consumers of that spirit to a smoky flavour. An experiment has been related to us in which methylic spirit was employed for the sake of its flavour by a Scotch distiller, and mixed with spirits in the minute proportion of one gallon to 1000 gallons. The flavour, although not objected to in the whisky when newly mixed, became rank and disagreeable in the course of two months. The mixing of methylated spirit with that low quality of rum known as Leeward Islands rum, is also to be apprehended, from the great impurity of that spirit, which would render any additional contamination less obvious to the palate. But when the liquid is deliberately examined, the presence of methylic spirit could not escape detection.

Strong alcohol of not more than 0.830 specific gravity should be employed as the basis of the methylated spirit. As the uniformity in quality of the wood-naphtha employed for mixing is important, it should be approved of by the Excise, and also added to the spirit under the inspection of an Excise officer. It appears to us that it would be proper to mix the spirit in the distillery, and to declare illegal the possession of the methylated spirit by a rectifier or publican. The retail sale of the methylated spirit would then fall into the hands of oilmen and druggists, who would be supplied directly by the distiller, or through the agency of a wholesale druggist or drysalter.

Although it appears scarcely probable that the methylated spirit will ever find its way into public-houses, it is, nevertheless, desirable to possess means by which, in cases of misapplication,



the presence of wood-naphtha could be readily detected and proved in the suspected liquid. The methylated spirit which was operated upon consisted of ninety measures of spirit of wine, of density 0.828, mixed with ten measures of wood-spirit of density 0.815, and had a density of 0.823, as has been already stated, and boiled about  $170^{\circ}$ . When the methylated spirit was deprived of all water, by distillation from anhydrous sulphate of copper, it boiled at  $169^{\circ}$ . These temperatures are both very sensibly under  $172^{\circ}5$ , the lowest temperature at which absolute alcohol or any mixture of pure alcohol and water can boil. The possession by a sample of spirits of a lower boiling point than the last, would indicate sophistication, particularly if the low boiling point was retained after rectification of the spirits from sulphate of copper, and the fact would suggest the existence of wood-naphtha in the spirits.

The attempt to identify wood-naphtha in spirits by means of chemical tests, must obviously be attended with great difficulties, for the very applicability of wood-naphtha for the purpose of producing an unpotable mixture which can be given to the public without fear of endangering the revenue, excludes the possibility of an easy separation of the two substances; and it may be at once stated that the experiments made with the view of finding an efficient chemical process for the identification of methylic spirit have been unsuccessful, and deserve to be noticed chiefly as affording additional illustrations of the safety of the mixture which is proposed. Fortunately, methylic spirit, even when highly purified,\* so as to become deprived of all the tarry and empyreumatic smell which it generally exhibits, possesses so characteristic and persistent an odour and taste, that after a little experience it is not difficult to detect its existence, even when it is highly diluted or masked by the presence of other flavours.

Among the properties of the two alcohols on which possibly a separation might be founded, the different volatility of the two liquids at once suggested itself: absolute alcohol boiling at  $173^{\circ}$  Fahr., whilst absolute methylic spirit boils at  $143^{\circ}$  Fahr. In order to test this process, half a gallon of the methylated spirit was submitted to distillation at a comparatively low tempera-

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\* By conversion into methyl-oxalate, decomposing this substance by ammonia, concentrating the reproduced spirit, and rectifying over anhydrous sulphate of copper, which retains also the ammonia.



ture, and in an apparatus which allowed the less volatile liquid to condense. The first quart which passed over was again distilled, the first pint being collected apart, and so on, until at last one sixteenth of the original bulk of the liquid was obtained as the most volatile portion. This liquid was repeatedly distilled over anhydrous sulphate of copper to remove any water which it might retain; it was found to boil between  $168^{\circ}$  and  $169^{\circ}$ , showing that the methylic spirit had been scarcely concentrated by this process. This fact, which at the first glance appears contrary to general experience, has been already explained; it is due, to a certain extent, to the difference of the vapour-densities of the two alcohols; for it is obvious that the smaller amount of alcohol-vapour which forms during distillation, on account of the higher boiling point of alcohol, must be compensated within certain limits by the greater weight this vapour possesses when compared with that of an equal bulk of methylic spirit vapour.

The isolation of the methylic spirit by a series of fractional distillations having proved impossible, the mixture was now boiled for several hours with dehydrated oxalic acid, in order to produce the oxalates of methyl and ethyl. The difference in the boiling point of the two ethers ( $363^{\circ} - 321^{\circ} = 42^{\circ}$ ) is not much greater than that which is observed with the alcohols from which they are derived. Oxalate of methyl being at the common temperature a solid crystalline substance, while oxalate of ethyl (true oxalic ether) is a liquid, it was hoped that the fractionation of the mixture of the two ethers might be more successful, and that by repeated distillation at last a product might be obtained in which the more volatile methyl-oxalic ether should predominate to such an extent as to crystallise. Experiment, however, showed that the presence even of a minute quantity of the former ether prevents the latter from assuming the solid form.

In studying the action of oxalic acid upon the methylic spirit, it had been observed that if a smaller amount of oxalic acid be used than is necessary for the etherisation of the entire quantity of the mixture, the methylic spirit appeared to be converted into ether with greater facility than the alcohol. Experiments were accordingly made with the view of isolating the methylic spirit by means of this reaction. The mixture was partially etherised by oxalic acid, and then submitted to distillation in order to separate the alcohol which had not been acted upon by the acid.



The residuary liquid, consisting chiefly of methyl-oxalic ether, was decomposed by distillation with water. The reproduced spirit certainly contained a larger amount of methylic spirit than the original mixture; nevertheless the quantity of alcohol which it retained was so considerable that the advantages gained by the process did not appear to be in proportion to the amount of time and labour which its practice requires. A further concentration might be obtained by a repetition of the process; but this would render it so tedious and troublesome an operation as to preclude the possibility of using it as a routine test for the purpose of recognising the presence of methylic spirit in a suspected liquid, although the process might be available for identifying and isolating that substance in cases of dispute.

Under the influence of oxidising agents, methylic spirit furnishes, together with other products, a considerable amount of formic acid, whilst alcohol under these circumstances yields principally acetic acid. Formic and acetic acids, although closely allied in composition and general characters, still offer a greater number of points of difference than the two alcohols which they represent. Formic acid may be readily distinguished from acetic acid by the facility with which the former precipitates the metals from the solutions of the more easily reducible metallic oxides, such as oxide of silver or oxide of mercury, which are not affected by acetic acid. Unfortunately this method of testing became inapplicable, since it was found that alcohol free from methylic spirit, when submitted to the action of oxidising agents, invariably yields, in addition to aldehyde, which can be resinified and removed by potash, a small quantity of formic acid; so that the presence of formic acid among the products of oxidation of a suspected liquid cannot with certainty be regarded as an evidence of the existence of methylic spirit in the original liquid.

It is well known that ordinary alcohol, when heated with an excess of concentrated sulphuric acid, furnishes, in addition to sulphurous acid, a considerable amount of olefiant gas. Methylic spirit, under the same circumstances, gives rise to the formation of a heavy oily liquid, which is insoluble in water, and consists chiefly of the neutral sulphate of methyl. The same liquid was obtained, together with olefiant gas and sulphurous acid, when the methylated spirit was distilled with eight or ten times its weight of concentrated sulphuric acid. But on careful examination it



was found that alcohol alone, when submitted to similar treatment yields likewise, in addition to olefiant gas, the chief product of the reaction, a small quantity of oily products (heavy oil of wine, &c.); so that the production of an oily substance from a suspected liquid by the action of an excess of sulphuric acid ceases to be an indication of the presence of methylic spirit in such liquid.

The action of sulphuric acid upon the two alcohols produces a very different result if the latter are in excess. Alcohol and methylic spirit under these circumstances exhibit the same deportment, the former yielding ether (common sulphuric ether), while the latter is converted into methyl-ether. It is, however, well known that the etherisation of common alcohol proceeds with far greater ease than that of methylic spirit. Accordingly, the methylated spirit was submitted to the ordinary continuous etherisation-process (ten parts of wood-spirit being successively exposed to one part of sulphuric acid). It was expected that after the evolution of the ether capable of being formed under these circumstances, the methylic spirit would remain behind as sulpho-methylic acid. But the residue, neutralised with lime and distilled with water, or with solution of potash, furnished no spirit, but an aqueous liquid in which no methylic spirit could be detected.

When anhydrous baryta is dissolved in dehydrated methylic spirit, a combination is formed, which crystallises in lustrous needles, and consists of equal equivalents of methylic spirit and baryta. This substance was found to resist the action of water; even when boiled with water, it gave up no methylic spirit. It was possible that alcohol might differ in this respect; but although no crystals were observed, nevertheless a similar compound, with analagous properties, appeared to be formed; a solution of anhydrous baryta in absolute alcohol, when distilled with water, yielding scarcely a trace of alcohol.

Lastly, a few experiments were made with the view of establishing the presence of methylic spirit in alcoholic mixtures by the dark yellowish brown colour wood-spirit assumes when left for some time in contact with either solid hydrate of potash or soda. But it was found that the brown colour assumed by methylic spirit was only little more intense than that which alcohol shows when similarly treated. Moreover, it seems to be chiefly due to the impurities, the colouration becoming less and



less marked the greater the care bestowed upon the purification of the methylic spirit; the pure methylic spirit obtained by decomposing methyl-oxalic ether showing, within a moderate time, no colouration whatever, either when left in contact in the cold, or when boiled with solid hydrate of potash or soda.

The principal uses to which spirit of wine is, or may be, applied, independently of its use as a beverage, appear to be the following:—

As a solvent of resinous substances, which, when thus dissolved, are used in the manufacture of hats, and otherwise as varnishes. As a solvent employed in the manufacture of many chemical preparations, including the alkaloids and other organic products, which are principally used in medicine. For the production of ether, chloroform, sweet spirit of nitre, and fulminating mercury. For burning in spirit-lamps as a source of heat, and for mixing with oil of turpentine or other hydrocarbons for burning in lamps as a source of light. As a solvent and menstruum for administering the active constituents of animal and vegetable substances used in medicine in the form of tincture, spirit, &c. As a solvent of essential oils and other odorous substances used in perfumery.

1. Spirit of wine is largely used for dissolving the resins employed by hatters and varnish-makers.

In the manufacture of *hats*, shellac, dissolved either in spirit of wine or in impure methylic spirit (known as wood-naphtha), is used for giving stiffness and elasticity to the felt or other foundation of the hat, and for causing the adhesion of the nap. When wood naphtha is used for this purpose, it is necessary to make a selection of those commercial samples which are found to be most suitable. Some varieties of wood-naphtha are imperfect solvents of the resins, and are therefore inapplicable for the purpose; but even among those samples which freely dissolve the resins there is much difference in quality, commercial methylic spirit being always a mixed and very variable product, some of the constituents of which exert an injurious effect in the varnishes made with it. Spirit of wine is preferred to wood-naphtha for hat making, being, in the state in which it is met with in commerce, more uniform in quality and less contaminated with foreign matters. Hatters state that when the felt has been stiffened with shellac dissolved in spirits of wine, the felt retains its elasticity



after it has been dried and hardened, without being much affected by atmospheric changes or exposure to wet, and it does not readily crack or break on being bent. But when the felt has been stiffened with shellac dissolved in naphtha, the hat, while it retains its stiffness is liable to crack on being bent, and it readily loses its stiffness and elasticity when wetted or exposed to a damp atmosphere. Wood-naphtha is, therefore, used only on account of its low price, the quality of the hats in the manufacture of which it has been used being inferior to that of hats made with solution of shellac in spirit. In those instances in which, from competition in price, the hat-maker is obliged to use wood-naphtha, it is found necessary to use more shellac than would be required if spirit of wine were the solvent, in order to give the required stiffness and elasticity. The weight of the hat is thus increased, sometimes to the extent of several ounces, in order to compensate for the deteriorating effect produced by the naphtha. English hatters generally complain that they have to compete with foreign makers under a disadvantage, in consequence of the high price of spirit in this country.

In the manufacture of *spirit varnishes*, which are applied to other purposes than that of hat-making, both spirit of wine and naphtha are used for dissolving the resins. Among the varnishes of this description are included French polish and lacquer, the consumption of which, as also of other spirit varnishes, is very great. Varnishes made with spirit of wine are considered to be better in quality than those made with naphtha. With regard to French polish, those who are practically engaged in the use of this varnish say that when it is made with wood-naphtha it is not so easily worked, and does not afford so durable and serviceable a polish as that made with spirit of wine. The disagreeable smell evolved during the evaporation of the wood-naphtha is also objected to, especially when the polish has to be applied to furniture in private houses, or in the warehouses of upholsterers which are visited by customers. In the manufacture of lacquer for brass and other metals, and of other sorts of spirit varnish, there are also equally strong objections to the use of wood-naphtha as a substitute for spirit of wine. Hitherto the French have been considered to excel us in lacquered goods, which may no doubt be ascribed to the superiority of their lacquer, in the manufacture of which they always use spirit of wine for dissolv-



ing the resins. English manufacturers, on the other hand, notwithstanding the inferiority of lacquer and other varnishes made with wood-naphtha, use large quantities of that solvent, in proof of which an extensive varnish-maker informed us that his consumption of wood-naphtha was equal to that of spirit of wine. There is reason to believe that if spirit were supplied to manufacturers duty free, the use of spirit-varnishes would be greatly extended, and varnished ornamental woods would frequently be substituted for painted deal.

Among the purposes to which spirit varnishes would be more generally applied, if spirit were cheaper, may be mentioned the manufacture of paper hangings, and especially those in which imitation gold leaf ("leaf metal") is used, which, unless protected with varnish, soon become tarnished by the sulphuretted hydrogen always present in a town atmosphere. Not only for gilt papers, however, but for many others, and especially those used in staircases, would the application of a good spirit varnish be advantageous.

Another application of spirit varnish would be in the production of waterproof papers, to be used as wrapping-paper for steel goods, for the construction of envelopes for transmission by sea, for the manufacture of military cartridges, &c.

Among the productions of ornamental stationery, there is a class of paper, with embossed patterns, originally called Morocco paper, but which, on account of the variety of the patterns, now appear under the more general designation of varnished papers which are very extensively used, especially for book-binding, and for cardboard box-making; and in the production of these papers the English manufacturer is at present precluded, by the high price of spirit of wine, from the use of spirit varnish. It is admitted that this manufacture would be greatly improved by the employment of spirit varnish, as the papers, when made as at present, with oil varnish, are not adapted for exportation, on account of their liability to become heated and to adhere together.

In some of the applications of leather, the employment of spirit varnish would be a great advantage, especially in book-binding. At present its use is restricted by the high price of spirit to the better class of bound books, but its employment not only increases the beauty of the work, but serves to protect the



leather, and there can be no doubt that, if spirit were cheaper, its use for this purpose would be greatly extended.

In the application of spirit of wine as a solvent of resinous substances for the purposes already referred to, it is not necessary that the spirit should be pure; but it is important that whatever foreign matter may be mixed with it shall volatilise without producing a very disagreeable odour, and that the resins shall be left, after the drying of the varnishes, unimpaired in quality and free from any offensive smells derived from the solvent.

There is reason to believe that a considerable quantity of illicit spirit is supplied to a certain class of hatters and varnish-makers, to the injury of the revenue and of the honest manufacturer. We are informed that this illicit spirit is sold for about 12s. per gallon, at 60 over proof.

As the employment of spirit for dissolving resinous substances appears to be the most extensive and important of its applications in the arts and manufactures, it was necessary to ascertain whether spirit mixed in the manner proposed in this Report is applicable for such purposes. With a view of determining this point, experiments were made by ourselves, and were also kindly undertaken, at our request, by gentlemen practically engaged in the several departments of manufacture referred to. The results have fully satisfied us that the methylated spirit is suitable for all these applications. We are indebted for much valuable assistance, in reference to this part of our inquiry, to Messrs. J. T. and E. Christy and Co., and Messrs. Cooper, Box and Co., hatters; to Mr. Rea and Mr. Heywood, varnish-makers, and to Mr. Warren De la Rue.

2. Spirit of wine is employed as a solvent in the manufacture of many chemical preparations, including the alkaloids and other organic products, which are principally used in medicine. In manufacturing the alkaloids derived from the cinchona barks, spirit is used in one part of the process. Indeed, alcohol appears to be the best and most general solvent for this class of substances. It is used in the manufacture of veratrine, and is required for crystallising morphine, although this alkaloid may be prepared from opium without spirit. It has hitherto been the object of English manufacturers to discover processes for the preparation of chemical products without the use of spirit, and



such processes are sometimes adopted to the injury of the product. Spirit of wine may be advantageously used in the preparation of some inorganic salts, such as protosulphate of iron, which, when precipitated from its aqueous solution by means of alcohol, is less subject to change from exposure to the air than it is when crystallised in the usual way. The resinous constituents of jalap and scammony which are used in medicine are separated from the drugs by means of spirit of wine, and the use of this solvent might no doubt be greatly extended for similar purposes with advantage. In some cases the manufacture of chemical products has been lost to English manufacturers in consequence of the high price of alcohol or of ether which is made from alcohol. Thus, pure tanin, the preparation of which involves the loss of a large quantity of ether, is imported from abroad at a price at which it cannot be produced at home. Among this class of productions, involving the use of spirit of wine as a solvent, may be mentioned transparent soap, a pure and elegant preparation for the toilet, which is much used in those countries in which alcohol is cheap, but which, from the high price of the solvent, is but rarely made and little used in this country.

For all the purposes here referred to, the methylated spirit appears to be applicable. In addition to our own experiments we have been favoured with a statement of results obtained by Mr. T. N. R. Morson in the preparation of chemical products, and by Mr. Pears in the manufacture of transparent soap.

3. Spirit of wine is used as an ingredient for the production of ether, chloroform, sweet spirit of nitre, and fulminating mercury. These are important articles of manufacture, the first three articles being valuable medicinal agents, and the last-named being used for making percussion caps for fire-arms. Ether and chloroform are also made use of on account of their solvent power, especially the former. Sweet spirit of nitre is used exclusively in medicine, but being a popular remedy the quantity used is very considerable. We may state with reference to this article, that it is made by distilling a mixture of spirit of wine and nitric acid, and that when properly prepared it consists of a solution of a small quantity of nitrous ether in spirit of wine. The proportion of nitrous ether present is extremely variable, and in some commercial samples is so small as merely to impart



a slight flavour to the spirit ; which flavour, moreover, is by no means disagreeable. From information derived from those practically acquainted with the commerce of this article, it may be inferred that a large proportion of the sweet spirit of nitre now used is made from illicit spirit, the price at which the wholesale dealer can purchase sweet spirit of nitre being less than that at which it can be produced with spirit on which the duty has been paid. It is scarcely to be expected that spirit which has been rendered permanently unpotable can be used for making sweet spirit of nitre, as the peculiar and unobjectionable flavour of that compound is the popular test of its good quality. When made with the methylated spirit, the compound acquires a disagreeable flavour, which is more especially developed on diluting it with water ; and it is impossible to recover the alcohol again in a pure state from such sweet spirit of nitre. On the other hand, the separation of pure alcohol from good potable sweet spirit of nitre such as the public are accustomed to use and require, is attended with no difficulty. It appears improbable, therefore, that any regulations could be devised for the preparation of sweet spirit of nitre from duty-free spirit, which could be adopted with safety to the revenue.

Ether and chloroform may be made with the methylated spirit, and when the products have been purified in the usual way they do not appear upon a superficial examination to differ from those made with pure spirit. Upon allowing them slowly to evaporate, however, a peculiar and disagreeable odour becomes perceptible, towards the end of the evaporation. This impurity would probably preclude their application for most medicinal purposes, for which they are required to be pure, or at least to be free from any foreign flavour either in taste or smell. When used as solvents, the same degree of purity is not generally essential, and we believe that ether and chloroform produced from the mixed spirit are perfectly applicable for most manufacturing purposes.

Fulminating mercury is produced from mercury, nitric acid, and alcohol, and in consequence of the large quantity of alcohol consumed in the process the price of the product is greatly influenced by the cost of this ingredient, so that the English manufacturer has found it difficult to compete with those who can command cheap spirit. We are informed that most of the fulminating mercury now used in this country is either made



from illicit spirit, or is brought from the Channel Islands, where the low price of spirit offers an advantage to the manufacturer. The methylated spirit is applicable for this manufacture.

We have been aided in this part of our inquiry by the information kindly afforded to us by Mr. Alfred White, Mr. Charles Davy, and Mr. F. Joyce.

4. A considerable quantity of spirit of wine is sold by retail dealers, chiefly chemists and druggists, for burning in lamps as a source of heat, including its application for singeing horses. It is also mixed with oil of turpentine or other hydrocarbons for burning in lamps as a source of light. The methylated spirit is quite suitable for such applications.

5. Spirit of wine is used as a solvent and menstruum for administering the active constituents of animal and vegetable substances used in medicine in the form of tincture, spirit, &c. These preparations being intended for the treatment of disease, and their efficacy frequently depending upon the association of substances which from long experience have been found to contribute to the required result, the unauthorized introduction into their composition of a new substance, and especially one of so marked a character as methylic spirit, cannot in any way be sanctioned. There is a large number of pharmaceutical preparations of the sort here referred to, most of which are made according to formulæ given in the Pharmacopœias, a strict compliance with which is enjoined upon those who compound them. We cannot recommend the substitution of any mixture for the pure spirit directed to be used in making these preparations.

6. Spirit of wine is employed as a solvent of essential oils and other odorous substances used in perfumery, and it is scarcely necessary to say that the addition of anything to the spirit imparting to it an unpleasant odour must render it unfit for purposes of that description. The methylated spirit, therefore, cannot be used for the preparation of perfumes.

7. The employment of spirit of wine in the manufacture of acetic acid by the German process of oxidation has been suggested as a possible result of the entire removal of the duty on pure spirit; but this application could not obviously be made of a mixed spirit, such as has been contemplated in this inquiry.

8. The methylated spirit would serve for the preservation of objects of natural history, and also for the purposes generally to



which alcohol is applied in chemical research. It would remove an impediment to the prosecution of science in this country, created by the high price of alcohol, which has long been complained of.

To recapitulate briefly the results of this inquiry—

It has appeared that means exist by which spirit of wine produced in the usual way may be rendered unfit for human consumption as a beverage, without materially impairing it for the greater number of the more valuable purposes in the arts to which spirit is usually applied. To spirit of wine of not less strength than corresponds to density 0.830, it is proposed to make an addition of 10 per cent of purified wood-naphtha, otherwise known as wood-spirit, pyroxylic spirit, and methylic spirit, and to issue this mixed spirit for consumption, duty free, under the name of "Methylated Spirit." It has been shown that methylated spirit resists any process for its purification; the removal of the substance added to the spirit of wine being not only difficult, but to all appearance impossible; and further, that no danger is to be apprehended of the methylated spirit being ever compounded so as to make it palatable. The privilege of using such mixed spirit should be open to all branches of the arts and manufactures without restriction; but it may be expedient to prevent the sale of methylated spirit in licensed public-houses, or the preparation and sale of it by the licensed rectifiers of spirits. The wood-naphtha employed in mixing should be supplied by the Inland Revenue, in order to ensure uniformity in its quality, and that substance be mixed with the spirit at the distillery, under Government inspection. The permission to use pure spirit of wine for any purpose of manufacture, under a bond of security, or in presence of a revenue officer, may reasonably be withheld till the methylated spirit now proposed has had a fair trial. It may be found safe to reduce eventually the proportion of the mixing ingredient to 5 per cent, or even a smaller proportion, although it is recommended to begin with the larger proportion of 10 per cent. The present supply of wood-naphtha is amply sufficient for the application contemplated of that substance, for mixing with the spirits used in the arts and manufactures of the country.



The command of alcohol at a low price is sure to suggest a multitude of improved processes and of novel applications, which can be scarcely anticipated at the present moment. It will be felt far beyond the limited range of the trades now more immediately concerned in the consumption of spirits: like the repeal of the duty on salt, it will at once most vitally affect the chemical arts, and cannot fail ultimately to exert a beneficial influence upon many branches of industry. The same measure also practically removes one of the last anomalies in the duties imposed for revenue; alcohol having, as a raw material of manufacture, a claim to exemption from duty according to sound principles of taxation.

We have, &c.,

THOMAS GRAHAM,  
A. W. HOFMANN,  
THEOPHILUS REDWOOD.

London, July 24, 1854.

John Wood, Esq.  
Chairman of the Board of Inland Revenue.

GENTLEMEN, Inland Revenue, 2d November 1854.

As I am informed that it is your intention to add some remarks to your report on the supply of spirit of wine duty-free for use in the arts and manufactures, I take the opportunity of requesting your attention to the passage in page 8 of the Report, in which you state, in effect, that as the oils in crude naphtha are removable from the mixed spirit by a process not very difficult, the question is reduced to the applicability of pure wood-naphtha for the object in view.

I am not entirely convinced that the question is thus narrowed. We have two objects: first, to prevent the recovery of spirit of wine from the mixture in such a state of purity as to render it potable; and, second, to render the mixed spirit so offensive as to prevent any temptation to its use among the workpeople, who will necessarily have access to it in the manufacturing processes in which it will be employed.

Now it is obvious that the use of crude naphtha produces a more offensive mixture than that of the pure naphtha; and that it would probably be so offensive as to preclude its consump-



tion by workpeople; and this would be an important point gained.

It is also obvious that any attempt to render it potable (as an article of commerce) would be more troublesome and expensive.

The question, then, remains, whether the crude mixture would be generally available in arts and manufactures.

This is a subject of great practical importance, and I shall be much obliged by your attention to it, and by the communication of the result of your inquiries.

I am, &c.

Thomas Graham, Esq., F.R.S. (Signed) JOHN WOOD.

A. W. Hofmann, Esq., F.R.S.

Theophilus Redwood, Esq.

SIR,

London, 8 January 1855.

THE observations which we desired to add to our "Report on the Supply of Spirit of Wine, free from Duty, for use in the Arts and Manufactures," have reference to the mode in which the public is to be supplied with the spirit. On a review of the subject, and after further inquiry among manufacturers and others, we doubt whether it would be prudent to permit, at first, the retail sale of the methylated spirit. It has been represented to us that the unrestricted sale of the spirit would cause it to get into the hands of individuals of perverted tastes, who, in extreme cases, may use it for producing intoxication. Although we are satisfied that such a misapplication of the methylated spirit could only occur in some isolated instances among persons of confirmed habits of intemperance, yet it may be feared that even such cases would cause a public outcry against the measure before it had received a fair trial. We would, therefore, recommend that the methylated spirit should be issued, by agents duly authorized by the Board of Inland Revenue, to none but manufacturers, who should themselves consume it, and that application should always be made for it according to a recognised form, in which, besides the quantity wanted, the applicant should state the use to which it is to be applied, and undertake that it should be applied for that purpose only. The manufacturer might be permitted to retail varnishes and other products containing the methylated spirit, but not the methylated spirit itself in an unaltered state.



In thus suggesting a restriction upon the sale of the methylated spirit, we must, however, express our belief that this limitation may eventually be removed with safety when the measure has been fairly and fully introduced.

Our attention having been directed, by your letter of the 2d November 1854, to that part of our Report in which we recommend the use of purified wood-naphtha, rather than crude naphtha, for preparing the methylated spirit, we have instituted new inquiries on this part of the subject.

We have, in the first place, to state, that the distinction of crude and purified wood-naphtha is not generally recognised in commerce. The term "crude wood-naphtha," when used, is understood to designate a very impure sort of naphtha, not in the state in which that substance is first produced, but in a partially, although very imperfectly, purified state. This product, which is of a brown colour, and contains tarry matter and oils which are not easily volatilized, after being further purified, constitutes the wood-naphtha generally met with in commerce, and which we have referred to as purified wood-naphtha. The terms "crude" and "purified," as thus applied, have not any definite signification; they are used to indicate an undefinable difference of purity, the principal feature of which consists in the presence of more difficultly volatilized matter in the less pure than in the more highly purified article.

We have further to state, that the purification of crude naphtha, to the extent to which this is effected for commercial purposes, is not attended with any difficulty. Methylated spirit prepared with crude naphtha may also be rendered as free from taste and smell as that made with purified wood-naphtha, by simple and inexpensive means. We have had a methylated spirit prepared containing 10 per cent. of the crudest wood-naphtha we could procure, and which was quite unsaleable. Now, by a simple distillation from 10 per cent. of potash, this is highly purified, so as to be quite equal, if not superior, to the methylated spirit made with Turnbull's purified wood-naphtha, as recommended in the Report. The cost of applying this purification of methylated spirit would be less than 1s. a gallon.

We believe that if very impure wood-naphtha be used for making the methylated spirit, the spirit so prepared will not fulfil the requirements of any class of manufacturers referred to in our



Report, unless the purification of the spirit before its use be permitted, and such, we presume, would not be deemed advisable; if this purification was forbidden, the honest manufacturer would obey the law, and work to a great disadvantage as compared with his less scrupulous competitors, who would resort to illicit purification. This of itself would be a great evil, and one, we fear, quite beyond the powers of the Excise to prevent. We admit that the methylated spirit made with crude naphtha would be more unpalatable than that made with purified wood-naphtha, and that the latter would be more likely than the former to be drunk by the workmen employed in manufactories where such spirit was used; but, as already stated, we can only conceive it possible that such use would be made of methylated spirit by individuals of perverted taste, and confirmed habits of intemperance; and in such instances we doubt if even the use of crude wood-naphtha would be sufficient entirely to prevent the evil.

The conclusions we have come to as the result of our investigations on this subject are, that methylated spirit made with a very impure wood-naphtha could not be advantageously used as a solvent for resins by hatters and varnish-makers, as the less volatile parts of the naphtha would be retained by the resins after the spirit had evaporated, and the quality of the resins would be thus impaired, and that such methylated spirit would be almost wholly inapplicable for chemical and pharmaceutical purposes, and for the preservation of objects of natural history. The benefits anticipated from the proposed measure would thus be greatly limited, without, as we believe, any adequate advantage resulting, either in increased security to the revenue, or otherwise.

It is purified wood-naphtha, and not the impurity which crude naphtha contains, that presents the great and insuperable difficulty we have indicated to its separation from spirit of wine with which it has been mixed; in fact, the more highly purified the naphtha is with which the spirit is mixed, the more difficult will it be to effect an alteration of this mixture in the way contemplated by any chemical process; and in proportion as his condition is fulfilled, the mixed spirit will be more valuable for use in the arts and manufactures as a substitute for spirit of wine; on the other hand, the impurity which constitutes the difference between crude and purified wood-naphtha presents little or no difficulty in the way of its separation, whilst for all



the purposes referred to it renders the mixed spirit contained in it less applicable, and for some of those purposes it entirely precludes its application.

We are, therefore, unable to recommend any alteration in the mode of preparing the methylated spirit suggested in our Report.

THOMAS GRAHAM.

A. W. HOFMANN.

T. REDWOOD.

To John Wood, Esq.,  
Chairman of the Board of Inland Revenue.



the purpose referred to is to render the mind more capable of  
it is applicable and for some of these purposes it is entirely  
practical in its application.

We are therefore unable to recommend any alteration in  
the mode of preparing the monthly report which is suggested in our  
Report.

THOMAS CHAMBERLAIN

A. W. HORTON

T. REDWOOD

To John Wood Esq.  
Chairman of the Board of Inland Revenue



REPORTS  
ON THE  
USE OF METHYLATED SPIRIT  
IN THE  
Arts and Manufactures,  
AND IN  
SEVERAL BRANCHES OF SCIENTIFIC RESEARCH  
UNDER THE PROVISIONS OF THE ACT  
18 & 19 VICTORIA, CAP. 38.  
ADDRESSED TO  
THE COMMISSIONERS OF INLAND REVENUE.



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USE OF METHYLATED SPIRIT  
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IS & IN VICTORIA CAP. 32  
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THE COMMISSIONERS OF INLAND REVENUE.



# REPORTS

ON THE

## USE OF METHYLATED SPIRIT IN THE ARTS, MANUFACTURES, &c.

PROFESSOR HOFMANN.

Royal College of Chemistry,

June 11th, 1856.

MY DEAR SIR,

WHEN expressing to you a few days ago how deeply indebted all those engaged in chemical pursuits must ever feel for the introduction of Methylated Spirit, I mentioned also the extensive use of this material in the Laboratories of the Arsenal at Woolwich. I have since received the enclosed letter from Mr. Abel, the chemical director of the department, which I thought might interest you.

I enclose likewise a proof of a little work, by the late Professor Fownes, which I am at present seeing through the press. On page 418 methylated spirit and some of its uses are mentioned.

I have, &c.

(Signed) A. W. HOFMANN.

John Wood, Esq.

F. A. ABEL, Esq.

Chemical Department, Royal Arsenal,

DEAR DOCTOR HOFMANN, Woolwich, 10th June 1856.

IN reply to your inquiries respecting the extent to which we have profited, in our manufacturing establishments, by the measure for the supply of the so-called methylated spirit, for



purposes connected with the arts, sciences, and manufactures, I have much pleasure in furnishing you with the following statement.

The measure alluded to no sooner came into operation than my recommendation to substitute methylated spirit for alcohol and wood-naphtha in all branches of manufacture of war-material in which these articles were employed, was adopted, and, independently of the considerable saving resulting from this step, I may cite the following examples of the benefits derived therefrom.

In the extensive use of alcohol, in the laboratory department, for moistening explosive compositions which are subject to considerable pressure or blows, it was impossible to prevent the workmen, into whose hands the alcohol was necessarily placed, from partaking of it to a very serious extent. All methods legitimately applicable with the view to check this practice were of no avail; even the mixture of the spirits with a small quantity of meal gunpowder did not prevent many workmen from indulging freely their propensity for alcohol. Since the introduction of methylated spirit there have been only very few instances of individuals who have ventured to partake of a small quantity of the spirit. It may also be mentioned that these men were immediately detected by the foremen, in consequence of the peculiar odour imparted to the breath by the methylated spirit; while formerly, although the illegitimate consumption of alcohol was very general among the men employed on that particular work, it was possible to detect only the most flagrant cases.

Wood-spirit has been employed by us very largely, from economical motives, for the preparation of varnishes and dye-liquid; but, although this material answered in every respect as a substitute for alcohol, its employment was attended with very grave objections; as even the purest commercial article obtainable, was found to act injuriously on the health, and particularly on the eyes, of the large number of boys working in apartments where the acrid oily matter contained in the naphtha was constantly and unavoidably passing into the atmosphere. But for the introduction of methylated spirit, it would have been necessary to return to the use,—for the purposes alluded to,—of the more expensive material, alcohol.



As an instance of the advantage with which methylated spirit may be substituted for alcohol in chemical processes, I may mention that no difficulty has been experienced in effecting such a substitution in the preparation of fulminate of mercury, and that we have, in consequence, been enabled to procure this substance, of which we employ large quantities, at a very important reduction in price.

You will perceive that we have every reason to be satisfied with the introduction of this important measure, and to hope that, if still experimental, its permanent adoption may be considered certain.

I have, &c.,

(Signed) F. A. ABEL,

Director of the Chemical Establishment  
of the War Department.

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(EXTRACT from a new EDITION of the late Professor FOWNES' Work on CHEMISTRY.)

"The high duty on spirits of wine in this country, has hitherto greatly interfered with the development of many branches of industry, which are dependent on the free use of this important liquid. The labours of the scientific chemist have been likewise often checked by this inconvenience. A remedy for this evil has been lately supplied by a very important measure proposed and carried out by Mr. John Wood, Chairman of the Board of Inland Revenue. This measure consists in issuing for manufacturing and scientific purposes, duty free, a mixture of 90 per cent. of spirits of wine of not less strength than corresponds to a density of 0.830 with 10 per cent. of purified wood-spirit, which is now sold by licensed dealers, under the name of methylated spirit. It appears that a mixture of this kind is rendered permanently unfit for human consumption, the separation of the two substances, in consequence of their close analogy, being not only difficult, but to all appearance impossible; at the same time, and from the same reasons, this mixture is not materially impaired for the greater number of the more valuable purposes in the arts to which spirit is usually employed. Methylated spirit may be used instead of pure spirit, as a solvent of resinous substances,



as a solvent employed in the manufacture of many chemical preparations, especially of the alkaloids and other organic products. It may be used for the production of fulminating mercury, of ether, chloroform, iodoform, olefiant gas, and all its derivatives, in fact for an endless number of laboratory purposes. Methylated spirits may be substituted for pure spirits in the preservation of anatomical preparations. The introduction of methylated spirit cannot fail to exert a very beneficial effect upon the development of organic chemistry in this country."

(See annexed Report on the Supply of Spirits of Wine, free from duty, for use in the Arts and Manufactures, addressed to the Chairman of Inland Revenue, by Professors Graham, Hofmann, and Redwood.)

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PROFESSOR ALEX. W. WILLIAMSON.

DEAR SIR,

University College,  
London, 20th June 1856.

The Excise duty on spirits of wine used for scientific purposes, was in truth a tax on organic chemistry; for the greater number of researches in that department of science, involve the use of alcohol or some of its derivatives; and its removal by the introduction of "Methylated Spirits" for such purposes, has already been productive of considerable benefit. The effects of this measure, may be compared to those observed on the removal some years ago of the duty on glass; which is now every year finding more and more useful applications in the arts.

Just so the use of the solvent powers of alcohol and its derivatives (such as ether, chloroform, &c.) is now extending most beneficially for science and those engaged in it, since the restrictive duty has been removed; and no doubt new uses for these valuable substances will continue to be found by manufacturers, in imitation of the laboratory processes in which they are first employed.

In illustration of the extensive influence of this cheapening of alcohol for useful purposes, I may mention that collodion,



one of the chief materials of the photographer, is now prepared from ether made from methylated spirits, and sold at a far lower price than formerly.

I am sure, that all persons who are aware of the immense variety of peculiar substances already prepared by the scientific chemist from alcohol, and which are gradually finding application in the industrial arts, will rejoice at the wise enactment which places the raw material within easier reach of all who can use it, for the benefit of the public.

I am, &c.,

(Signed) ALEX. W. WILLIAMSON, F.R.S.

John Wood, Esq. Professor of Chemistry,  
University College, London.

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GEORGE HUTCHISON, Esq.

THOS. DOBSON, ESQ.

Glasgow, 24th June 1856.

SIR,—In reply to your inquiry of yesterday's date, I beg to acquaint you for the information of the Commissioners of Inland Revenue, that the use to which methylated spirit was applied by me, was primarily the manufacture of oleic ether for the purpose of making a lubricant suitable for fine machinery, and incidentally the manufacture of sulphuric ether which is used in medicine and photography. Unfortunately I have had little practical experience of the advantages of duty free spirit, as my work was destroyed by fire on the 17th November last, when I had enjoyed the privilege little more than a month. The lubricant which I produced was only introduced in this neighbourhood, and to a limited extent, and had not attained an expansion, such as to make itself felt in a national sense, but the cotton spinners who used it, evince by their repeated and anxious inquiries as to when I shall be able to supply them again, that they felt the new oil as a welcome boon, and I have not a doubt that when time and opportunity have been given for its general adoption, it will be found of national importance, as being an efficient substitute for sperm oil, which is getting scarcer year by year.

I had made arrangements for the disposal of 200 gallons of sulphuric ether per week, but from the calamity above-men-



tioned these were never carried out, and I am unable to give any information as to the commercial importance of this product.

The condition of the workmen in my employment was in no way affected by the change in the law.

I am, &c.,

(Signed) GEORGE HUTCHISON.

MESSRS. THOMAS DE LA RUE & CO.

London, 110, Bunhill Row,

SIR,

25th June 1856.

IN answer to your letter of the 23rd inst, we beg to state that the privilege of using methylated spirit has been of material benefit to us in the manufacture of our goods, and that we are continually extending its employment.

We have great hope of ultimately entirely superseding the use of the so-called oil varnishes in our branch of manufacture.

We are, &c

(Signed) THOS. DE LA RUE & CO.

Thomas Dobson, Esq.

MESSRS. THOMAS DEVEREUX & SON.

To the Commissioners of Inland Revenue.

10 & 19, Eldon Street, Finsbury,

GENTLEMEN,

26th June 1856.

WE beg to acknowledge the receipt of your communication of the 23rd inst, having reference to the new law admitting the use of spirits of wine duty free.

Our business being exclusively that of French Polishers our opinion of the working of the new law must necessarily be confined to that trade.

The free introduction of the methylated spirit has proved of great advantage, but, at the same time, we would respectfully suggest that whilst the admixture of *one ounce* instead of *three* of gum, to the gallon of spirit, would equally protect the revenue from fraud, it would be much more applicable to the purposes of our trade, so large a proportion of gum rendering it unfit for the finer descriptions of work in finishing, and in varnishes.



The condition of the workmen has been much improved by the advanced rate of wages that employers have been enabled to make through the reduced cost of material.

With reference to the illicit traffic in spirits having been superseded, we can only give it as our opinion that the new law has operated as an effectual check.

We are, &c.,

(Signed) THOMAS DEVEREUX & SON.

MR. FREDERICK JOYCE.

Waltham Abbey, Essex,

June 28th 1856.

SIR,

IN reply to yours of the 23d inst. requiring information on the part of the Commissioners of Inland Revenue touching the operation of the law allowing the use or methylated spirits in manufactures, I have much pleasure in stating that it answers well for making varnish, the methyl in such case not interfering and that I make no doubt shortly of rendering it equally available in the formation of fulminate of mercury, and nitric æther the only processes to which it is applied by me. In these cases it will certainly be very beneficial in enabling manufacturers to meet foreign competitors, as also those at home, who by the use of illicit spirits could undersell the fair trader. To what extent the alteration in the law will act in the manufacture of illicit spirits generally is a question not easily answered, and one in which I am no way conversant, but as far as manufacturers are concerned it will entirely do away with illicit traffic in every shape and form. The health of the workmen is doubtless improved in all cases, where, from the previous high duty, wood spirit was made the substitute.

As one of those manufacturers interested by the alteration of the law, I return my thanks for the change.

I remain, &c.,

(Signed) FREDERICK JOYCE.

Patentee and manufacturer of anti-corrosive percussion caps and chemically prepared gun-wadding.

Thomas Dobson, Esq.



PROFESSOR GEORGE WILSON, M.D.

To the Secretary of the Inland Revenue.

Industrial Museum of Scotland, Edinburgh.

SIR,

28th June 1856.

IN answer to the questions addressed to me by the Commissioners of Inland Revenue in your letter of the 23rd instant, viz.,—"Whether the privilege of using the methylated spirit is likely to prove an acquisition to persons engaged in scientific pursuits, and whether it has been found beneficial to any branch of manufacturing industry?"—I have to reply that methylated spirit is employed, so far as I have learned, chiefly by two classes of scientific persons, viz., analytical chemists, and naturalists, including among the latter those medical professors and lecturers who have occasion to preserve the bodies of animals or parts of them, in antiseptic liquids.

Chemists employ it in the same way as they formerly did pure alcohol or spirits of wine: (1.) As a smokeless, cleanly fuel for their spirit lamps. (2.) As a solvent of vegetable and animal substances, which water and the more familiar chemical reagents will not dissolve: and (3.) as a means of testing or recognising bodies in the course of analysis.

For the first of these purposes methylated spirit is equal to pure spirit of the same strength.

For the second, it is nearly equal to pure spirit, measure for measure, and as its slight inferiority is more than compensated by its cheapness it can be used in larger volume, so as to excel wine-alcohol in value as a solvent. The modified sulphuric ether made from methylated spirit has a similar value for analytical chemical purposes, and the chemistry of plants and animals (organic chemistry,) which hitherto has been comparatively neglected in this country, as compared with the Continent, owing to the cost of alcohol and ether, will now be much more largely prosecuted by British chemists than before.

For some analytical purposes methylated spirit cannot be substituted for spirits of wine; but these are few, and consume so little alcohol, that this defect is of comparatively small importance. I can assure you, accordingly, that so far as scientific chemistry is concerned, the methylated spirit is highly



prized by all who are engaged in research, and from personal knowledge I can testify that it is in constant use in the analytical laboratories of Edinburgh and Glasgow. I enclose a note in illustration of this from Dr. Macadam, one of the lecturers here under the College of Surgeons.

To naturalists and medical lecturers, methylated spirit is of still more value than to chemists. From my colleagues, the professors of natural history, and anatomy, in the University of Edinburgh, and from the medical lecturers under the sanction of the Colleges of Surgeons and Physicians, I learn that they find the methylated spirit of the greatest service. Mr. Goodsir, indeed, the professor of anatomy, recently took occasion in a public lecture, to express spontaneously the obligation under which he and his pupils lay to the Commissioners of Inland Revenue, for granting them, on such liberal terms, the use of the methylated spirit as a means of preserving the soft parts of animals. Professor Goodsir has sent me a note to the same effect which I enclose to you. You will perceive from its contents that he hesitates, till it has undergone a longer trial, to affirm that methylated spirit will equal spirit of wine as a *permanent* preserver of animal organs, but even if it should fail in this respect, which he does not anticipate, and I feel certain is in the highest degree unlikely, its importance as a temporary antiseptic would render it a substance of great value to the naturalist.

Thus it is impossible to dissect satisfactorily certain organs of the body, unless they are previously hardened in spirit, but the cost of this has hitherto greatly limited its use in our anatomical rooms much to the disadvantage and discomfort of the student. To him, accordingly, the introduction of the methylated spirit is a great boon.

Again the comparative anatomist, when dealing with large animals, has hitherto found his inquiries seriously impeded by the expensiveness of alcohol. Thus within the last few years, the bodies of two elephants, a giraffe, a tiger, a dromedary, and various smaller animals have been sent to the University Museum from the Zoological Gardens or menageries where they have died. The cost of preserving the soft parts of animals so large has hitherto made it impossible in many cases to do more than retain the bones, but now it is found possible to



set aside, in methylated spirit, the softer parts, and dissect them at leisure, so that a most valuable series of specimens, hitherto wanting, will now be added to our museums of comparative anatomy. In incidental illustration of this, I enclose a letter from Dr. Struthers, who has collected the opinions of his brethren in the medical school before addressing his note to me.

I am unable, from personal knowledge, to refer minutely to the applications of methylated spirits in the useful arts. From the compounders of methylated spirits I learn that they dispose of it chiefly to the manufacturing pharmaceutical chemists and varnish makers. These chemists inform me that they consume it to a considerable extent in the preparation of the medicinal ethers and chloroform, for which they formerly employed spirits of wine; and still more largely in the preparation of varnishes.

As I find, however, that you have addressed queries on these points to the pharmaceutical chemists here, who can speak regarding them from personal knowledge, which I cannot do, I need not refer further to the industrial applications of the methylated spirit.

I have, &c.

(Signed) GEORGE WILSON, M.D.,

Regius Professor of Technology, University,  
Edinburgh, and Director of the Industrial  
Museum of Scotland.

PROFESSOR GOODSIR.

DEAR WILSON,

The College, 25th June 1856.

It will be some time before we can speak with confidence as to the applicability of the methylated spirit to museum preparations.

It has proved, however, most useful for general anatomical purposes, and has enabled us to work much more comfortably than hitherto.

I have, &c.

(Signed) JOHN GOODSIR,

Professor of Anatomy, University  
of Edinburgh.



DR. STEVENSON MACADAM.

Analytical Laboratory, 72, Princes-street,  
Edinburgh, 26th June 1856.

DEAR SIR,

I HAVE found the methylated spirit of great value in analytical research, and, from its comparative cheapness, I have been enabled to prosecute inquiries in organic chemistry, which I could not have undertaken had I been compelled to purchase pure ethylic alcohol.

For the majority of purposes, it certainly takes the place of ordinary alcohol, but in a few instances, as in testing for acetic acid, the methylated spirit cannot be used. I am, therefore, of opinion, that the present distribution of methylated spirit is a great boon to scientific chemists, but I would prefer using the pure ethylic alcohol, provided the cost of such approached that of methylated spirit.

I am, &c.,

(Signed) STEVENSON MACADAM, Ph. D., F.R.S.E.,  
Lecturer on Chemistry in the Medical School,  
Surgeons' Hall, Edinburgh.

Professor George Wilson.

DR. JOHN STRUTHERS.

DEAR SIR, Surgeons' Hall, Edinburgh, June 28th, 1856.

IN reply to your inquiries regarding the use of methylated spirit, I have to state :—

1. That the late increase of duty in Scotland would have driven us almost to abandon the use of spirit for anatomical and pathological purposes.
2. That the methylated spirit has been used in preference to all other preservative agents in the museum of the Royal College of Surgeons, and in the museums of the various teachers of medicine.

I trust, therefore, that the Inland Revenue Office will continue to grant the use of methylated spirit for scientific purposes as at present.

I am, &c.,

(Signed) JOHN STRUTHERS, F.R.C.S.,  
Lecturer on Anatomy, and  
Secretary to the Medical School, Edinburgh.

Dr. George Wilson.



PROFESSOR W. SHARPEY, F.R.S.

University College, London,

30th June 1856.

MY DEAR SIR,

WE have been using the "methylated spirit" for some time past in preparing and in permanently preserving specimens in the Anatomical Museum of University College, and, so far as our experience goes, the mixed spirit seems generally to answer these purposes as well as pure spirit of wine.

A large share of the expense of establishing and maintaining anatomical and pathological collections has heretofore been owing to the necessary outlay for spirit, and as an efficient substitute can now be obtained at less than a third of the price of alcohol, it may thence be readily judged how great a favour has been conferred on medical science by the late Act of the Legislature.

I remain, &c.,

(Signed) W. SHARPEY, F.R.S.,

Professor of Anatomy and Physiology,

John Wood, Esq.

University College, London.

Mr. ALEXANDER CHRISTIE.

27, Southwark-Bridge-Road,

June 30th 1856.

To the Honourable the Commissioners of Inland Revenue.

HONOURABLE SIRS,

I HAVE the honour to acknowledge the receipt of your letter of the 23d inst. in reference to the operation of the law allowing duty free spirits of wine in the arts and manufactures, the various purposes to which it has been found applicable, whether the privilege of using it has proved beneficial to any branch of manufacturing industry, or superseded to any extent, the traffic in illicit spirits; and in reply thereto beg to state that for the last fifteen years I have been extensively engaged in the naptha trade as well as in that of spirit of wine, and during that period I have had ample means of knowing the baneful effects produced by the use of naptha on the working classes, who were compelled to use it instead of spirits of wine;



the high duty imposed on the latter article almost entirely precluding its use, and that therefore, so far as my experience goes in reference to the recent act permitting the use of methylated spirit, I consider that few measures of late years have proved, or will continue to prove, more beneficial.

Whether we look to the advantages to trades of various kinds who have, or will ultimately use it—the social improvement, and comfort of a numerous class of workmen whose health and sight were seriously injured by the use of naphtha—the almost total suppression of illicit distillation, and its demoralizing effects—the extension of its use to many branches of trade in which it has not as yet been applied—I cannot, during the short period in which the act has been in operation, over-estimate its advantages, or limit the purposes and extent to which methylated spirit will ultimately be applied.

The measure is of the highest importance to the manufacturing industry of the country, and a boon to the working classes engaged therein; and in order to more than double the present consumption, it is only necessary to alter the present standard of the naphtha used, and if possible, to dispense with the bond, which is a great obstacle to its unlimited use by the smaller class of consumers.

The great outlet for illicit spirits has been in the manufacture of spirits of nitre and other chemicals, as well as in varnishes, polishes, &c.; but the recent permission of your Honourable Board to use methylated spirit for the manufacture of the former article, and the low price at which it can be sold, viz., 4s. 6d. to 5s. per gal., has completely upset the illicit trade. I may mention that of my own knowledge, I could name four individuals whose united consumption of illicit spirit did not, for years, amount to less than 500 to 600 gallons weekly, and who now do not use a gallon, but are considerable consumers of methylated spirit.

I understand that methylated spirit is being used in a large brewery, not only in cleaning the machinery from the spent oil and grease, but in coating their vats and casks with a solution of shellac, on which the beer has no action, and by which must and absorption is entirely prevented.



Should this experiment prove effective, which I have no doubt it will, it would confer the greatest benefit on that extensive trade.

The restrictions which your Honourable Board have felt necessary to impose, on this first trial of the measure, have precluded a great many parties from availing themselves of its use, and from a feeling of uncertainty as to the continuance of the measure, and a doubt as to the number of purposes to which you would allow it to be applied, some firms have been deterred from erecting apparatus for manufacturing various articles from it.

This remark will apply to manufacturing chemists, as well as others, who are only now beginning to use it to any extent.

Among those who have applied to me, and who would have been considerable consumers could they have obtained it in a pure state, without the addition of gums, and without giving bond, to which there is the greatest objection from all classes of consumers, I would mention house-decorators, gold-beaters, dyers, veterinary surgeons, philosophical instrument-makers, photographers, and also for general domestic purposes, to all of whom your regulations, as to bond, is a great barrier to its use.

To render the measure, which is one of national importance, of general benefit by making the spirit more accessible to those who may think it of advantage to use it; I would most respectfully suggest, as I have already observed, certain relaxations and alterations in carrying out the details, which would not affect the main question, and would not lessen the security as regards the revenue.

I shall be glad at another time to submit the alterations I have suggested to the consideration of the Board.

I have, &c.,

(Signed) ALEX. CHRISTIE.

EXTRACT of LETTER from Messrs. T. R. & A. WHITE.

Castle Street, Saffron Hill,

HONOURABLE SIRS,

1st July 1856.

ALTHOUGH our use of methylated spirit is very limited, when compared with what must be consumed in other branches of manufacture, still, an account of our experience, in the great



benefit bestowed on arts and manufactures, by the use of spirit of wine, duty free, may be useful in ascertaining the extent of those benefits, and the probable amount of illicit production prevented.

The use of duty-free spirit has already been very beneficial to our branch of manufacture. It has enabled us to supply sulphuric ether at such a price that its use in the arts has been increased by a quantity represented by about 2,000 gallons of spirit, while in the first six weeks after we were permitted to use it in the manufacture of sweet spirit of nitre, 600 gallons were used in the production of that article, the greater part of which 600 gallons, if not the whole, has taken the place of what was generally produced from illicit spirit; and these results have been obtained without diminishing the duty paid on spirits of wine, as we still use pure spirit as largely as formerly.

The advantages we have obtained, are but a small proportion of those enjoyed by chemists, many of whom have already applied methylated spirit and its products to the preparation of the alkaloids and chloroform, the latter substance being now used very largely in the arts and manufactures, and this principally from its reduced cost.

The improvement in the condition of the workmen will be found amongst those who use varnishes, and more especially the workers in French polish; here the use of spirit of wine in small quantities was a constant temptation to drink it, which has been prevented by the use of methylated spirit, and the injurious effects on the health of the workmen in naphtha polish and varnishes has been very considerably abated. In our case the spirit of wine given out for use was so soon mixed with substances which rendered it unfit for drinking that our men have been free from temptations of this kind.

We must urge upon your honourable Board that, at present, we are at the dawn of a great amount of benefit to be derived from the use of duty-free spirit of wine in manufactures, many of the manufacturers who will ultimately be most benefited have not taken advantage of the privilege, and many others (like ourselves) are busied in finding out the best means of working with the new form of spirit. For although the separation of the naphtha from the spirit is quite as impossible as it at



first appeared, still the products of the two substances, we find, may be to a very great extent separated.

We remain, &c.,

(Signed) T. R. & A. WHITE.

To the Honourable the Commissioners  
of Inland Revenue.

C. HAWKINS, Esq.,

22, Saville Row, Burlington Gardens.

MY DEAR SIR,

July 4th 1856.

I BEG to enclose you two letters that I have received with regard to "methylated spirit," one from Mr. Quekett, of the Royal College of Surgeons, and one from Dr. Page, of St. George's Hospital.

I am, &c.,

To John Wood, Esq. (Signed) CHARLES HAWKINS.

DR. W. E. PAGE.

DEAR HAWKINS, 38a, Curzon Street, June 19th, 1856.

WE have been using "methylated spirits" in the museum of St. George's Hospital for putting up preparations since the middle of February last, and as far, as we can judge from such limited experience, it appears to answer the purpose, with the exception that there may be a deposit,\* which is an inconvenience, otherwise the cost of it, which is exactly a quarter of what we were paying for the best spirit, makes its employment very desirable, where economy is of great consequence.

I am, &c.,

Charles Hawkins, Esq. (Signed) W. E. PAGE, M.D.

PROFESSOR JOHN QUEKETT.

Royal College of Surgeons,  
Monday Evening.

MY DEAR SIR,

WE have used a good quantity of methylated spirit in the museum, but the principal objection to it is the colour; our first sample was tolerably bright, but the last deposits a sediment\*

\* This deposit must have been an accidental impurity.



like the rust of iron. I have spoken to two of the officers of excise about it and they have promised to try to obtain for me some colourless naphtha (which is the name they give to the article they mix with the alcohol). Our saving will be about 12s. 6d. upon every gallon.

I am, &c.,

Charles Hawkins, Esq.      (Signed)      JOHN QUEKETT.

Messrs. J. F. MACFARLAN, & Co.

SIR, Edinburgh, 7th July, 1856.

IN answer to your enquiry regarding the uses to which the methylated spirit has been found applicable, I have the pleasure of saying that we found it useful, Firstly: in the preparation of spirit varnishes; these include French polish and furniture varnish; both of these are employed by cabinet makers in beautifying furniture, and are used in very considerable quantity; they include also lacquers, which are very various, and are employed by brass founders, gas fitters, &c. As each of these has generally his own formula for preparing his lacquers we have found the "Finish" of great service. The small quantity of shell or seed lac it contains does not unfit it for their purpose, and they therefore purchase it freely. In these cases the measure has been completely successful, the use of duty paid spirits is entirely dispensed with, and thus a great boon has been conferred on these branches of manufacture.

Secondly. In the preparation of chloroform.—At first it was regarded as extremely improbable that we would succeed in preparing this article fit for use in medicine, from the methylated spirit. I am, however, happy to say that we have been able to prepare it as free of flavour, as high in density, and as pure in every respect as that from spirit of wine, so that no difference can be traced between them; and that from methylated spirit has been employed as freely and with as much advantage as the other in surgical operations in the public theatre of the Royal Infirmary and in private. It has been employed also in the Maternity Hospital and by private prac-

*Note.* "Finish" is methylated spirit containing in solution 3 oz. of shellac or sandarac, per gallon, and in that state it is allowed to be sold without restriction.



titioners, and with us it has almost superseded that made from pure spirit of wine. In this particular also a great boon has been conferred on the community by the general reduction in price which has been effected. In England, however, the prejudice against the methyl has not as yet been overcome; and hence the employment of the chloroform from it is only to a limited extent, but I feel satisfied that it will ultimately prevail.

Thirdly. In the preparation of ethers.—The sulphuric ether is a mixed fluid with a boiling point directly in proportion to the quantity of methyl in the spirit. It has been found, however, equally safe as a medicine, and in the extraction of alkaloids by solution answers equally well with the other. We have employed it also in the preparation of tannin, of fine quality, and are thus enabled to compete with the foreign manufacturer. We have also prepared a good deal of it for photographers. In this beautiful art it now seems to answer as well as that from spirit of wine, though some still retain an affection for that from PURE spirit of wine, believing it to be superior. I am inclined to think, however, that the cheaper will in the end supersede the dearer.

Nitrous ether, sweet spirit of nitre.—In the preparation of this ether we were long delayed by unexpected difficulties, which have been overcome, and have now prepared it of the proper ethereal flavour, and of good quality, so as to be available in medicine, and have every reason to expect that the consumption of the methylated spirit for this kind of ether will be very considerable.

Chloric ether we do not expect to succeed with. For this febrifuge pure spirit of wine must still, we fear, be employed, as a fine flavour is an essential point.

Besides these we have employed the methylated spirit in some preparations in which hitherto spirit of wine has been employed, and hope to be able to employ it in others, though at present we cannot give any report that would be satisfactory, but we feel it a great boon and are grateful to Government for doing so much to put us on an equal footing with our continental brethren.

In the state of "Finish" we have sold it to hatters and others, and believe it to answer their purpose, but naphtha itself



had been found to do so, and that being offered at a low rate, we do not know how far they may avail themselves of the privilege.

We have neither seen nor heard of any case of the methylated spirit being employed as an intoxicating drink; and can have no hesitation in saying, that the privilege of using the methylated spirit is a valuable one, and has proved a well-timed concession to those arts and manufactures in which spirit of wine has hitherto been employed.

I have, &c.,

Thos. Dobson, Esq.      (Signed)      J. F. MACFARLAN & Co.

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Messrs. J. T. & E. CHRISTY & Co.

35, Gracechurch Street, London,

19th July 1856.

SIR,

IN answer to your letter of the 23d June, we have the honour to inform the Inland Revenue Commissioners that the methylated spirit which has entered our manufactory has been applied to the purpose of waterproof stiffening for hats. Varnishes, which also contain spirit, are prepared upon our premises, and not now purchased from varnish makers.

So far as we are able to come to an opinion from the limited period the privilege has been available, it has been beneficial to the manufacture of hats.

We should suppose the distillers would be more competent to give an opinion as to the effect upon the condition of the work-people or the suppression of illicit traffic.

We are, &c.,

(Signed)      J. T. & E. CHRISTY & Co.,

Thos. Dobson, Esq.,      Hat Manufacturers.

Inland Revenue Office.

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